

Actas del V Congreso Internacional de Arqueología Subacuática (IKUWA V)

Ministerio
de Educación, Cultura
y Deporte

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de Arqueología Subacuática

Un patrimonio para la humanidad

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A heritage for mankind

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Imprime:

Seguramente nunca vamos a poder conocer con seguridad la riqueza patrimonial que descansa en el lecho de los océanos. De lo que desgraciadamente no tenemos duda es que este gran legado cultural de la Humanidad no sólo está sujeto a los estragos del tiempo y los elementos naturales, sino también a amenazas como el expolio o el deterioro causado por el ser humano.

Como ustedes saben, España fue uno de los primeros países en ratificar la Convención de la UNESCO para la Protección del Patrimonio Cultural Subacuático del año 2001, adquiriendo así un compromiso permanente con la defensa y estudio de este importante conjunto de bienes del Patrimonio Cultural.

España está ya integrada en numerosos programas de protección de carácter internacional. Pero, con el fin de traducir ese compromiso en un conjunto de acciones eficaces y bien planificadas en nuestro propio territorio, en el año 2007 el Consejo de Ministros aprobó el Plan Nacional de Protección del Patrimonio Arqueológico Subacuático, elaborado por el entonces Ministerio de Cultura y aceptado por el Consejo del Patrimonio Histórico y, en consecuencia, por los representantes de todas las Comunidades Autónomas.

En este plan se marcaron las líneas prioritarias que deben llevarse a cabo en España para la tutela efectiva del patrimonio cultural subacuático. Tras su aprobación, se creó una Comisión Científica de expertos para el seguimiento del Plan Nacional de Protección de Patrimonio Cultural Subacuático.

Esta tarea de protección, no obstante, sólo puede llevarse a cabo mediante esfuerzos coordinados de muchas fuerzas en juego. Es por ello por lo que la Secretaría de Estado de Cultura mantiene lazos de cooperación con diversas instituciones y organismos de nuestro país, como el Ministerio del Interior, el Ministerio de Defensa o el Ministerio de Asuntos Exteriores. Asimismo, el Ministerio está presente en los trabajos conjuntos de desarrollo de las Cartas Arqueológicas del litoral de España que están siendo llevados a cabo por las Comunidades Autónomas.

En suma, este congreso internacional no es sino un eslabón más en una cadena de trabajo y cooperación interinstitucional e internacional que viene demostrando que es rigurosa, altamente profesionalizada y sobre todo eficaz en la protección del Patrimonio Subacuático a nivel internacional, por lo que no cabe sino esperar que de este encuentro fructifiquen nuevas iniciativas que hagan aún más sólidos estos lazos.

Miguel Ángel Recio Crespo
Director General de Bellas Artes y Patrimonio Cultural

Probably we will never be able to know with certainty the patrimonial heritage that rests in the bed of the oceans. What we unfortunately have no doubt is that this great legacy is not only subject to the ravages of time and the natural elements, but also to the plunders or deterioration caused by humans.

As you probably know, Spain was one of the first countries to ratify the UNESCO Convention of 2001 on the Protection of the Underwater Cultural Heritage, acquiring thus a permanent commitment to the defense and study of this important set of goods of our Cultural Heritage.

Spain participates in many International Protection Programs. But, in order to translate this commitment into a set of effective and well-planned actions in our own territory, in 2007 the Council of Ministers issued the «National Plan for the Protection of the Underwater Cultural Heritage», prepared by the Ministry of Culture. This Plan was accepted by the Council of Historical Heritage of all the Autonomous Communities. The Plan discussed the main lines to be carried out in Spain for the protection of Underwater Cultural Heritage. Then, a Committee of «Scientific Experts» has been set up, as an advisory group.

This task, however, can only be carried out through coordinated efforts of the many Administrations involved. That is why the «Secretary of State» of the Ministry of Culture maintains many lines of cooperation with several Institutions and Organisms of our country, such as the Home Affairs Ministry, the Ministry of Defense and the Ministry of Foreign Affairs. The Ministry is also present in the joint work on the development of the archeological charts of the coast of Spain that are being carried out by the Autonomous Communities.

In sum, this International Congress has been an opportunity to increase the inter-institutional and international rigorous professionalized cooperation, for the protection of Underwater Heritage.

Finally: we hope that this International Congress will bring new initiatives and cooperation for the future of mankind.

Miguel Ángel Recio Crespo
Director General of Fine Arts and Cultural Heritage

Estamos felices y orgullosos de que personas de todos los rincones del mundo hayan acudido para intercambiar sus conocimientos más recientes en arqueología subacuática. Somos investigadores de la historia, pero también somos una parte de la historia. Podemos mirar hacia atrás 60 años en la arqueología subacuática. Un plazo muy corto para un historiador, pero un notable periodo de tiempo para el desarrollo que esta disciplina.

Desde la década de 1960, cuando los pioneros como George Bass, Bernabò Brea, Honor Frost, Elisha Lindner, Gerhard Kapitän y, el más joven de todos ellos, el aquí presente David Blackman, comenzaron sus estudios, se ha recorrido un largo camino hasta hoy.

Hubo que desarrollar métodos, inventar herramientas y encontrar lugares donde tratar y mostrar los hallazgos. Se fundaron instituciones y las autoridades incluyeron el patrimonio subacuático en sus competencias.

Se puede ver la historia de la arqueología subacuática como un progreso constante de llegar a ser más y más profesional y de implementar el valor del patrimonio cultural subacuático a la sociedad humana. Pero esto es solo una verdad a medias.

El éxito de la arqueología subacuática que tenemos hoy en día está casi exclusivamente basado en el compromiso individual. Había que ser un loco para promover la arqueología subacuática y en muchas partes del mundo, hay que ser un loco, aún hoy.

No quiero hacer hincapié en este punto, pero sí mencionar dos casos que muestran lo que se ha alcanzado.

El primer caso es el de *Nuestra Señora de las Mercedes* y creo que habéis visto la exposición aquí en el museo. La justicia estadounidense condenó a Odyssey Marine Exploration a restituir todas las monedas de plata robadas a España y envió un aviso: ¡la caza del tesoro se ha acabado! ¡Respetad el patrimonio donde quiera que esté!

El segundo caso se refiere a la llamada *Santa María* de Haití. Un aventurero lanzó la noticia de que se había encontrado la nave de Colón. La Unesco a través del Consejo Asesor, formado por un equipo de expertos que examinaron el sitio, en relativamente poco tiempo declaró que los restos no pertenecen a la *Santa María*. ¿Y qué pasó? La autoridad de la Unesco fue aceptada inmediatamente en todo el mundo por la prensa y los medios de comunicación. De nuevo, esto es un aviso de que el aventurerismo ha terminado y se requiere ciencia seria.

No quiero valorar estos dos casos muy positivamente, pero la dirección es la correcta.

Una característica notable de la arqueología subacuática es su carácter internacional. Fue internacional desde el principio: el estadounidense George Bass excavó un barco bizantino en Turquía; la dama inglesa Honor Frost excavó un barco púnico en Italia. No quiero extenderme. Se encuentra en la naturaleza del tema: los barcos que viajan y las culturas que se intercambian, son internacionales y también lo son los investigadores. No pueden desarrollarse comunidades

cerradas de investigadores como las de palafitos o las arqueologías provinciales. La arqueología subacuática es un poco como el fútbol: ¡el juego es igual en todo el mundo!

IKUWA ha sido internacional desde la primera conferencia en Sassnitz en 1999 a la quinta conferencia aquí en Cartagena y para IKUWA VI vamos a salir de Europa e ir a Australia.

Agradecimientos

En nombre del Comité Directivo, tenemos que agradecer a los organizadores el gran trabajo que han hecho. En primer lugar, tenemos que agradecer a Patricia Recio y Rocío Castillo, que dedicaron al menos un año de su vida a la preparación de esta conferencia.

Un cálido agradecimiento va al Ministerio de Cultura de España que financió no solo la preparación y la ejecución de la conferencia, sino también la publicación final. Tenemos que agradecer a la Subdirectora General de Protección del Patrimonio Histórico del Ministerio, Elisa de Cabo, por este generoso apoyo y un agradecimiento especial a su colaboradora, María Agúndez, por unirse a nosotros en las reuniones de preparación.

Tenemos que agradecer al Rector Magnífico José Antonio Franco Leemhuis que nos recibió en esta hermosa universidad. Se usaron tres salas simultáneamente, que se llenaron de vivas discusiones, pero la alegría y el zumbido de las conversaciones de los delegados en el soleado patio durante las pausas para el café seguirá siendo un recuerdo especial.

Y tenemos que agradecer profundamente al director de ARQVA Iván Negueruela, que aceptó sin ninguna duda acoger IKUWA y lo apoyó en todos los ámbitos, incluido el personal.

Hanz Günter Martin
Presidente de IKUWA V

We are happy and proud that people from all corners of the world came here together to exchange their latest knowledge in underwater archaeology. We are researchers of history, but we are also a part of the history. We may look back on 60 years of underwater archaeology. A very short term for a historian, but a remarkable timespan for the development that this discipline has taken.

From the early 60ies of the last century when pioneers like Georg Bash, Bernabò Brea, Honor Frost, Elisha Lindner, Gerhard Kapitän and the youngest of them all, the here present David Blackman started their studies until today, there was a long way to go.

Methods had to be developed, tools had to be invented and places had to be found where the findings could be treated and displayed. Institutes were founded and the antiquity authorities included the underwater heritage into their competences.

You may see the story of underwater archaeology as a steady progress of becoming more and more professional and of implementing the value of underwater cultural heritage to human society. But this is only the half of the truth.

The success of underwater archaeology that we have today is nearly exclusively based on individual engagement. You had to be a freak to promote underwater archaeology and in many parts of the world, you have to be a freak still today.

I do not want to stress this point, but mention two cases that show what has been reached.

The first case is the *Nuestra Señora de las Mercedes* and I think you have seen the exhibition here in the museum. The American Court that condemned Odyssey Marine to restitute all stolen silver coins to Spain sent out a strong signal: treasure hunting is over now! Respect the heritage wherever you are!

The second case regards the so-called *Santa Maria* of Haiti. An adventurer launched the breaking news that he found Columbus' ship. Unesco via the Advisory Board formed a team of experts that examined the site and declared within relatively short time, that the remains do not belong to the *Santa Maria*. And what happened? The authority of Unesco was immediately and worldwide accepted by the press and the media. This again is a strong signal that adventurism is over and serious science is wanted.

I do not want to see these two cases too positively, but the direction is the right one.

A remarkable feature of underwater archaeology is its internationality. It was international from the beginning on: the American George Bass excavated a byzantine ship in Turkey; the English lady Honor Frost excavated a Punic ship in Italy. I do not want to drive this too far. It lies in the nature of the subject: ships that are travelling and thus combining cultures are international and so are the researchers. Closed communities of researchers like for lake dwellings or for

provincial archaeologies cannot develop. Here underwater archaeology is a bit like football: the game is the same all over the world!

IKUWA has been international from the very first conference on in Sassnitz in 1999 to the fifth conference here in Cartagena and for IKUWA VI we will leave Europe and go to Australia.

Acknowledgements

On behalf of the Steering Committee, we have to thank the organisers for their great work they have done. In first place, we have to thank Patricia Recio and Rocío Castillo, who dedicated at least one year of their life to the preparation of this conference.

A warm thank goes to the Ministry of Culture of Spain that financed not only the preparation and the execution of the conference, but also the final publication. We have to thank the Vice-Director of the Ministry Elisa de Cabo for this generous support and a special thank goes to her assistant María Agundez for joining us in the preparation meetings.

We have to thank Magnificent Rector José Antonio Franco Leemhuis for hosting us in this beautiful university. Three rooms contemporaneously used were filled with lively discussions, but the cheerfulness and the buzzing talks of the delegates in the sunny courtyard during the coffee breaks will remain a special memory.

And we have to thank deeply the Director of ARQVA Iván Negueruela, who accepted without any hesitation to host IKUWA and supported it in every also very personal way.

Hanz Günter Martin
President of IKUWA V

Para la historia institucional de este Museo Nacional la organización del V Congreso «IKUWA» marca, como un sólido jalón, uno de los cuatro o cinco hitos de su vertiginoso desarrollo.

El Museo se inauguró en 1982 con la celebración del VI Congreso Internacional de Arqueología Submarina.

Veinte años después, en los años 1999 y 2000 el Museo fue la sede del FEMAM (Foro Europeo del Mediterráneo de Arqueología Marítima).

El 23 de enero de 2001 se puso la primera piedra de la nueva sede, que se inauguró en noviembre de 2008.

Finalmente, la celebración de IKUWA V, entre los días 14-18 de octubre de 2014, ha significado otro jalón de esta importante serie.

Cuando me re-incorporé a la dirección del Museo el 26 octubre 2013 hubo inmediatamente que poner a trabajar toda la maquinaria organizativa de cara a la celebración de IKUWA V. En las páginas de estas Actas se informa detalladamente del alto número de comunicaciones y de posters que acogió el Congreso.

Ante el elevado número de participantes, hubo que gestionar sedes ajenas, preparar actos, transportes de los numerosos congresistas, sedes diversas y salas diversas, movimiento interno y externo del personal, alojamiento, manutención, relaciones con la Universidad Politécnica de Cartagena, con el Ayuntamiento y con diversas instituciones de la ciudad. Y, en fin, los mil aspectos, unos grandes y otros pequeños, de los que depende que una convocatoria internacional tan numerosa pueda dar satisfacción, hasta en sus más mínimos detalles, a quienes habían depositado su confianza en el Museo.

El párrafo anterior no es sino la manera de reconocer el inmenso trabajado realizado por todo el equipo del Museo, especialmente encarnado en las personas de Rocío Castillo Belinchón, Patricia Recio Sánchez, ayudadas en una segunda etapa por Ana Miñano Domínguez y David Munuera Navarro. La infinita generosidad de su tiempo y de sus cerebros que demostraron desde noviembre de 2013 hasta octubre de 2014 solo podrá serles compensada cuando tengan, cada uno de todos ellos, un ejemplar de estas Actas en sus manos y sus bibliotecas.

Terminado el Congreso, hubo que proceder con la preparación de las Actas para su publicación, tarea tan apasionante intelectualmente como tediosa. De la pasión se encarga el conocer de primera mano todas y cada de las aportaciones. Del tedio, el obligado repaso meticuloso de erratas, formatos diferentes, referencias bibliográficas, etc. Ahí entró, junto a Rocío Castillo Belinchón, Abraham Ramírez Pernía. Ambos contaron con la ayuda de Luis Ángel Torres Sobrino, Felicidad Arias Fernández, Niccolò Bassan, M^a José Espín Sáez, Félix Ferrero García y Juan Jesús Oliver Laso.

A todos ellos mi reconocimiento más auténtico, porque sin ellos y su profesionalidad no se habría podido realizar y publicar el congreso.

Así mismo, el apoyo de la Dirección General de Bellas Artes del Ministerio de Cultura en la persona de su Director, que aporta una breve presentación a estas Actas, ha hecho posible la celebración con éxito del Congreso.

Finalmente, debemos agradecer la colaboración de la Universidad Politécnica de Cartagena en la persona de su rector, Doctor D. José Antonio Franco Leemhuis que, desde el primer momento en el que nos entrevistamos con él, apoyó completamente la idea y nos facilitó las espléndidas instalaciones de su Universidad para la celebración de las numerosas y muy diversas Sesiones.

Y en fin: no quiero cerrar estas líneas preliminares sin el agradecimiento a todos y cada uno de cuantos colegas nos visitaron en Cartagena para tomar parte en el Congreso, ya con Comunicaciones, ya con pósteres.

A todos ellos, nuestro agradecimiento y reconocimiento.

Dr. Iván Negueruela Martínez
Director facultativo del Museo Nacional de Arqueología Subacuática

For the institutional history of this National Museum the organization of the Congress «IKUWA-V», has been one of the four or five milestones of its short history.

The Museum was inaugurated in 1982 with the celebration of the VI International Congress of Underwater Archeology.

Twenty years later, in 1999 and 2000 the Museum organized the FEMAM (Euro-Mediterranean Forum on Maritime Archaeology), the first international attempt for the diffusion and awareness of this discipline, with the participation of 17 Governments.

On January 23, 2001, the foundational stone of the new building was settled.

And finally, in November 2008 the new Siege of the Museum was inaugurated.

And now, the celebration of IKUWA V, October, 14-18, 2014, has marked another milestone of this important series.

When I re-entered the Museum's direction on November 2013, I organized immediately the Museum's team and machinery in order to host the celebration of IKUWA V in october-2014. The pages of these Acts detail the high number of communications and posters hosted by the Congress.

In view of the large number of participants, it was necessary to manage other venues, prepare acts, transportation of the numerous congressmen, various venues and various halls, internal movement and external staff, housing, maintenance, relations with the Technical University of Cartagena, with the Town Hall and various institutions of the city. And finally, the thousand aspects, some large, some small, on which depends the success of such an international event. Even in the smallest details, we were obliged to satisfy to all those who had deposited his faith in the Museum.

The previous paragraph is only the way of recognizing the immense work done by the whole team of the Museum, especially embodied in Rocío Castillo Belinchón and Patricia Recio Sánchez, assisted by Ana Miñano Domínguez and David Munuera Navarro. The infinite generosity of time and brains that they demonstrated from November 2013 to October 2014 will only be compensated with the publication on these Acts of the IKUWA 5 Congress.

After the Congress, it was necessary to organize the proceedings for its publication; a task as exciting intellectually as tedious: in one hand, to know every one of the contributions. In the other, the meticulous review of errata, different formats, bibliographical references, etc. Then joined the team Abraham Ramírez Pernía, and for some months or weeks, Luis Ángel Torres Sobrino, Felicidad Arias Fernández, Niccolò Bassan, M^a José Espín Sáez, Félix Ferrero García and Juan Jesús Oliver Laso.

To all of them my best recognition. Because without their professionalism the congress could'nt have been celebrated, nor published.

Also, the support of the Directorate General of Fine Arts and Cultural Heritage of the Ministry of Education, Culture and Sports in the person of its Director has made possible the successful celebration of the congress.

Finally, we must thank the collaboration of the Technical University of Cartagena in the person of its Rector Magnífico, Dr. D. José Antonio Franco Leemhuis who, from the very first time I met him, he fully supported the idea and provided us with the splendid facilities of its University for the celebration of the numerous and very diverse sessions.

And finally: I could not close these Preliminary lines without giving the personal thanks of the staff of the Museum to each of our colleagues who visited us in Cartagena to take part in the Congress.

To all of them, our warmest appreciation.

Dr. Iván Negueruela Martínez
Director of the National Museum of Underwater Archaeology

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INTRODUCCIÓN

INTRODUCTION

Historia de IKUWA

El primer congreso internacional de arqueología subacuática (IKUWA I, entonces IKUWA '99) se celebró en febrero de 1999 en Sassnitz en la isla de Rügen, en la costa del mar Báltico en Alemania, con el tema «La protección del patrimonio cultural bajo el agua». Se recibió un apoyo considerable del Programa Raphael de la Unión Europea, en el marco del refuerzo de los lazos culturales y educativos de este a oeste. Fue organizado por iniciativa de la Deutsche Gesellschaft zur Förderung der Unterwasserarchäologie (DEGUWA) por siete organizaciones asociadas alemanas y cinco no alemanas (Suiza, Reino Unido, Grecia, Países Bajos y Polonia).

El congreso fue un éxito rotundo, con amplia participación internacional. Tenía una serie de sesiones cronológicas y una serie de sesiones temáticas sobre materias como la conservación, gestión y documentación. Particular importancia se le dio a una mesa redonda sobre la protección del patrimonio cultural subacuático de Europa, con particular referencia a la Convención de la Unesco de 2001. Los participantes fueron principalmente de Europa, pero también de la India, Israel y los EE. UU. También hubo un concurso de vídeo, con 25 presentaciones de las cuales una fue premiada, y un concurso de trabajos científicos en los que se premió a las tres presentaciones. Las actas de la conferencia se publicaron el año 2000 como *Schutz des Kulturerbes unter Wasser. Veränderungen europäischer Lebenskultur durch Fluß- und Seehandel*.

Se acordó en Sassnitz inaugurar un ambicioso programa de congresos para construir una red internacional de instituciones relacionadas con la arqueología subacuática. Esto se logró mediante la celebración de IKUWA II e IKUWA III.

IKUWA II se celebró en Zúrich (Suiza) en octubre de 2004. El comité organizador incluyó también miembros alemanes y británicos. Asistieron alrededor de 200 participantes de 25 países. Las actas se publicaron en 2006 como *Die Neue Sicht. Une nouvelle interprétation de l'histoire* en la serie Antiqua, vol. 40. En los días previos al congreso se realizó un taller de capacitación de postgrado, con 21 participantes de 11 países europeos.

IKUWA III se llevó a cabo bajo los auspicios del Director General de la Unesco. Se celebró en el University College de Londres (Reino Unido) en julio de 2008, con el título «Más allá de las fronteras» y fue organizado por la Nautical Archaeology Society (NAS) y el Institute of Field Archaeologists. Los socios del proyecto incluyeron a la Unesco, la British Academy, Historic Scotland e English Heritage. El Comité Directivo incluía miembros de Alemania y Suiza. 260 participantes de más de 20 países diferentes presentaron 126 trabajos durante los tres días. Las actas fueron publicadas en 2012 por los Römisch-Germanische Kommission des Deutschen Archäologischen Instituts y NAS como *IKUWA 3. Beyond boundaries*. La conferencia fue precedida por una escuela de campo de desarrollo profesional con participantes de casi una docena de naciones organizadas por el NAS. Un día antes, la Unesco organizó una conferencia intergubernamental de un día en la British Academy sobre la Convención de 2001.

IKUWA IV se celebró en octubre de 2011 en la Universidad de Zadar (Croacia). No mucho tiempo antes de que el International Centre for Underwater Archaeology (ICUA) se hubiera establecido bajo los auspicios de la Unesco. ICUA organizó la conferencia junto con la Universidad y el Ministerio de Cultura. Bajo el título «La gestión del patrimonio cultural subacuático» 176 comunicaciones y 34 pósteres fueron presentados por académicos de 40 países de todo el mundo. Incluso China envió una delegación a observar la conferencia. La publicación está todavía en curso.

IKUWA V se llevó a cabo en Cartagena (España) en octubre de 2014 y fue organizado por el Museo Nacional de Arqueología Subacuática, con el tema «Un Patrimonio para la Humanidad». El Congreso fue financiado por la Subdirección General de Protección del Patrimonio Histórico del Ministerio de Educación, Cultura y Deportes de España y contó con la colaboración de la Universidad Politécnica de Cartagena. El Comité Directivo incluía miembros de Alemania, Suiza, Reino Unido, Italia, Croacia, Australia y España. Los participantes, casi 300 personas entre autores y oyentes, procedían de más de 30 países de los cinco continentes. En total se presentaron 173 trabajos: 105 comunicaciones y 68 pósteres. Sus Actas son el objeto de esta publicación.

IKUWA VI se celebrará en 2016 en el Western Australian Maritime Museum de Fremantle (Australia). Su programa preliminar fue presentado en Cartagena en octubre de 2014. Su programa definitivo se cerrará en mayo de 2016.

About IKUWA

The first international congress for underwater archaeology (IKUWA I, then IKUWA '99) was held in February 1999 in s heritage under water». It received considerable support from the Raphael Programme of the European Union, in the context of reinforcing east-west cultural and educational ties, and was organised on the initiative of the Deutsche Gesellschaft zur Förderung der Unterwasserarchäologie (DEGUWA) by seven German and five non-German (Switzerland, UK, Greece, Netherlands and Poland) partner organizations.

The congress was a resounding success, with wide international participation. It had a series of chronological sessions and a series of thematic sessions on subjects such as conservation, recording and management. Particular importance was given to a round table on the protection of the European underwater cultural heritage, with particular reference to the Unesco 2001 Convention. The participants were mainly from Europe, but also from India, Israel and the USA. There was also a special video contest with 25 submissions of which one was given an award and a contest of scientific works where all three submissions were given an award. The proceedings of the conference were published 2000 as *Schutz des Kulturerbes unter Wasser. Veränderungen europäischer Lebenskultur durch Fluß- und Seehandel*.

It was agreed at Sassnitz to inaugurate an ambitious programme of congresses to build an international network of institutions dealing with underwater archaeology. This was achieved by the holding of IKUWA II and IKUWA III.

IKUWA II was held in Zurich (Switzerland) in October 2004. The organizing committee included also German and British members. About 200 participants from 25 countries attended. The proceedings were published in 2006 as *Die Neue Sicht. Une nouvelle interprétation de l'histoire* in the series Antiqua, vol.40. In the days preceding the congress a postgraduate training workshop was held, with 21 participants from 11 European countries.

IKUWA III took place under the auspices of Unesco's Director-General. It was held in University College London (UK) in July 2008, with the title «Beyond Boundaries» and was organized by the Nautical Archaeology Society (NAS) and the Institute of Field Archaeologists. Project partners included Unesco, the British Academy, Historic Scotland, and English Heritage. The Steering Committee included German and Swiss members. 260 participants from more than 20 different countries presented 126 papers over the three days. The proceedings were published in 2012 by the Römisch-Germanische Kommission des Deutschen Archäologischen Instituts and NAS as *IKUWA 3. Beyond boundaries*. The conference was preceded by a professional development field school with participants from almost a dozen nations organized by NAS. One day before, Unesco held a one-day intergovernmental conference in the British Academy on the 2001 Convention.

IKUWA IV was held in October 2011 at the University of Zadar (Croatia). Not long before the International Centre for Underwater Archaeology (ICUA) had been established under Unesco's auspices. ICUA organised the conference together with the University and the Ministry of Culture. Under the title «Managing the underwater cultural heritage» 176 talks and 34 posters were presented by scholars from 40 countries all over the world. Even China sent a delegation to observe the conference. Concerning IKUWA IV (Zadar), the Proceedings has been published in *SKYLLIS*, 14 (2014).

IKUWA V took place in Cartagena (Spain) in October 2014 and was organized by the National Museum of Underwater Archaeology, with the theme «A Heritage for Humanity». Congress was funded by the Office for the Protection of Historical Heritage of the Ministry of Education, Culture and Sports of Spain and with the collaboration of the Polytechnic University of Cartagena. The Steering Committee included members from Germany, Switzerland, UK, Italy, Croatia, Australia and Spain. Participants, almost 300 people between authors and listeners, came from more than 30 countries on five continents. A total of 173 works were presented: 105 communications and 68 posters. Their proceedings are the object of this publication.

IKUWA VI will be held in November 2016 in the Western Australian Maritime Museum in Fremantle (Australia). Their preliminary program was presented in Cartagena in October 2014. Its final program will close in May 2016.

IKUWA V

Comisión directiva / Steering Committee

Hanz Günter Martin, presidente de IKUWA V (DEWUGA, Alemania)
 David Blackman, vicepresidente de IKUWA V (Oxford University, Reino Unido)
 Iván Negueruela (MNAS, España)
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 Hrvoje Potrebica (Croatian Archaeological Society & University of Zagreb, Croacia)
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 Shipwreck Galleries, Fremantle WA Australia)
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 Wendy Van Duivenvoorde (ACHRC, AIMA, Flinders University, Adelaide, Australia)
 Annalisa Zaratini (Dirección General de Bienes Culturales, Italia)
 Peter Winterstein (DEWUGA, Alemania)

Organización / Organization

Museo Nacional de Arqueología Subacuática (MNAS)
 National Museum of Underwater Archaeology
<http://museoarqua.mcu.es/>
informacion.arqua@mecd.es
 Director: Dr. Iván Negueruela

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 Rocío Castillo Belinchón

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 Eloísa Íbero Solana
 Juan Alberto Cano Sánchez
 Eva Villar González
 Mar Mirón Álvarez
 Abraham Ramírez Pernía

Lugar de celebración / Venue

Museo Nacional de Arqueología Subacuática
Paseo del Muelle Alfonso XII, n.º 22
30202 Cartagena

Universidad Politécnica de Cartagena
Campus Muralla del Mar (Antiguo Real Hospital de Marina)
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Cultura y Deportes de España

Office for the Protection of Historical Heritage
Ministry of Education, Culture and Sports of Spain

Participantes

A la convocatoria de IKUWA V, cerrada en febrero de 2014, llegaron en plazo 233 solicitudes: 189 de comunicación y 42 pósteres. De las 189 propuestas de comunicación, presentadas en plazo, 125 se aceptaron, 19 desestimaron, 44 se propusieron como pósteres y una más se dejó en reserva. Por su parte, todas las propuestas de pósteres fueron aceptadas.

Al Congreso, celebrado en octubre de 2014, asistieron casi 300 personas en total: los autores que presentaron sus comunicaciones y pósteres, más los oyentes, los miembros del comité de IKUWA V y el personal del museo.

En el programa final hubo 105 comunicaciones: 83 fueron presentadas por profesionales internacionales (79%) y 22 por colegas nacionales (21%). Por otra parte se presentaron 68 pósteres: 43 realizados por autores internacionales (63%) y 25 por nacionales (37%). Estas estadísticas refrendan el carácter internacional de IKUWA V.

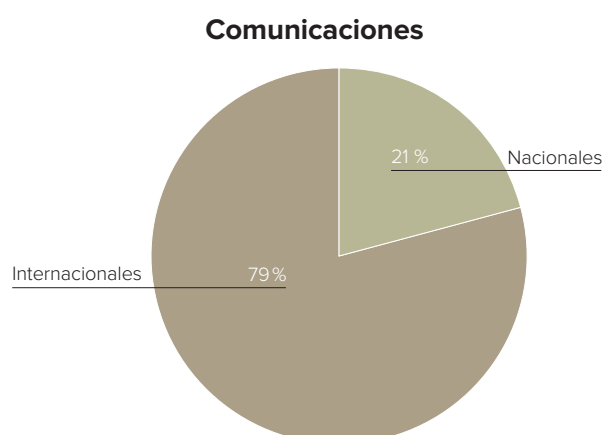


Figura 1. Procedencia de las comunicaciones presentadas.
Figure 1. Origin of papers.

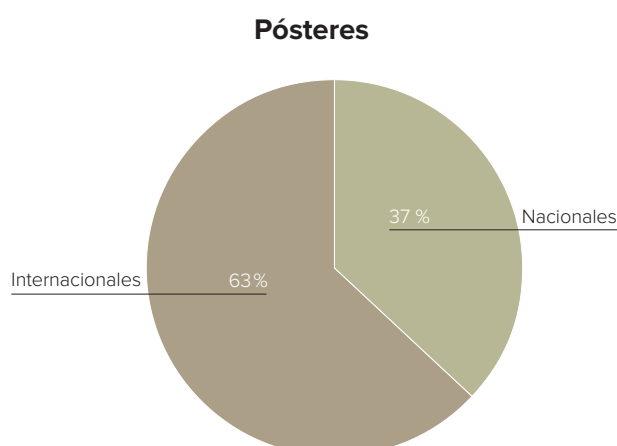


Figura 2. Procedencia de los pósteres presentados.
Figure 2. Origin of the posters.

Si se analiza la procedencia geográfica por continentes, se observa que la mayoría de las comunicaciones y pósteres procedían de Europa (84%) y el resto de otras latitudes (16%), estando representados 30 países de los cinco continentes:

Países / Countries	Comunicaciones / Papers	Pósteres / Posters	Total
Argentina / Argentina	1	1	2
Australia / Australia	3	1	4
Bélgica / Belgium	4	2	6
Brasil / Brazil	1		1
Canadá / Canada	1		1
Chipre / Cyprus	1	1	2
Croacia / Croatia	4	4	8
Dinamarca / Denmark	1		1
Egipto / Egypt	2		2
EE. UU. / USA	3	1	4
Eslovenia / Slovenia	1		1
España / Spain	24	25	49
Estonia / Estonia		1	1
Finlandia / Finland	1		1
Francia / France	6		6
Grecia / Greece	2	1	3
Irlanda / Ireland	1		1
Israel / Israel	2		2
Italia / Italy	8	14	22
Japón / Japan	1		1
México / Mexico		1	1
Países Bajos / Netherlands	2		2
Polonia / Poland	1	3	4
Portugal / Portugal	10	7	17
Reino Unido / United Kingdom	12	1	13
Rusia / Russia	3	2	5
Suecia / Sweden	6		6
Suiza / Switzerland		1	1
Ucrania / Ukraine	1	2	3
Uruguay / Uruguay	3		3
Total	105	68	173

Figura 3. Países de procedencia de las comunicaciones y pósteres presentados.

Figure 3. Countries of origin of the papers and posters presented.

Los países con mayor participación fueron cuatro: España con 49 presentaciones (24 comunicaciones y 25 pósteres); Italia con 22 (8 comunicaciones y 14 pósteres); Portugal con 17 (10 comunicaciones y 7 pósteres); y Reino Unido con 13 presentaciones (12 comunicaciones y 1 pósteres).

Por otra parte, asistieron al Congreso, en calidad de oyentes, 87 personas de 15 países. De ellos la mayoría eran nacionales (66%), y el resto internacionales (34%).

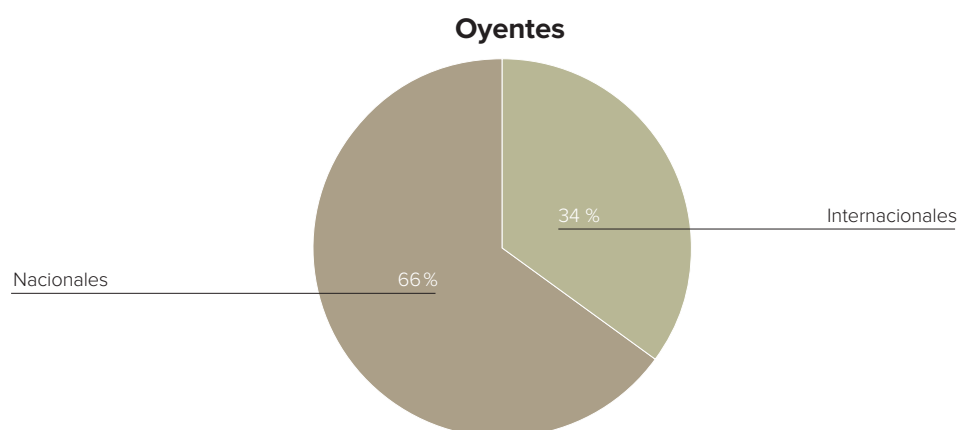


Figura 4. Procedencia de los oyentes asistentes.

Figure 5. Listeners' origin.

Respecto a la procedencia geográfica de los 87 oyentes asistentes al Congreso, hay que señalar que la inmensa mayoría eran europeos (96,5%) y solo tres personas procedían del resto de continentes (3,5%). De los europeos 57 eran españoles, de casi todas las comunidades autónomas, y 27 personas del resto de Europa. Los oyentes procedían de 15 países:

Países / Countries	Oyentes / Listeners
Alemania / Germany	6
Australia / Australia	1
Brasil / Brazil	1
Croacia / Croatia	1
Dinamarca / Denmark	1
España / Spain	57
Francia / France	2
Irlanda / Ireland	1
Italia / Italy	1
Líbano / Lebanon	1
Luxemburgo / Luxembourg	1
Portugal / Portugal	5
Rusia / Russia	3
Suiza / Switzerland	2
Reino Unido / United Kingdom	4
Total oyentes	87

Figura 5. Países de procedencia de los oyentes asistentes a IKUWA V.

Figure 5. Countries of origin of the listeners in IKUWA V.

Finalmente, para la publicación de estas actas se han recibido 119 aportaciones: 71 comunicaciones y 48 pósteres.

	COMUNICACIONES Papers	PÓSTERES Posters	Total
Solicitudes presentadas Applications submitted	189	42	231
Solicitudes aceptadas Applications accepted	125	86	211
Participación en el Congreso Participants in the Congress	105	68	173
Participación en las Actas Participants in the Proceedings	71	48	119

Figura 6. Comparación entre las solicitudes presentadas, aceptadas y los participantes en el Congreso y en las Actas de IKUWA V.
Figure 6. Comparison between the applications submitted, accepted and participants in the Congress and in the Proceedings of IKUWA V.

Participants

The Call for papers to IKUWA V, closed in February 2014, 233 applications arrived on time: 189 communications and 42 posters. Of the 189 communication proposals, submitted on time, 125 were accepted, 19 rejected, 44 were proposed as posters and one more was left in reserve. Meanwhile, all the posters proposals were accepted.

Congress, held in October 2014, attended by nearly 300 people in total: the authors who submitted papers and posters, the listeners, the IKUWA V committee members and the museum staff.

In the final programme there were 105 communications: 83 were submitted by international professionals (79%) and 22 by national colleagues (21%). Also 68 posters were presented: 43 by international authors (63%) and 25 by national ones (37%). These statistics endorse the international character of IKUWA V (Fig. 1 y 2).

If the geographical origin by continent is analyzed, it is observed that most of the papers and posters came from Europe (84%) and the rest from other latitudes (16%), being represented 30 countries from five continents (Fig. 3).

Countries with the highest participation were four: Spain with 49 presentations (24 communications and 25 posters); Italy with 22 (8 communications and 14 posters); Portugal with 17 (10 communications and 7 posters); and the United Kingdom with 13 presentations (12 papers and 1 posters).

Moreover, 87 people from 15 countries attended the Congress, as listeners. Most of them were nationals (66%), and the rest international ones (34%) (Fig. 4).

Regarding the geographical origin of the 87 listeners attending the Congress, noted that the vast majority were Europeans (96.5%) and only three people came from other continents (3.5%). From the Europeans 57 people were Spanish, nearly from all regions, and 27 people from the rest of Europe. Listeners came from 15 countries (Fig. 5).

Finally, for the publication of these Proceedings we have received 119 contributions: 71 communications and 48 posters (Fig. 6).

PATRIMONIO CULTURAL SUBACUÁTICO: ASPECTOS LEGALES

UNDERWATER CULTURAL HERITAGE: LEGAL ASPECTS

Hacia un patrimonio cultural subacuático común hispánico

Towards a shared Hispanic underwater cultural heritage

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Resumen: el patrimonio histórico subacuático de origen hispánico ha sido y sigue siendo objetivo principal de una industria global, eficiente en capital y tecnología: la industria cazatesoros. La situación puede calificarse como de una de las crisis culturales más importantes de la humanidad. En esas circunstancias la escasez de recursos jurídicos eficientes exige acciones añadidas. Entre ellas lograr el equilibrio entre las pocas soluciones legales que funcionan, como es el reconocimiento de la inmunidad soberana de los buques históricos de origen hispánico a favor de España, y asegurar el carácter necesariamente común, vinculado exclusivamente a la cultura, a favor de la comunidad de países que los forjó es un desafío urgente e imprescindible.

Palabras clave: patrimonio cultural hispánico, pecios, cazatesoros, aguas territoriales e internacionales, aproximación legal.

Abstract: The situation in the last 50 years related to the Hispanic underwater heritage can be described as one of the most important cultural crisis of humanity. The Hispanic underwater heritage has been the traditional and main target of a destructive international industry, the treasure hunter industry, efficient overall in capital and technology. In these circumstances the lack of effective legal remedies requires added actions. Only few legal measures have been proven useful against this global menace: the recognition of the sovereign immunity of Historic Ships of Hispanic origin in favor of Spanish Kingdom must be necessarily linked exclusively to culture and cooperation and force the collaboration of the community of countries which forged it. This is an urgent and essential challenge and it is necessary to determine immediate steps.

Key words: Hispanic Heritage, shipwrecks, treasure-hunters, national and international waters, legal approaches.

Introducción

El 7 de octubre de 2014, doña Pilar Luna, titular del Área de Arqueología Subacuática del Instituto Nacional de Antropología e Historia de México, sin duda una de las personalidades que más ha contribuido a la defensa y difusión del patrimonio histórico sumergido, hacía una afirmación que permitiría cambiar el sesgo de una guerra, la que nos enfrenta al cazatesorismo, que no está, hoy por hoy, ganando la Cultura. Efectivamente, a preguntas de este abogado durante una conferencia en la Fundación Ramón Areces, doña Pilar expresó que México reconocía el principio de inmunidad soberana de los buques históricos españoles hundidos en sus aguas (Fig. 1).



Figura 1. Pilar Luna, sin duda una de las personalidades más relevantes en la defensa del patrimonio común hispánico.

Para quien conozca la escasa cooperación eficiente entre los Estados donde descansa patrimonio histórico sumergido hispánico, esta manifestación venía prácticamente a obligar a cooperar a los Estados Unidos Mexicanos y al Reino de España en una tarea común. Porque el alcance de esta afirmación no consistía en la mera adhesión a un principio de derecho marítimo sino que aprovechando el margen que permite uno de los pocos principios de derecho marítimo que se respetan, el principio de inmunidad soberana, incluso aplicado a los buques históricos aprovechaba una herramienta, hasta ahora la más eficiente, para frenar a los cazatesoros como industria global.

Desgraciadamente la Convención Unesco del 2001 no ha sido el instrumento que diese la respuesta a corto plazo necesaria para contener a la industria internacional de cazatesoros. La presente situación, en relación a este tipo de patrimonio, puede definirse como una de las crisis culturales más importantes que le acontece a la humanidad. Una crisis global, frente a la que hay muy pocas herramientas jurídicas eficaces por muy controvertida que pueda parecer esta afirmación.

Dimensiones de una crisis. ¿Cuánto tiempo nos queda?

El 7 de mayo de 2014 durante las Jornadas de Arqueología Subacuática organizadas en Madrid por el diario *ABC*, el Ministerio de Cultura y La Casa de la Lectura pude hacer la presentación de un modelo teórico, ayudado por importantes ingenieros europeos, que pretendía dar una respuesta a esta pregunta. Si queríamos determinar soluciones y el nivel de respuesta necesario, había que conocer el horizonte temporal en que todavía había algo que proteger. Así, para dimensionar la crisis, se trataba de ver por una vez desde los propios parámetros creados por la industria extractiva de los cazatesoros y cuantificando los pecios y yacimientos arqueológicos no explotados como si fueran un recurso extractivo, no renovable, tal como lo considera esta industria del expolio. Los modelos sirven para ayudar a la mente humana a entender realidades complejas y, aunque no hay un modelo que pueda predecir con exactitud el futuro, lo que sí puede darnos es una idea de lo que se debe esperar. Por cuestiones profesionales, me había familiarizado con un área en la que los modelos son importantes y es la del agotamiento de los recursos. En ese ámbito se ha extendido la denominada curva de Hubbert, que sirvió con éxito para prever el año pico para producción de recursos de petróleo crudo en los Estados Unidos en la década de 1950. Un equipo multidisciplinar que respaldaban importantes ingenieros, como Alfonso Fernández Durán, e historiadores y arqueólogos como doña María Cruz Berrocal de la



Figura 2. El desmembramiento de un yacimiento.

Universidad de Konstanz, autoridad en lo que se refiere a la presencia hispánica en Oceanía, nos permitieron concluir un horizonte temporal de 10 años, en lo que afecta al patrimonio histórico sumergido hispánico, para considerar, en términos de agotamiento de recursos, el expolio del patrimonio subsistente actualmente en los fondos oceánicos.

Es decir, manteniendo las circunstancias presentes, dispondríamos de menos de una generación para detener esta destrucción, que, en algunos casos, como Estados Unidos, ya ha posibilitado la eliminación de prácticamente todo un registro histórico de legado común. En la segunda mitad del siglo xx, surgió una industria basada y orientada exclusivamente a la explotación del legado sumergido histórico, siendo los tres motores fundamentales de la misma: madurez tecnológica y financiera de esas empresas, una poderosa base ideológica que alimenta la denominada «leyenda negra» y que consiste en negar valor histórico nada menos que al patrimonio histórico de origen hispano y, finalmente, la tolerancia legal de los mercados norteamericanos y europeos (Fig. 2).

A pesar de la continua agresión, muy específica en intensidad y mecánica ideológico-jurídica, que sufre el patrimonio histórico sumergido hispánico, apenas se ha efectuado una cuantificación de la dimensión de esta catástrofe, un contorno empírico del alcance de esta pérdida. Sorprende, en ese sentido, la escasa literatura académica española al respecto, siendo el fenómeno económico y jurídico internacional de los cazatesoros prácticamente inédito. En ese sentido me permito destacar que fue en la revista *Economía Exterior* donde se hizo la primera aproximación económico-empresarial, en español, al mundo internacional de los cazatesoros siendo su autor Jesús García Calero (García, 2009, *Economía Exterior*, n.º 49, verano 2009, tit. «El expolio no cotiza en bolsa», pp. 123-130). Por mi parte pude presentar en la Real Academia de Legislación y Jurisprudencia un análisis sobre el tratamiento que recibían los yacimientos arqueológicos de origen hispánico correspondientes a buques históricos en los tribunales norteamericanos, resultando entre otras conclusiones, después de estudiar los sumarios de decenas de casos que la legislación y la práctica legal de Estados Unidos no garantiza que un yacimiento arqueológico submarino correspondiente a un pecio de origen español obtenga las máximas garantías jurídicas y protección legal posibles con base al ordenamiento norteamericano. Resultando, asimismo, significativo que los niveles de protección en España y Estados Unidos no son equiparables y que, en este sentido, no hay una debida reciprocidad en cuanto a la protección de un patrimonio y otro, echándose de menos un instrumento bilateral que zanje estas diferencias y acabe con la sucesión de asuntos judiciales que reiteradamente afectan al patrimonio histórico de este origen. Otras conclusiones alarmantes son que la práctica, amparada en las leyes federales y estatales de Estados Unidos y la

liberalidad práctica de algunos de sus jueces, no garantiza en los yacimientos, objeto de explotación comercial, el respeto de criterios arqueológicos homologados, ni una adecuada consecuencia científica y académica de la intervención en el yacimiento. La normativa norteamericana incentiva la inversión en la industria cazatesoros, garantizando porcentajes extraordinarios a favor de esas empresas. En ese sentido, la desprotección efectiva de los yacimientos de restos de origen hispánico resulta evidente y es parte de esa misma incentivación. Es decir, la ausencia de garantías arqueológicas en el acceso a los yacimientos históricos de pecios españoles es una obvia necesidad de la industria cazatesoros (entre las muchas singularidades del patrimonio arqueológico sumergido hispánico se encuentra su especial relación con una industria, la cazatesoros, tanto hoy día como lo ha sido en más de 100 años y ha hecho del mismo su principal recurso).

El dilema del guardián: ¿por qué las sociedades implicadas no están tomando decisiones idóneas?

¿Por qué las sociedades en las que precisamente reside la vinculación histórica y la proximidad geográfica con este legado no han tenido éxito en la protección del patrimonio sumergido hispánico? ¿Qué hace que hayan fracasado las políticas y las respuestas de los Estados implicados? Es evidente que, incluso en este siglo XXI, cuestiones necesariamente internacionales no se han visto favorecidas por los enfoques nacionales del problema, que estos «enfoques nacionales» se han mantenido preponderantes y que los hegemónicos elementos políticos no han rediseñado su acción de cara a dar respuesta a una crisis cuya extensión demuestra la necesidad de interdependencia mundial en esta materia.

Un clásico en los modelos de decisión, dentro de la teoría de juegos, es el denominado dilema del prisionero en el que se describe una situación en la que la efectiva falta de información impide la colaboración entre dos prisioneros y la posibilidad de adopción de la mejor opción objetiva para ambos. Pero ese análisis puede ser transpolado a naciones democráticas, a los guardianes del legado arqueológico, y verifica que la falta de colaboración implica necesariamente una pérdida de oportunidades. En un contexto nacional, la respuesta ante una cuestión internacional puede permitir una respuesta cortoplacista, el oportunismo político en defecto del aprovechamiento del multilateralismo, que sería lo que proveería de más y mejores beneficios a las sociedades en forma de acceso a lo que hemos concluido que son bienes públicos mundiales¹. Sin embargo, el enfoque que estamos demandando sabemos que hoy por hoy no existe. Uno de los elementos que este papel viene a denunciar es que no es posible vincular las agendas de políticas nacionales y mundiales por medio de los convenios e instrumentos internacionales existentes en relación al patrimonio arqueológico subacuático (Fig. 3).



Figura 3. La consecuencia última de todo un registro histórico en manos de un cazatesoros.

¹ Una forma particular de este género de conflictos de interés se ha venido a denominar tragedia de los comunes. Consiste en una situación en que un número de agentes de consumo consume de una fuente de propiedad compartida sin que exista una regulación eficiente y efectiva respecto a la cuantía y forma en que puede hacerse su consumo. La razón excluyente encuentra su eficiencia argumentativa en el siguiente axioma «lo que no consuma ahora lo va a hacer otro ahora o después». La conducta racional en un entorno de incertidumbre legal es recoger antes de que lo haga otro aun cuando tal cosa conduzca al agotamiento y extinción del recurso en perjuicio de las sociedades civiles. Esa falacia argumentativa está muy difundida y define una mala conducta racional en relación a una decisión pública.

Resulta más que probado que los efectos reales de la Convención del Derecho del Mar en favor de nuestros pecios ha sido escaso, o insignificante. Además, debemos tener en cuenta que el mecanismo previsto por el artículo 303 de esta Convención se basa en el principio de cooperación, escasamente explorado por nuestro país, algo especialmente alarmante en el ámbito norteamericano y el de los demás países hispánicos. Esa proactividad supondría una política cultural exterior consecuente y, en otro caso, es imposible que este artículo del Convenio y los principios que encierra tengan ninguna o escasa virtualidad, ni siquiera con países preservacionistas de primera línea como Australia o México.

En términos similares, debemos reconocer que nuestra querida Convención Unesco de 2001 sobre la protección del patrimonio cultural subacuático sigue siendo un interrogante debido a la falta de efectos prácticos y/o de información de su efectividad por parte de las Administraciones competentes. La ausencia de transparencia que adolece nuestra Administración en este ámbito, en opinión de este abogado, resta sentido a todos los principios de la Convención Unesco.

Las crisis requieren las mejores estrategias disponibles: desideologización, inmunidad soberana de los yacimientos, cooperación en torno a una nueva categoría de bienes comunes

La principal cualidad del problema debe ser la primera cualidad de la solución. Me refiero a que es la identidad del origen del patrimonio subacuático común hispánico precisamente el objetivo estratégico de la industria cazatesoros internacional. Reconocer las dificultades específicas de ese patrimonio arqueológico, que por supuesto incluyen el tratamiento mercantilista que algunos Estados de la comunidad hispánica hacen sobre este patrimonio común y que impide que sea hoy por hoy, *de facto*, un bien público mundial. En la América hispánica no suponen un conocimiento específico, objeto de protección eficiente y bastante desde bases de no rivalidad y no exclusividad.

Solamente aceptando la especificidad de este patrimonio se permitiría avanzar en hacer efectiva su protección desmontando los dos motores ideológicos que han permitido a la industria cazatesoros, incluso en nuestros días, descualificar el legado hispánico de su naturaleza histórica que le es propia, esto es: una de las huellas más singulares, originales y a la vez constitutivamente mestizas de la humanidad, el registro histórico de una larga experiencia colectiva cuya memoria, no siempre sencilla, no es prescindible para la humanidad. Uno de esos motores se basa en la «leyenda negra»² de cuya virtualidad, incluso en algunos tribunales de Estados Unidos ya hemos hablado. La segunda es intrínseca a los países hispanos, de uno y otro lado del Atlántico: el papel político preponderante del elemento identitario.

Recordemos que con el pretexto del caso Odyssey Marine en los tribunales norteamericanos se abrió un debate sobre la identidad de lo hispánico. El pretexto ha sido que, una cápsula del tiempo, un buque hundido hace más de dos siglos, sumergido a 1100 metros de profundidad en el olvido y el Atlántico ha sido expoliado con el fin de ser revendidos sus restos. En ese buque viajaban españoles de dos continentes, europeos y americanos, de una España que entonces los abarcaba. Más de dos siglos más tarde, la España política que subsistió a esa otra

² Sobre el análisis de las mecánicas de las leyendas negras resulta fundamental el análisis de Luis Español Bouché en *Leyendas negras: vida y obra de Julián Juderías: la leyenda negra antiamericana*, Salamanca, Junta de Castilla y León, 2007. Sobre el uso específico de este mecanismo ideológico en lo que atañe al patrimonio arqueológico de origen español: José María Lancho, «The Stolen Memory: The Legal Crisis of the Hispanic Sunken Heritage in America and its causes», 2014, Universidad de Hawai y del que existe recurso electrónico <http://www.themua.org/collections/files/original/3c8c5c4168d375e26cf0f06e8af3b422.pdf>.

España más vasta ha peleado judicialmente, inicialmente en solitario, contra los cazatesoros en los tribunales hasta obtener una victoria legal.

Sin embargo, la caja de los debates ha permanecido abierta, entre ellos aquellos que tenían su apoyo principal en el derecho moral de quienes alegan ser herederos de la memoria de pueblos que antes que los españoles ocuparon las tierras de América. De descendientes de pueblos que muchos de ellos fueron postergados por una sociedad nueva que produjo, en duras condiciones, parte de los restos arqueológicos que contenía la fragata *Mercedes* expoliada. La respuesta jurídica dada por la representación procesal española en Estados Unidos a las reclamaciones de la República de Perú, que argumentaba la titularidad legítima de esos restos, se centraba en que Perú era un Estado sin vinculación jurídica con la fragata hundida, nacido entre las naciones con posterioridad al hundimiento y en condiciones que reflejan obligaciones jurídicas incompatibles con esa pretensión judicial. El Tribunal dio la razón a España, pero en todo caso dejó sin tocar todo el debate histórico e identitario que encerraba la pretensión de Perú y que sigue afectando, de una manera o de otra, a la protección de este patrimonio.

¿El sufrimiento actual de amplios sectores de la sociedad hispanoamericana es parte de la memoria de la conquista? ¿Tienen más relación con el pasado que con el presente nuestros problemas como hispanos? ¿Puede ser parte de ese debate el riesgo de destrucción de este registro histórico? La legitimidad de esta pregunta parece advertirse en hechos, sorprendentes para los españoles de Europa, como son que partes de la opinión pública de Perú entendieran que el expolio de la fragata *Mercedes* no afecta tanto a la destrucción arqueológica de un registro común de la historia hispánica, sino de los derechos de los originarios habitantes de América.

Sin embargo, el aspecto actual de la polémica, el puente argumentativo buscado para enlazar las pretensiones del gobierno peruano consiste en concebir los restos arqueológicos de la fragata *Mercedes* como una cuestión de metales preciosos. Oro y plata de las Américas de nuevo para la vieja metrópoli. Una parte de la opinión pública y la política peruana no han sido capaces de entender esos restos como arqueológicos. España tampoco ha sido capaz de argumentar a este respecto, un silencio oficial y un silencio arrogante ha ayudado a producir otra de esas postales que se envían desde lugares muy lejos de la inteligencia. Ha sorprendido la escasa defensa del valor universal y el contenido necesariamente común de esos restos, su carácter de testimonio de nuestra contribución común a la historia humana, un significante común porque tiene un significado común, al menos así lo tenía para quienes estuvieron implicados en aquella tragedia. Ninguna iniciativa al respecto se ha emprendido (Fig. 4).



Figura 4. La incompatibilidad entre ciencia arqueológica y cazatesorismo.

El yacimiento de la fragata *Mercedes* y sus restos arqueológicos marcan el momento para familiarizarse con un concepto necesario: UN PATRIMONIO CULTURAL SUBACUÁTICO COMÚN HISPÁNICO. En ese sentido es imprescindible la cooperación, el protagonismo de los científicos sobre los políticos, que se habiliten espacios de actuación legal, una Carta Hispánica del Patrimonio Histórico Sumergido o una Declaración conjunta que sienten las bases de una política coordinada de defensa, difusión y conservación de ese patrimonio histórico sumergido.

Es imprescindible que se hagan afirmaciones nuevas, radicalmente nuevas, en el ámbito de la cooperación, en el ámbito de la ciencia. Afirmaciones del tipo que es un patrimonio común, cuyo destino científico es preferible a servir de pretexto a conflictos identitarios, ajeno a toda posibilidad de comercio, que refleja un pasado común y un compromiso de preservar para las generaciones futuras el testimonio de un vínculo que hoy en día es mucho más libre, amplio, más comprometido con una forma de humanidad no excluyente y vinculada con el conocimiento y la ciencia. Un compromiso internacional en ese sentido es perfectamente compatible, como instrumento de reforma legal, perfectamente viable, desde el punto de vista de mi país, desde su propia constitución y en modo alguno perturba sus fundamentos legales íntimos. Como heredero de una tradición constitucional que, en 1812, proclamó para cuatro continentes la inviolabilidad del derecho individual sujeto a leyes frente al poder.

Una comunidad amplia de Estados bien puede, colectivamente, proveer de medios proporcionados a una tarea digna. El patrimonio histórico sumergido hispánico es un patrimonio arqueológico común de todos los pueblos hispanoamericanos sujeto a la servidumbre de su protección, de la preservación en la participación de su investigación, acceso científico y su difusión.

Citando a James Madison: «Knowledge will forever govern ignorance, and a people who mean to be their own governors must arm themselves with the power which knowledge gives». Así, unos buscando ventajas políticas cortoplacistas invocando viejos demonios para desplazar hacia la digestión de los siglos la propia responsabilidad presente y otros buscando desproveer de carácter arqueológico esos restos para poder comercializarlos sin obstáculos legales, han creado un contorno ideológico propicio a la destrucción de este patrimonio. Solamente desmontando semejantes falacias se podrá salvar lo que queda en beneficio de las sociedades actuales y las generaciones que han de venir.

El siguiente elemento, que sabemos que funcionará porque ya funciona es, paradójicamente, la principal baza jurídica de protección del patrimonio sumergido hispánico en el mundo, y nos la proporciona el posicionamiento efectivo de un país que ni siquiera ha suscrito la Convención del Derecho del Mar ni la Convención Unesco del 2001: me refiero por supuesto a los Estados Unidos. La figura es la atribución de carácter soberano y por tanto inmunidad a los pecios de los buques de Estado. Esta doctrina extraída de su forma ciertamente «arcana» ha sido esgrimida por España con vigor y éxito, y su vigencia ha sido asumida por los tribunales norteamericanos en relación al estatus jurídico de la fragata *Mercedes*.

Las inmunidades de los «buques armados públicos» en términos reconocidos hace casi 200 años resulta asimismo coherente con la normativa internacional actual, como la Convención de las Naciones Unidas sobre el Derecho del Mar de 10 de diciembre 1982, cuyo artículo 95, igualmente invocado por España, quien lo estima aplicable para los restos arqueológicos de la fragata *Nuestra Señora de las Mercedes*, expresa: «Los buques de guerra en alta mar gozan de completa inmunidad de jurisdicción respecto de cualquier Estado que no sea el de su pabellón». El 5 de febrero de 2004, España procedió a notificar oficialmente a EE. UU. que sus barcos hundidos, no pueden ser «alterados» sin su autorización y el Departamento de Estado norteamericano

no procedió a publicar en el Registro Federal esta advertencia. Esto, y es de lo más significativo, nada tiene de contradictorio con la Convención sobre la Protección del Patrimonio Cultural Subacuático de 2 de noviembre de 2001, artículo 2.8. La intención fue, desde un amplio sector comprometido con la defensa para el conocimiento y la ciencia de este patrimonio y en un país en el que es ilegal cualquier carácter comercial de los bienes arqueológicos, reforzar las posibilidades de proteger el carácter arqueológico de los buques de guerra históricos de origen hispánico³ (Fig. 5).



Figura 5. Tecnología y capital a disposición de una industria internacional centrada en una prioridad de expolio de patrimonio cultural hispánico.

Este es el único argumento que ha funcionado con alguna eficacia en territorios donde se practica el cazatesorismo o, como lo quieren llamar ahora, la arqueología comercial. En este sentido España no tiene por qué, ni puede, renunciar a la inmunidad soberana de sus buques históricos de Estado, así le son reconocidos por las naciones marítimas y se ha demostrado un instrumento eficiente de preservación y protección de los yacimientos. Ello no es incompatible con aceptar, en condiciones científicas y culturales objetivas, el acceso común y desde luego el disfrute común con las sociedades americanas del patrimonio histórico de que son portadores esos pecios históricos hispánicos. Científicos y sociedades son evidentemente ajenas a la pugna por titularidades exclusivas de bienes que son esencialmente información arqueológica. Las leyendas negras son recursos políticos y comerciales, esa realidad es autoevidente, y se han usado para reforzar dudosos argumentos jurídicos que erosionen la protección de lo que quiere ser expoliado. Por eso la gestión común de ese patrimonio debe servir para desactivar los prejuicios de poner sobre la mesa las discusiones de nuestros desencuentros. De momento no hay otra, a nivel de sociedad civil, de ciencia, de interés popular por la historia. De hecho, hay un importante nicho económico en la industria cultural vinculada a este patrimonio.

Este es el momento de los agentes tradicionalmente postergados: la comunidad científica como criterio técnico superior, la sociedad civil y quienes, habitualmente, en los países hispánicos disponen de las herramientas tecnológicas necesarias: las respectivas Armadas.

Instituto para la Memoria Arqueológica Naval Hispánica

Ha sido un honor poder presentar en este Congreso IKUWA la iniciativa del Instituto para la Memoria Arqueológica Naval Hispánica, que surge desde la sociedad civil española y americana haciéndose eco de una justificada sensación de urgencia sobre uno de los legados más amenazados de la humanidad, los yacimientos arqueológicos correspondientes a los buques hispánicos de la Edad Moderna (ss. XVI, XVII y XVIII). La iniciativa pretende vincular a los sectores de la sociedad civil sensibles por la protección del patrimonio sumergido de origen his-

³ LANCHO, José María, «La protección penal en aguas internacionales del patrimonio histórico sumergido español», *Revista General de Marina*, Madrid, mayo 2012.

pánico. La idea surgió con el propósito de crear una red por los distintos países hispanos desde Estados Unidos hasta Argentina y Chile e incluso Filipinas. Que los ciudadanos que se adhieran puedan proporcionar información a la red sobre las amenazas a ese patrimonio en sus respectivos países. Que expertos puedan intercambiar impresiones y coordinar propuestas, que se informe a los medios y se genere una corriente de opinión contraria a la industria cazatesoros, que se favorezcan los convenios para la protección y finalidad cultural común de este patrimonio. Falta en este ámbito prácticamente todo, el Convenio Unesco con todo lo positivo que ha supuesto no ha logrado los efectos claves, inmediatos y contundentes que todos esperábamos. Hacen falta convenios bilaterales, transparencia, compromisos efectivos y participación de nuevos agentes, especialmente la sociedad civil. Y aunque nos sorprenda muchas veces ha sido la inmunidad soberana de los buques históricos españoles la que ha proporcionado protección mucho más que los convenios culturales. Siempre que se garantice la finalidad cultural de los yacimientos protegidos mediante esta fórmula este principio me parece idóneo.

Con el respaldo de arqueólogos, abogados, historiadores, periodistas y asociaciones de ambos lados del Atlántico surge este observatorio que ha de tener un importante recorrido en esta tarea de protección urgente.

Un primer caso de denuncia del Instituto: el galeón *San José* en Panamá

Expertos y sociedad civil panameños nos han trasladado su preocupación y alarma en relación a la posibilidad de que la República de Panamá, a través de sus autoridades culturales o económicas, finalmente prorrogue las autorizaciones de los contratos que mantiene con la empresa Investigaciones Marinas del Istmo, S.A. (IMDI), de Concesión de Exploración n.º 231 de 26 de junio de 2003 y de Concesión de Salvamento n.º 231 de 25 de julio de 2003 para la explotación comercial de la zona arqueológica en derredor del archipiélago de las Perlas en Panamá. Sin embargo, el gobierno panameño fue más allá al conceder a la empresa IMDI la explotación comercial del galeón *San José* hundido en costas panameñas en 1631, mediante una resolución del Instituto Nacional de Cultura, Dirección Nacional del Patrimonio Histórico RESOLUCIÓN n.º 136-13 del 16 de julio de 2013, es decir años después de la entrada en vigor de la Convención Unesco. Durante todo el año 2014 hemos trasladado nuestra inquietud no solo a las autoridades competentes panameñas sino a responsables culturales españoles intentando favorecer una solución urgente, siendo este evento, el IKUWA donde se hace pública a la comunidad científica estos graves acontecimientos que ponen en cuestión todo el sistema construido sobre la Convención Unesco 2001.

Efectivamente, la República de Panamá es uno de los primeros Estados que dio su respaldo internacional a la Convención sobre la Protección del Patrimonio Cultural Subacuático de 2001, documento que fue suscrito y ratificado por esta República en fecha 20 de mayo de 2003, lo cual ha hecho que varias resoluciones ampliatorias de las actividades de IMDI, especialmente la de 2013, fueran ilegales nacional e internacionalmente. El contenido de esas autorizaciones supone una directa transgresión de la Convención Unesco para empezar con el artículo 2 que define los objetivos y principios generales de los Estados contrayentes y es que excluyen la explotación comercial, favorecen la preservación *in situ*, la preservación en beneficio de la humanidad, cooperación, etc., por mencionar algunos. Pero la empresa cazatesoros ha tenido margen para llevar a efecto la destrucción del yacimiento mediante deflectores de hélice sin sujetarse, desde luego, a los aspectos fundamentales del plan del proyecto arqueológico propuesto por la Convención.

CRITERIOS DE INTERVENCIÓN	
Objetivo prioritario de la intervención	Comercial. Incompatible con los principios de la Convención Unesco.
Criterios y protocolos propuestos por la empresa	En los 10 primeros años de actividad de la empresa no existió un plan de proyecto en un sentido arqueológico. La resolución n.º 136-13 de 2013 concediendo la explotación del galeón <i>San José</i> no ha exigido y de hecho no existe un plan arqueológico que responda al sentido, alcance y contenido del previsto en la Norma 9 y 10 del Anexo de la Convención Unesco: objetivos científicos; un programa de publicaciones; la metodología y las técnicas que se utilizarán aceptadas por Unesco y equiparables con proyectos arqueológicos similares; una evaluación de los estudios previos o preliminares; acuerdos de colaboración con museos y otras instituciones, en particular de carácter científico; el plan de financiación; calendario previsto para la ejecución del proyecto; planes para los análisis y otras actividades que se realizarán después del trabajo de campo. En el 2013 la empresa intenta alcanzar un convenio con la Universidad de Panamá cuya virtualidad y efectos desconocemos. De hecho, algunos de los principales consultores que colaboran con la empresa concesionaria son empresas notorias en el ámbito cazatesoros como Blue Water Ventures y el director científico James Sinclair es un colaborador habitual de las empresas cazatesoros como Odyssey Marine y las empresas de la familia Fisher.
Criterios de control y supervisión arqueológicos establecidos por el Estado panameño	Virtualmente inexistentes y del todo inidóneos. No hay control antecedente ni simultáneo a la intervención. Los que se prevén son a posteriori y no ofrecen garantías objetivas.
ANÁLISIS SOBRE EL PECIO	
Métodos de datación e identificación	La empresa se dedica básicamente a la recuperación de materiales no orgánicos lo cual clarifica el alcance simplificado de su intervención y la pérdida y descontextualización de la información.
Análisis historiográfico del pecio	No ha existido labor de contraste por parte de ningún centro científico autónomo sobre las manifestaciones periódicas de la empresa cazatesoros. La comunidad científica desconoce las pruebas de la identidad efectiva del pecio o pecios intervenidos.
Otros análisis sobre los materiales rescatados	Ninguno publicado.
Garantías de acceso de la comunidad científica	Ninguno que se conozca, aunque la empresa después de 10 años pretende hacer una base de datos <i>online</i> con finalidad comercial.
Resultados científicos publicados	No ha existido publicación de resultados científicos.

Es obvio que respaldar oficialmente semejantes actividades resulta incomprensible y una vulneración de la Convención algo con lo que están de acuerdo los arqueólogos que han podido conocer este asunto. No creo que la actual administración de Panamá esté conforme con la dispersión irremediable de un patrimonio arqueológico único, con el acceso comercial e incontrolado sobre un yacimiento de tan enorme valor cultural y científico. No se sabe lo que la concesionaria ha hecho ni cómo lo ha hecho solo lo que ha querido identificar como extraído de diversos puntos y que podrían suponer yacimientos diferentes. No hago más que exponer por escrito las sospechas más que razonables de la comunidad arqueológica internacional. Este es el primer caso que el Instituto viene a denunciar públicamente.

Conclusión

La idea práctica del Instituto consistirá en recibir y encauzar denuncias sobre expolio, establecer una serie de principios prácticos en torno a la protección del patrimonio cultural sumergido hispánico (incluido en los EE. UU.) que incorpore criterios y acción jurídicos, protocolos arqueológicos y posibilite cauces de participación de la sociedad civil. Estudiar el fenómeno de la industria cazatesoros, verificar el cumplimiento y eficacia de la Convención Unesco, proponer medidas que complementen los instrumentos jurídicos existentes a los efectos de proteger con eficacia la espe-

cificidad del patrimonio histórico sumergido hispano. Defender una unidad e intangibilidad del mismo. Ser capaz de oponerse a la actividad cazatesoros es otro elemento fundamental del Instituto... Informando sobre la amenaza y los daños. Difundir las investigaciones y logros arqueológicos sobre este patrimonio. Conseguir una colaboración no solo desde las instituciones culturales sino también a través de las Armadas. Si esto último se consigue, puesto que la Armadas defienden ser agentes morales, con una vinculación histórica viva sobre esos restos, eso generará más oportunidades que riesgos y eso no solo no interferirá con la labor de los científicos ni agotará otros agentes y principios inmateriales sino que puede proporcionar un respaldo técnico imprescindible.

Puedo asegurar que la visión de que la industria cazatesoros está arrinconada y acosada en el mundo es una irrealidad. Que carecemos de una hoja de ruta de actuación internacional para frenar esto, que los planes que se desprenden del denominado Libro Verde carecen de la necesaria perspectiva exterior y de la integración de los agentes fundamentales que podrían transformar esto como podría ser la sociedad civil o la Armada o, por poner otro ejemplo, el ARQUA. Lo único que hoy por hoy arrincona a esa industria es que efectivamente los recursos arqueológicos y culturales bajo los océanos son limitados y se van agotando.

La cultura y la arqueología son un lugar en el que queremos hablar del futuro de la historia. Del amor por la historia compartida, que es también la vida de los profesionales que luchamos en esta defensa. En la medida de que estas líneas sirvan a ese propósito, que entiendo común, y de que el patrimonio arqueológico sumergido no sea patrimonio comercial, preservaremos una pieza sobre la que se puede construir conocimiento y sociedad civil, los dos elementos esenciales de las sociedades democráticas contemporáneas.

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Versus expolio. Datos dispersos sobre la lucha contra el expolio de los galeones españoles. I: Desde la *Juno* y *La Galga* (1998-2000) hasta *Nuestra Señora de las Mercedes* (2007-2012)

Versus plundering: scattered data on the fight against the pillaging of Spanish galleons I: From the *Juno* and *La Galga* (1998-2000) to *Nuestra Señora de las Mercedes* (2007-2012)

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Resumen: la recuperación para el patrimonio colectivo del pecio *Nuestra Señora de las Mercedes* (en adelante: NSM) gracias a la lucha jurídica del gobierno español a partir de junio de 2007 contra la compañía de cazatesoros Odyssey Marine Exploration, ha marcado un hito de gran trascendencia histórica en el contexto internacional. Hito que es imposible infravalorar, pero que ni empezó en junio de 2007, como habitualmente se cree y se ha venido publicando, ni fue el primero. Se dan algunos datos no comentados con anterioridad.

Palabras clave: Expolio, *Juno*, *La Galga*, *Nuestra Señora de las Mercedes*, patrimonio cultural subacuático.

Abstract: The recovery of the wreck *Nuestra Señora de las Mercedes* (hereinafter: NSM) for collective heritage thanks to the legal struggle of the Spanish Government since June 2007 against the company of treasure hunters Odyssey Marine Exploration, is a milestone of great historical significance in the international context. This milestone is impossible to underestimate, but it neither began in June 2007, as is believed commonly and has been published, nor was the first. Some data not discussed previously are given.

Key words: Plundering, *Juno*, *La Galga*, *Nuestra Señora de las Mercedes*, Underwater Cultural Heritage.

Antes de que, en relación con este afortunado asunto de la lucha contra el expolio que viene liderando el gobierno español, termine de cerrarse una determinada historia que pudiera no ser completa, es obligatorio que quienes hemos estado cerca del asunto sigamos aportando cuantos datos permitan a nuestros sucesores reconstruir la historia completa, que ni siempre ni todos han sido recogidos en las versiones publicadas hasta ahora. En esta ocasión daremos algunos datos como anticipo de un trabajo más amplio y exhaustivo. Por otro lado, hay ya diversas publicaciones sobre la exitosa recuperación del pecio que narran tanto la batalla jurídica como el estudio de los materiales (AA.VV., 2014).

Esa situación de haber «estado cerca» es la de quien suscribe por razones meramente administrativas. El marco cronológico del que yo puedo hablar con algo más de conocimiento del habitual, comienza con mi incorporación en enero de 1993 a la dirección del Museo Nacional de Arqueología Subacuática en Cartagena (en adelante: MNAS)¹, hasta que en enero de 2006, una ministra de Cultura me cesó de la dirección del centro. Tras una muy desigual batalla judicial, la recuperé el 26 de octubre de 2013. Es decir: de 1993 a hoy, con un larguísimo paréntesis ilegal de casi ocho años entre enero de 2006 y octubre de 2013².

¹ Me incorporé al museo de Cartagena en enero de 1993 con un «Proyecto para la Reforma y revitalización de la Institución» cuyos ejes principales expuse en público ya en septiembre de 1993 (Negueruela, 1994). Tan pronto como 1995, se encargó el Pre-Proyecto para la construcción de una nueva sede. Y el Proyecto definitivo se presentó oficialmente en mayo de 1996 en el Palacio de San Esteban, Presidencia de la Región de Murcia (Negueruela *et alii*, 1999). Por su parte, el Programa Museográfico para la nueva Sede se entregó al Ministerio en once volúmenes a finales de 2002 y fue supervisado y aprobado por una Comisión de diez expertos creada *ad hoc* a solicitud mía, tras vencer las resistencias de la Subdirección General de Museos de 2003. Se concedió a cada uno de los «expertos» un plazo de tres meses para que lo estudiaran, al término del cual se los convocó en el Ministerio con sus conclusiones. Los dictámenes fueron todos extremadamente generosos con quien suscribe (M. Martín-Bueno, J. L. Casado Soto, Dolores Higuera, R. Azuar, X. Nieto, etc.). El nuevo director que la ministra Carmen Calvo nombró en 2006 para sustituirme tras mi cese, el Sr. Rafael Azuar Ruiz, redactó otro completamente distinto que es el que se inauguró en 2008 y del cual no soy responsable ni en los conceptos generales, ni en los detalles.

² El caso de mis dos ceses, único en el Ministerio de Cultura, no se ha contado nunca por escrito, pero demasiado entre pasillos (en los círculos relacionados con la Arqueología Subacuática), en España, en algunos países europeos y en Unesco; si lo traigo hoy aquí es porque, como el lector comprenderá, tiene alguna importancia en lo que pueda atañer al tema que tocamos hoy. El director general de Bellas Artes, don Julián Martínez, me llamó a Madrid para comunicarme el cese el 17 de noviembre de 2005, pero que no lo iban a hacer efectivo hasta el 8 de enero de 2006. No hubo más explicación que la de que los directores de los Museos debían ser nombrados por Designación Política. Le dije que era ilegal y no podían hacerlo porque yo no había ganado el puesto del Museo «Por Libre Designación Política», sino tras las preceptivas Oposiciones y Concursos Públicos. Me respondió que si yo estaba tan seguro, «podía recurrir a la vía judicial, pero que eso tardaría cuatro años y que, mientras, el Museo lo gobernarían ellos». Para sustituirme nombraron a Rafael Azuar, sin convocar en el BOE el obligatorio Concurso Público de Méritos, y duplicando así la ilegalidad de aquel nombramiento: i) porque no podían cesarme, como afirmarían luego repetidas veces los Tribunales de Justicia; y ii) por saltarse el obligatorio Concurso Público del Código de Buenas Prácticas del Ministerio para cubrir los puestos de Dirección. Probablemente por una curiosa mera coincidencia, en diciembre de 2005 el buque de la Compañía de cazatesoros *Odyssey* cargado con el ROV Zeus para iniciar la fase final del expolio arqueológico en el pecio NSM llegaba a Gibraltar. Estuvo trabajando en ello a lo largo de 2006 como se cuenta en el texto. El Tribunal Superior de Justicia de Madrid decretó la ilegalidad de mi cese en mayo de 2009, es decir, efectivamente cuatro años después, cuando ya la ministra había cambiado (de Carmen Calvo a Ángeles González Sinde). Pero la nueva directora general de Bellas Artes, Ángeles Albert, retrasó mi reposición durante ocho meses, desde mayo-2009 hasta el 1 de febrero de 2010, sin que el subdirector general de Museos de entonces, Santiago Palomero, a quien le pedí explicaciones de aquel segundo atropello, me diera ninguna. A los tres meses de mi reposición por los Tribunales, el 28 de abril de 2010, la nueva ministra me volvió a cesar, también sin la menor explicación. En mi lugar, nombró director a Xavier Nieto Prieto, de Gerona, pero, como en 2006, de nuevo sin convocar el preceptivo «Concurso Público de Méritos» y de nuevo, con las mismas dos ilegalidades que en el caso Azuar de 2006. Para cerrar aquel extraordinario empeño del Ministerio por alejarme de la dirección del Museo, solicité a la Audiencia Nacional la constitución de un Tribunal de Apelación que quedó formado por cuatro juezas. Este Tribunal volvió a darme la razón, ahora definitiva y firme, el 29 de junio de 2013: declararon mis ceses completamente nulos y consecuentemente aquel nombramiento del Sr. Nieto, que hubo de dejar el Museo. De nuevo, el Ministerio retrasó la ejecución de mi sentencia hasta que el 15 de octubre Nieto cumpliera 65 años, la edad de jubilación. Probablemente, también por mera coincidencia. De modo que parece claro que desde 1993 he «padecido» una posición que me ha permitido «conocer de cerca» diversos detalles de la gestión del patrimonio subacuático en España.

Durante aquellos primeros trece años (1993-2005), el Museo había desarrollado una amplia actividad en frentes diversos cuyo primer resumen se publicó en inglés en el *International Journal of Nautical Archaeology* (IJNA) (Negueruela, 2000a)³ y por su eco, la Unesco lo publicó también en español (Negueruela, 2000b). Para trabajos posteriores hasta 2005, Negueruela, 2003; Negueruela, 2005.

Quizá merece mención aparte la creación en 1996 y puesta en marcha en 1999-2000 del Foro Euro-Mediterráneo de Arqueología Marítima (FEMAM), con la participación de los gobiernos de 17 países de Europa y países árabes, Israel y Turquía incluidos, que fue el intento europeo más serio de crear un Centro de Formación internacional para las sucesivas promociones de jóvenes universitarios del Mediterráneo (Negueruela, 1999; Negueruela, 2001; Negueruela, 2003) y que el 21 de febrero de 2000 suspendió el director general de Bellas Artes, Benigno Pendás, sin dar la menor explicación a los 17 países participantes, ni, por supuesto, al equipo del Museo que lo habíamos gestado durante cuatro años de trabajo muy intenso. (Por coincidencia, en aquel año estábamos además en plena vorágine de la lucha por los casos *Juno* y *La Galga* ante el Tribunal Supremo de EE. UU.).

Al tiempo, en Mazarrón hacíamos el «Proyecto Nave Fenicia» para la excavación y estudio de los dos barcos del siglo VII a. C., el proyecto más complejo que se había hecho hasta entonces en arqueología subacuática en España (Negueruela *et alii*, 1995; Negueruela *et alii*, 2000c; Negueruela, 2000d; Negueruela, 2002; Negueruela *et alii*, 2004a; Negueruela, 2004b; Negueruela, 2005a; Negueruela, 2005c).

En fin: para contextualizar los trabajos del equipo, en 1993 se comenzó a publicar una Revista del Museo y Centro de Investigaciones en la que se fueron dando muchas noticias de la marcha del Museo⁴.

Y por supuesto: en aquellos muy ocupados primeros años no teníamos ningún conocimiento de que el barco de la empresa que en 2007 se llevaría a EE. UU. las 600 000 monedas de plata de la *Mercedes*, el *Odyssey Explorer*, estaba navegando por las aguas comprendidas entre la costa andaluza y la marroquí. Ese dato yo lo desconocería completamente hasta 2002.

Sin embargo, sí conocí muy directamente desde su origen en 1998 otros dos casos: las fragatas *Juno* y *La Galga* que habían sido expoliadas por la Compañía Sea Hunt en aguas de Virginia. En septiembre de 1998 una funcionaria del Ministerio de AA.EE. me telefoneó para preguntarme que qué sabía yo del expolio de esas dos fragatas españolas. Le dije que nada; me dijo que la prensa norteamericana llevaba varios meses publicando los datos, que algunos funcionarios de nuestra embajada en Washington los remitían a la Dirección General de Bellas Artes del Ministerio de Cultura, pero que desde este no se había hecho nada y no se había recibido en la embajada ninguna respuesta. Le pedí que me enviaran al fax del Museo algunas fotocopias de la citada prensa, lo que hizo aquella misma tarde de viernes. La semana siguiente fui al Ministerio y planteé el asunto con las fotocopias citadas.

Tras algunos escritos oficiales que remití a la Dirección General y a la Subdirección General de Protección del Patrimonio, y diversas anécdotas enjundiosas que no vienen al caso, propuse al Ministerio que se contratara al abogado James Goold, del bufete de Washington Co-

³ La primera vez que la arqueología subacuática española salió fuera de España, con trabajos publicados en inglés, fue nuestro trabajo en el IJNA de 1995 sobre los barcos de Mazarrón. La segunda, fue este artículo sobre la gestión del Museo Nacional de Cartagena.

⁴ *Cuadernos de Arqueología Marítima*. Hasta 2006 se publicaron los números 1 a 7. Tras mi cese, en enero de 2006, la revista fue drásticamente interrumpida hasta hoy. En 2016 pretendemos publicar el número 8.

vington & Burlin, que yo había tenido que buscar personalmente. El Ministerio acabó contratándolo, Goold contactó conmigo, vino a conocerme a Cartagena, aceptó el caso y finalmente, bajo su dirección, aquellos dos expolios se saldaron con una victoria en el Tribunal Supremo de EE. UU. en diciembre de 2000, coincidiendo con el final de la Convención de Unesco para la Protección del P.A.S. La última sesión de la Convención fue en enero de 2001 y los cinco miembros de la delegación española pudimos anunciar oficialmente ante toda la Convención nuestra recientísima victoria judicial contra el expolio. Nunca podremos olvidar la ovación que nos brindó la Convención de Unesco.

A pesar de aquel extraordinario éxito, la primera e importantísima victoria internacional contra los expoliadores y que además había sido liderada por España, la Dirección General se limitó en 2000 a dar una nota de prensa muy breve y que, además, recogieron muy pocos periódicos y, salvo el *ABC*, de una manera secundaria.

Durante los años siguientes al 2000 ningún alto cargo del Ministerio habló de aquellos dos barcos, la *Juno* y *La Galga*. Era como si se hubiera decretado silencio total sobre una victoria; sobre la victoria legal más importante de la arqueología en el ámbito internacional, lo que ni yo ni el reducidísimo equipo del Museo de Cartagena podíamos entender. Cualquiera que quiera hacer un seguimiento en las hemerotecas desde diciembre de 2000 hasta el caso *Odyssey* de 2007 no encontrará información sobre ello. Mi infinita sorpresa vino cuando en marzo de 2003 me informó un arqueólogo de Málaga que en 2002 el Ministerio había firmado un Convenio con la Empresa Sea Hunt por el que los restos de ambos expolios no vendrían a España sino que se quedarían en Virginia, y que su empresa construiría un museo para ellos. El mismo Convenio me lo había propuesto a mí un muy alto directivo de Sea Hunt en primavera de 2002, para que yo lo elevase al Ministerio como iniciativa mía, lo que me negué a hacer porque ocurre que el Patrimonio es en España un Bien demanial, y, por tanto, inalienable⁵. En mi opinión su sitio era y sigue siendo el Museo Nacional de Cartagena, a donde, desde luego, no ha venido nada. No es esta la ocasión de desarrollar en detalle la historia de aquellos dos expolios desde su origen hasta su final, lo que se hace en otro sitio.

El siguiente caso con batalla judicial fue «*Odyssey-N.ª S.ª Nuestra Señora de las Mercedes*». Para la mayoría de la gente, el asunto comenzó el 17 de mayo de 2007, pero, como veremos, esa no es más que la fecha en la que la empresa *Odyssey*, decidió hacer pública la noticia de que se había llevado desde Gibraltar a los EE. UU. (Tampa, Florida) 600 000 monedas de plata procedente de un buque «posiblemente inglés hallado en aguas internacionales». Ahí comenzó una historia de largo e intenso éxito mediático cuya repercusión duró hasta 2014 con la inauguración de la exposición de las monedas en el MNAS de Cartagena el 29 de mayo y en el Museo Arqueológico Nacional (MAN) en Madrid el 9 de junio.

Esa «mayoría de la gente» ha recibido entre 2007 y 2014 dos tipos de información: la más abundante, la oficial, procedente de las diversas instituciones de la Administración. Otra, menor, la que procede de lo que llamaremos «la sociedad civil», recabada por diversos periódicos y por personas individuales. Y como veremos en este incompleto resumen, en el brillante asunto de la recuperación de la *Mercedes* por parte de España han quedado lagunas por rellenar. Veremos aquí solamente algunas.

En primer lugar, porque el asunto venía de varios años atrás, como –lógicamente– no podía ser de otra manera. Pero cuando el 17 de mayo de 2007 saltó la noticia, prácticamente

⁵ Los Bienes Patrimoniales, al ser Bienes demaniales son por esencia «inalienables, inembargables, e imprescriptibles». Su destino obligatoriamente es el uso público y han de inventariarse y disponer de registros adecuados.

nadie sabía que ya había dos precedentes que venían nada menos que desde 1998: la *Juno* y la *Galga*. Y en segundo, porque ha habido falta de reconocimientos, dilaciones, marginación de personas, y, quizá, hasta apropiaciones de méritos ajenos, práctica común en España. Y todo ello ha dejado para la Historia una versión incompleta. Por ello, y sin menoscabar en nada la cara positiva de este éxito del que todos estamos especialísimamente orgullosos, es hora ya, nueve años después, de que se cite a personas que se arriesgaron mucho, y estoy seguro de que mucha más gente se ha quedado fuera de esta nota simplemente por desconocimiento mío.

El mérito de haber sido el primero en alertar a la sociedad de la posibilidad de que se tratase de un buque español no corresponde a ninguno de los organismos de los Ministerios de Cultura o de Asuntos Exteriores de 2007, sino a un periodista del diario vespertino *La Gaceta* de Madrid, don Santiago Mata, quien aquel mismo día 17 de mayo publicó la noticia que Odyssey acababa de colgar en su página web⁶, alertando de que todo indicaba que se trataba de un buque español. Santiago Mata es, además de licenciado en Periodismo, doctor en Historia Contemporánea, y a su profesionalidad en ambos campos debemos el que ya desde el primer momento supiera poner el punto de mira donde se debía para advertir a la sociedad española de la noticia que Odyssey acababa de hacer pública horas antes.

A partir del día siguiente, los grandes periódicos de Madrid (*ABC*, *El Mundo*, *La Razón* y *El País*) se hicieron eco del asunto con amplio despliegue, alertados por el análisis del Sr. Mata. Específicamente, *La Gaceta* y los tres primeros mantuvieron altamente motivada a la opinión pública durante toda la semana posterior. Pero mientras pasaban las primeras horas y los primeros días, cruciales en un asunto así, la Administración (Cultura y Exteriores) guardaba silencio y no salía de ella ni ninguna acción ni ninguna información.

Por su parte, los periódicos citados comenzaron, ante aquel silencio, a rebuscar en sus archivos y en internet. La postura de los primeros tres periódicos fue la de exigir a la entonces ministra de Cultura y a su director general de Bellas Artes (nombrados ambos en abril de 2004), alguna acción. Todos ellos alertaban sobre las sospechas de que la versión de la compañía Odyssey (recordemos: «buque inglés») tenía todos los visos de ser falsa.

Odyssey, al ver la enorme atención que la prensa y la oposición española estaban desde el segundo día dando al asunto, comenzó a lanzar tres nubes de humo: i) Que las monedas pertenecían a un buque de origen aún desconocido, pero probablemente inglés al que ellos estaban siguiendo la pista desde hacía años en la zona del estrecho de Gibraltar, y al que provisionalmente bautizarían como «Black Swan»; buque que se había hundido en aguas internacionales. ii) Que las monedas procedían del *Merchant Royal*, buque inglés hundido en 1641 cerca de Cornualles cargado de oro. iii) O, volviendo a la teoría que Greg Stemm, de Odyssey, publicaba desde 2000, que se trataba del *Sussex*, hundido en la zona del estrecho de Gibraltar el 19 de febrero de 1694 con 10 toneladas de oro y plata en sus bodegas, barco que había zarpado días antes al mando del almirante inglés Francis Wheeler con dinero destinado a sobornar al duque de Saboya para que abandonase a Francia y se aliase con Inglaterra. En ambos casos, Cornualles y estrecho, *Merchant Royal* y *Sussex*, eran buques no españoles y hundidos en aguas internacionales: punto final para cualquier intento de reclamación española. Pero todo ello no eran sino esas «cortinas de humo» a las que he aludido: falsedades destinadas a cegar a nuestros medios de comunicación, como sentenciarían años después los tribunales de EE. UU.

Por el contrario de Odyssey, en España alguien apuntaba ya a un buque español concreto: como en el caso de Santiago Mata, también considero de justicia recordar aquí que tan tem-

⁶ *La Gaceta*. 17-V-2007. Portada e interior.

prano como el día 8 de junio otra persona avanzaba en solitario en un artículo en el diario *ABC* la posibilidad de que el barco origen del «tesoro» se tratase de la fragata *Nuestra Señora de las Mercedes*⁷, lo que los estudios de los años siguientes confirmarían. Me refiero a Juan Manuel Gracia Menocal, de la Sociedad Española de Amigos de los Galeones. Pero tampoco el Sr. Gracia ha sido recordado en las publicaciones que se han editado desde entonces, hasta donde yo sé, y ello a pesar de lo temprano y agudo de su artículo.

La oposición parlamentaria se alineó desde el principio con las sospechas de la prensa de Madrid, en la línea de exigir alguna actuación al Ministerio. Se le pedían principalmente tres cosas: 1) Que reaccionase inmediatamente a través de nuestra embajada en Washington. 2) Que solicitase por vía de urgencia que se bloquease el cargamento en Florida hasta que se aclarase si se trataba o no de un robo gigantesco. 3) Que se pidiera información a Londres sobre si se había dado licencia de exportación y sobre su contenido.

Sin embargo, y a pesar de esta fuerte presión de la prensa y de la oposición, aquella inacción del equipo ministerial duró casi una semana completa, mientras toda la oposición pedía a la ministra que actuase o compareciese; la noticia surgía a diario en la prensa nacional e internacional literalmente inundada de comentarios de todo tipo sobre el asunto. Siguieron pasando los días (para algunos de nosotros, las horas), por delante de la puerta del Ministerio. Inacción del Ministerio que, en términos objetivos, a todos les parecía que solo podía favorecer a una parte: a la empresa Odyssey, que disfrutó de unos días preciosos para poner «su tesoro» a buen recaudo en unas naves de su propiedad de la ciudad de Tampa.

Finalmente, ante el clamor social que se había creado y que no solo no cedía sino que iba a más, el Ministerio de Cultura puso su maquinaria a trabajar y tras diversas consultas, se decidió contactar con el abogado James Goold, del bufete de abogados de Washington, Covington & Burlin. Bufete y abogado ya conocidos en el Ministerio desde 1998, como ya he explicado.

Había certeza de que Odyssey no acababa de llegar a las aguas del estrecho en 2007. Desde 1999 hasta 2007 Odyssey estaba prospectando por aquella zona (en un sentido lato, de cabo de San Vicente a cabo de Gata). Y también, de que utilizaba como base un puerto andaluz, el de Sotogrande, en Cádiz, cercano a Gibraltar. En 2001, el subdirector general de Protección del Patrimonio del Ministerio me había enviado a Sotogrande con otros dos técnicos del Museo⁸ para supervisar los hallazgos de la empresa Odyssey que afirmaba haber localizado un importante cargamento perteneciente al *Sussex*. Los datos de sus idas y venidas los tenían controlados tanto la Armada como la Guardia Civil, que los iban elevando a sus superiores tanto en Madrid como en Sevilla. Mi encargo era elevar un Informe escrito a la citada Subdirección a fin de que la empresa pudiera continuar libremente su trabajo también por parte del Ministerio de Cultura. He escrito «también», porque para nuestra sorpresa, Odyssey ya tenía el permiso mediante Nota Verbal del Ministerio de Asuntos Exteriores y operaba con conocimiento de la Junta, como declararían repetidamente Greg Stemm y como recordarían años después en la prensa algunos miembros de nuestra Armada.

Así que cuando llegamos en 2001 nos encontramos con dos desconciertos: los datos que vimos allí de las operaciones de Odyssey, y la situación de los permisos, autorizaciones expresas o no expresas, conocimientos de los políticos que no se derivaban en la interdicción de las actividades, etc. Estuvimos en Sotogrande solo las horas justas para ver el «cañón» y hablar con Greg Stemm. Tras todo lo que vimos y oímos, los tres técnicos del Museo nos limitamos a infor-

⁷ *ABC*, 8-VI-2007, pg. 84. El tiempo confirmaría lo acertado de su temprana hipótesis. De nuevo, la sociedad civil dejaba atrás al Ministerio.

⁸ Marina Gamboa Gil de Sola, Emilio Peñuelas González y yo mismo.

mar al subdirector general de Protección del Patrimonio de que como toda prueba de sus muy largas andanzas desde 1999 Odyssey nos había mostrado una informe bola de hierro en un estado de oxidación terminal que, al decir de Stemm, pertenecía a la culata de un cañón inglés del siglo XVII, el *Sussex*, lo que era perfectamente dudable dado el pésimo estado de aquel informe muñón de hierro.

Días después de nuestra visita a Sotogrande la misma Subdirección General encargó a Odyssey que esa pieza la enviaran al MNAS de Cartagena para que la restaurásemos. Y ello, a pesar de mi escrito en contra a la citada Subdirección, porque nos parecía una maniobra de Odyssey para implicar en sus actividades al Ministerio y así poder afirmar que contaba, además, con el permiso del Ministerio de Cultura y con la peritación del Museo. Cuando la pieza llegó al Museo ordené que se acondicionase para su estabilización ambiental, pero que no se restaurase hasta que se viera la situación legal de aquel objeto. Meses después me informó el citado S. G. de P. P. de que esta anécdota (nuestra visita y la bola de hierro-cañón) motivó inmediatamente una seria y larga reacción de la consejera de Cultura de la Junta (lo era Carmen Calvo), contra la ministra de Cultura (lo era Pilar del Castillo), en el sentido de que se trataba de una invasión de las competencias andaluzas y de que el Ministerio no tenía por qué ir por las aguas de Andalucía sin su permiso. Reacción por un problema de competencias, mientras desde al menos 2001 (parece que desde 2000 o 1999) seguía la larga y amenazante presencia de Odyssey en el puerto andaluz de Sotogrande y sus constantes salidas conocidas (como ya he dicho) por la Armada y la Guardia Civil.

A la vista de todo lo que sucedió después y hasta hoy mismo, es evidente que el Informe que se nos encargó redactar hubiera sido instrumentalizado por los abogados de Odyssey cuando en 2007 decidieron llevarse la plata a los EE. UU. Y lo habrían utilizado de una manera parecida a las reiteradas declaraciones que entre 2007 y 2009 hizo Greg Stemm a la prensa española y norteamericana en el sentido de que la consejera y el director general de la Consejería de Cultura de la Junta de Andalucía tenían conocimiento de sus actividades.

Por otro lado, según publicó el diario *ABC* el 12 de julio de 2007, un mes después de que saltara la noticia, Odyssey había pedido que un arqueólogo de la Junta estuviese a bordo durante sus operaciones, a lo que esta nunca habría respondido. En fin: que todo lo venían haciendo con el permiso de Ministerio de Asuntos Exteriores (de lo cual exhibieron un documento en ese sentido), y con conocimiento de la Junta de Andalucía.

Hay que decir que la citada consejera de Cultura de la Junta y su director general de Cultura siempre negaron estas afirmaciones de Stemm, quien a fin de cuentas no es sino un expoliador de nuestro Patrimonio capaz de enmarañar todo lo posible en la defensa de sus intereses. Pero también lo es que ni la consejera (y posterior ministra desde abril de 2004), ni su director general (ya en Sevilla, y también desde 2004 en Madrid), pueden negar que conocían nuestro viaje de inspección a Sotogrande de muchos años antes de 2007 y sus causas, motivos y porqués: justamente por la protesta que elevaron a la ministra de Cultura. El libro de Pipe Sarmiento que cito más abajo abunda en este enfoque.

Así que cuando los días 17 a 22 de mayo de 2007 la prensa de Madrid publicó el asunto Odyssey, ni a la ministra ni a su director general (anteriores responsables en la Junta) ni al subdirector general de Protección del Patrimonio del Ministerio, les resultaba completamente ajeno ni desconocido el tal Stemm, la tal empresa Odyssey o el puerto de Sotogrande. Ni, tampoco, a los Ministerios de Cultura, Exteriores, Interior y Defensa.

En plena vorágine del caso Odyssey, el día 27 de mayo de 2007, Pipe Sarmiento publicó un artículo en *ABC* en el que contó que el Consejo de Ministros de 10 de abril de 2001 había

concedido permiso a Odyssey para buscar el *Sussex*. En su artículo, Sarmiento afirma que en aquel permiso de la ministra Pilar del Castillo de 2001 se estipulaba que a bordo del barco de Odyssey tenía que ir un oficial de la Armada y yo mismo. Pues bien: a pesar de figurar aquella estipulación en aquel Consejo de Ministros, nunca se me dijo nada de ello por parte de nadie. No sé si a la Armada. De modo que no alcanzo a entender lo acordado en aquel Consejo.

Lo único que, en aquel caos de noticias y desmentidos mutuos entre las partes, nos iba apareciendo poco a poco como cierto a los arqueólogos era que entre 1999 y 2005 Odyssey había estado rastreando la zona del estrecho con base en un puerto de Andalucía. De hecho, ahí se enmarcaba el viaje que hicimos los tres técnicos del MNAS.

El abogado Lorenzo (Pipe) Sarmiento venía haciendo el seguimiento de las navegaciones de Odyssey pagándose de su bolsillo tan agradable misión. En su libro (Sarmiento, 2012), muy comprometido con la defensa del Patrimonio, cuenta con detalle la cantidad de «dificultades» que se le pusieron continuamente desde las instancias de la Administración andaluza y de la nacional. (A él, y a algún guardia civil de Algeciras que quizá puso demasiado celo profesional en su trabajo, por lo que, al parecer, fue, al menos, trasladado). Los datos de Sarmiento resultaron de importancia en la elucidación del asunto y el seguimiento de los movimientos del barco americano, pero, como a Mata o a Gracia, nadie del Ministerio le ha agradecido nada, cuando no me cabe duda de que en otro país se les habría concedido alguna distinción. Antes al contrario: según cuenta Sarmiento en su libro, no ha sufrido más que amenazas y persecuciones emanadas de la Administración por olfatear en un asunto en el que no debía olfatear. El lector interesado en la historia de la lucha contra el expolio, puede leer su libro y juzgar libremente sobre él.

Tampoco ha sido todavía completamente aclarada la reconstrucción de los hechos del expolio de *La Mercedes*, por lo que tiene lagunas. Y es previsible que quede para la posteridad como lo que se ha publicitado, ciertamente con mucho éxito: un gran triunfo de la ley y la razón contra los saqueadores de la arqueología. Pero sí que se han publicado algunos hechos que quizá puedan aportar alguna luz más:

1. El primer dato a considerar da la clave: la llegada a Gibraltar del barco *Odyssey Explorer* con el robot Zeus no se produjo en 2007, sino en una fecha tan temprana como diciembre de 2005, como ya he dicho en la nota 2⁹.
2. El dossier de prensa del asunto Odyssey que el museo ha ido acopiando a lo largo de los años supera con creces los quinientos folios, y no es, desde luego, exhaustivo. Y según dicho dossier, ya entre junio y otoño de 2006 el *Ocean Explorer* estuvo realizando numerosas salidas, casi diarias, previsiblemente para ¿localizar? el pecio. Todas ellas las iban conociendo los servicios de la Armada y de la Guardia Civil que lo elevaban a sus superiores ministeriales.
3. A mediados de abril de 2007 Odyssey solicitó a Londres Permiso de Exportación para llevarse el cargamento de Gibraltar a EE. UU. Ello significa que al comienzo de abril las monedas ya debían estar en tierra, si no todas, la mayoría. Y que ya habían sido ordenadas, revisadas, precatalogadas y encajadas. Por lo tanto, todo ese trabajo se hizo en los meses anteriores. Para sacar las 600 000 monedas desde los 1200 m de profundidad tardaron, cuando menos, un mes completo a jornada completa. Pero es más creíble que tardaran, cuando menos, dos meses. Una vez que las monedas estaban arriba necesitaron, cuando menos, otro mes para el conteo-inventario, separación, encajado en los botes y su sellado. Quizá algo más.

⁹ ABC del 9 de junio de 2007. Ya he resumido en la nota 2 las fechas de mi primer cese entre el 17 de noviembre de 2005 y el 8 de enero de 2006.

- Un plazo de unos tres meses puede resultar viable para todas estas operaciones. Desde luego, una vez que ya estuviera localizado el pecio, lo que, a su vez, tuvo que llevar muchos meses o años de rastreo, dada la profundidad a la que está: 1200 m.
4. Dado que a primeros de abril de 2007 se pide a Londres el Permiso de Exportación para los EE. UU., hay que pensar que, al menos, han trabajado enero, febrero y marzo. Meses de invierno, de mucho menos tráfico y turistas, y mejor si es en fechas navideñas.
 5. De modo que el expolio pudo haberse producido entre esos hitos cronológicos que he marcado entre el punto 2 y el punto 4: julio de 2006 y enero de 2007.
 6. Por su parte, el diario *El País* de 23 de julio de 2007 publicó que en noviembre de 2006, es decir, justo en medio de esos meses que estamos enmarcando de junio-2006/enero-2007, Greg Stemm se entrevistó en el Ministerio de Cultura con un alto cargo del mismo. Stemm acudió a aquella cita con su abogado español, José Luis Goñi y ofreció que el Ministerio colaborase en el pecio, pero no se firmó nada. Esta reunión, de la que el Ministerio no había informado, la conoció y recogió *El País* porque una vez que en 2007 «explotó» todo el asunto, los abogados de Odyssey enviaron un informe de 109 páginas a la Junta, Guardia Civil, Fiscalía de Cádiz y tres Ministerios el día 6 de junio de 2007. Además de ello, este dato podría indicar que Odyssey había localizado el pecio ya en noviembre de 2006 y que estaba a punto de comenzar su saqueo; y que al comprobar que su ubicación estaba fuera de las 12 millas del Mar Territorial cuya gestión le podría corresponder a la Junta, decidió acudir directamente al Ministerio.
 7. [Nota añadida en septiembre de 2016]. Y finalmente, tras las campañas del Museo en el pecio de *La Mercedes*, en agosto de 2015 y septiembre de 2016, sabemos que con mala mar no se puede trabajar allá. Por lo que hemos de descartar los meses de octubre de 2006 a marzo de 2007. Este dato nos lleva, de nuevo, a la hipótesis más creíble: que el saqueo se produjo en los meses de primavera-verano de 2006.

Junto al abogado Pipe Sarmiento, hay otro abogado al que es obligado citar. Hasta donde sé, la única querrela aceptada en España contra Odyssey Marine Exploration no la puso el Ministerio, sino el jurista José María Lancho¹⁰. Su contribución resultó fundamental para poder desactivar las reclamaciones de los herederos de todos aquellos que portaban dinero y propiedades en el buque hundido. Odyssey había trabajado durante mucho tiempo para que algunos de los descendientes de quienes portaron sus bienes en el desdichado buque reclamasen a España su parte, lo que habría supuesto un sinfín de pleitos que hubieran durado décadas. Pero Lancho localizó y estructuró jurídicamente el hecho y los documentos de que el Reino de España había indemnizado a quienes habían perdido sus bienes en aquel terrible acontecimiento y lo había realizado a través de decenas de expedientes durante todo el siglo XIX. Este hecho hacía inviable las reclamaciones de los descendientes sobre los restos expoliados de *La Mercedes*, una de las maniobras jurídicas más peligrosas y hábiles de los abogados de Odyssey. Hay que decir que muchos de los herederos se negaron, espléndidamente, a secundar las maniobras de Odyssey.

No satisfecho aún, Lancho se involucró en un segundo expediente: la recuperación de los restos que Odyssey mantenía en Gibraltar, tras haber entregado a España el grueso de las monedas. Su análisis sobre el incumplimiento por parte de Gibraltar de su propia legislación sobre marina mercante evitando que los restos expoliados en el fondo del mar por Odyssey fueran entregados al Receiver of Wrecks, fue argumentado por el Reino de España ante las autoridades gibraltareñas y permitió recuperar los últimos restos del expolio de Odyssey.

¹⁰ Juzgado de Instrucción n.º 3 de La Línea de la Concepción, Diligencias Previas 855/2007 a instancias de la empresa privada Nerea Arqueología.

Y como en los otros casos comentados en esta breve nota, Lanchó tampoco ha recibido el reconocimiento público del Ministerio. Tan solo el diario *ABC* se hizo eco de estas aportaciones y dejó constancia de su trabajo y de cómo, a pesar de las decenas de comunicaciones y correos profesionales con los abogados norteamericanos y los responsables de la embajada en Washington y las expresiones reconociendo el valor técnico y fundamental de esas aportaciones jurídicas en el procedimiento, nunca se tradujeron en un mínimo reconocimiento por parte de la Administración española (Ministerios de Cultura y de Exteriores).

En los breves párrafos que preceden he esbozado parte del origen de la defensa jurídica del patrimonio sumergido español, esqueleto cuyos ejes para la Historia son:

1. La empresa Sea Hunt con los buques *Juno* y *La Galga*, entre 1998 y diciembre de 2000.
2. La empresa Odyssey Marine Exploration entre 1999-2000 y enero de 2012 con *N.ª S.ª de las Mercedes*.

Para los años venideros, para las décadas o siglos que nos sucedan, este es el origen de la victoria judicial en la defensa de nuestro patrimonio sumergido en ultramar.

Con anterioridad a los casos *Juno-Galga* el Estado español no había hecho nada, hasta donde yo sé. Junto a los tres casos citados (*La Galga*, la *Juno* y *N.ª S.ª de Las Mercedes*) podríamos citar seis o siete barcos más, alguno de los cuales merece un tratamiento muy especial por las personas a las que atañe, lo que se hace en otro sitio.

De doloroso recuerdo para quienes hemos dedicado nuestra vida a la defensa del Patrimonio, es el caso del *Nuestra Señora de Atocha* expoliado décadas antes por otro conocido saqueador, Mel Fisher, al tiempo que otro viejo conocido del expolio arqueológico, Robert Marx, publicaba en 1974 un libro titulado *Shipwrecks of the Americas* que recogía más de 2000 barcos hundidos, en su mayoría españoles.

Y junto a los citados, hay que contar con Franck Goddio, quizá, con Robert Ballard, el más inteligente del grupo en cuanto a la manera de relacionarse con las Administraciones públicas de muchos países. Todos ellos, Marx, Fisher, Ballard, Goddio, Stemm y Sea Hunt han formado en las últimas tres o cuatro décadas el grupo de los muy acaudalados individuos dedicados a actividades no siempre claras y transparentes en el fondo del mar.

De especial relevancia para este embrión de Historia, es el caso del *San Diego*. Hundido a comienzos del siglo XVII en aguas de Filipinas, fue «excavado» por el equipo de cazatesoros de Franck Goddio el cual contrató a un arqueólogo «oficial» del gobierno de aquella queridísima nación al que puso a trabajar a sueldo de Goddio, como asalariado suyo.

Pues bien: los objetos del *San Diego* que «sobraron» tras la distribución que Goddio y el Museo de Filipinas hicieron, fueron ofrecidos en venta a su propietario legítimo, España, y la Comunidad Autónoma de Madrid los compró ante la indignada reacción de algunos de nosotros. Y entre la Comunidad de Madrid y una institución financiera española abonaron en 1998 ochocientos millones de pesetas (5 millones de euros) y los materiales fueron al Museo Naval de Madrid, el cual previamente había redactado informes favorables a la adquisición.

En un paso más hacia delante (y más importante), Franck Goddio contrató los servicios de otro arqueólogo «oficial» para que le hiciera el estudio arqueológico del expolio de este barco español de cara a la publicación del libro correspondiente. Se trataba, vano es decirlo, de lavar la cara ante la comunidad científica. Pero esta vez no contrató a un arqueólogo filipino sino a uno

francés y destacado, Michel L'Hour¹¹, para que le escribiese un muy amplio informe arqueológico del galeón *San Diego*, como manera de darle «visio oficial». Michel L'Hour sería nombrado, unos doce años después de su colaboración con Goddio, director de la DRASSM de Marsella.

Una historia diferente que no tiene que ver con España fue la intervención de Goddio en los restos ptolemaicos sumergidos en la bahía de Alejandría, frente al equipo arqueológico oficial francés que lideraba Jean-Yves Empereur y que dio mucho que hablar en la década de los años noventa en los coros internacionales de arqueología subacuática¹².

He pretendido aportar para la memoria colectiva unos pocos datos, que no he visto citados en las publicaciones sobre el expolio de los galeones y sobre la *Mercedes*, aunque quedan bastantes más. Es un reconocimiento a individuos de fuera de la Administración que han tenido un protagonismo importante en diversos frentes a la hora de enfrentarse con éxito a los cazate-soros, personas que corriendo riesgo personal (incluso algunos que acabaron amenazados) se enfrentaron con más rapidez, valor, y eficacia al expolio que algunos «responsables oficiales». Porque como muchas veces a lo largo de la Historia, quizá algunas medallas no están en los pechos que deben.

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¹¹ L'Hour, Michel: «Un galeón fortuito». *El San Diego. Un tesoro bajo el mar*. Edit. CEPESA, ELF. Cooperación Española. 1995, pp. 128-163.

¹² Empereur era secretario general de l'École française d'Athènes y luego creó el Centre d'Etudes Alexandriennes. Entre 1993 y 1996 descubrió en el fondo de la bahía de Alejandría varios cientos de bloques y estatuas que corresponden al Faro de Alejandría y posiblemente a los palacios de los Ptolomeos. Jean Yves EMPEREUR: *Le Phare d'Alexandrie, la Mer-veille retrouvée*, Gallimard, Paris, 2004. La llegada de Goddio a Alejandría con sus costosos medios subacuáticos y su enorme potencial económico le desplazó.

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El patrimonio cultural subacuático: un patrimonio para la humanidad. Algunas precisiones jurídicas

Underwater cultural heritage: heritage for Humankind. Some legal clarifications

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Resumen: dado que el congreso IKUWA V tiene por lema «El patrimonio cultural subacuático: un patrimonio para la humanidad», en el presente trabajo se estudia el sentido que, desde una perspectiva jurídica, debe darse a esa expresión *patrimonio para la humanidad* así como las relaciones existentes entre la misma y otras expresiones afines, tales como patrimonio común de la humanidad y beneficio de toda la humanidad, todas ellas empleadas en numerosos tratados internacionales en la segunda mitad del siglo xx. Igualmente se examina la posible existencia de un derecho al patrimonio cultural subacuático, integrado entre los derechos humanos y, más concretamente, entre los llamados derechos culturales.

Palabras clave: patrimonio cultural subacuático, patrimonio común de la humanidad, patrimonio cultural de la humanidad, derechos humanos, derechos culturales.

Abstract: Due to the motto of the IKUWA V congress is «The Underwater Cultural Heritage: An Heritage for Humankind», in the present paper is studied the sense that, from a legal perspective, must be given to that particular expression Heritage for Humankind as well as the existing relationships between this and other similar expressions like Common Heritage of the Humankind and Benefit for all the Humankind, all of them used in numerous international treaties in the second half of the Twentieth Century. Furthermore, it is also analysed the possibility of the existence of a right to underwater cultural heritage, integrated among the Human Rights, and more specifically, among those called Cultural Rights.

Key words: Underwater cultural heritage, common heritage of humankind, cultural heritage of humankind, human rights, cultural rights.

Introducción

El IKUWA V lleva por lema «El patrimonio cultural subacuático: un patrimonio para la humanidad», y se trata de una expresión que a primera vista todos entendemos pues nos transmite la idea de que los objetos arqueológicos e históricos hallados en el mar, en expresión de la Convención sobre el Derecho del Mar (CNUDM), o el patrimonio cultural subacuático, en expresión de la Convención Unesco 2001, pertenecen a todos los seres humanos, que son los que deben beneficiarse de los mismos.

Esta idea primera no anda desencaminada pues se corresponde bastante con la idea que transmiten, en su articulado, esas convenciones internacionales que hemos citado. Pero en un plano jurídico, a poco que se profundice, encontramos dificultades ya que algunas preguntas que se pueden formular en relación con este asunto no tienen, desde la perspectiva del derecho, una contestación fácil.

La primera dificultad viene constituida por la diferente terminología empleada en el derecho internacional. La CNUDM en su artículo 149 dice que todos los objetos arqueológicos e históricos hallados en la Zona serán reservados o se dispondrá de ellos en beneficio de toda la humanidad, que es una expresión cercana pero no la misma que la que emplea esta misma convención en su artículo 136, artículo también perteneciente como aquel a la Parte XI, cuando dice que la Zona y sus recursos son patrimonio común de la humanidad. Por otro lado, la Convención sobre la Protección del Patrimonio Cultural Subacuático de 2001 reconoce en su preámbulo la importancia del patrimonio cultural subacuático como parte integrante del patrimonio cultural de la humanidad y, más tarde (artículo 2.3), establece que los Estados partes preservarán el patrimonio cultural subacuático en beneficio de la humanidad. Al margen de estos tratados internacionales, otros convenios también utilizan estas mismas expresiones, u otras parecidas, como por ejemplo el Tratado Antártico¹ (que dice en su Preámbulo que «es en interés de toda la humanidad que la Antártida continúe utilizándose siempre exclusivamente para fines pacíficos»), el Tratado sobre la exploración y utilización del espacio ultraterrestre² («la exploración y utilización del espacio ultraterrestre [...] deberán hacerse en provecho y en interés de todos los países [...] e incumben a toda la humanidad», art. 1), el Acuerdo sobre la Luna y otros cuerpos celestes³ («la exploración y utilización de la Luna incumbirán a toda la humanidad y se efectuarán en provecho e interés de todos los países», art. 4.1) o, en el ámbito de la cultura, la Convención Unesco 1972 sobre la Protección del Patrimonio Mundial, Cultural y Natural («Considerando que ciertos bienes del patrimonio cultural y natural presentan un interés excepcional que exige se conserven como elementos del patrimonio mundial de la humanidad entera», Preámbulo, y además la Convención menciona un «patrimonio universal» en su art. 6.1) y, más recientemente, la Convención de 2005 sobre la Protección y la Promoción de la Diversidad de las Expresiones Culturales («Consciente de que la diversidad cultural constituye un patrimonio común de la humanidad que debe valorarse y preservarse en provecho de todos», dice en su Preámbulo).

Pero más allá de la terminología empleada, otras dudas se refieren a la composición de ese patrimonio común. En efecto, todo patrimonio está constituido por una serie de elementos que lo componen, y no está claro cuáles puedan ser los integrantes de tal patrimonio común de la humanidad. Por otro lado, ¿cabe catalogar a la humanidad como titular de este patrimonio?, y, consiguientemente, ¿este término se refiere a la totalidad de los Estados o más bien a todos los individuos que son nacionales de ellos? Por último, tampoco está claro qué clase de beneficio reporta o produce ese patrimonio, pues naturalmente el beneficio puede ser de muy diverso signo.

¹ De 1 de diciembre de 1959.

² Celebrado en el seno de la ONU el 27 de enero de 1967.

³ Acuerdo que debe regir las actividades de los Estados en la Luna y otros cuerpos celestes, de 18 de diciembre de 1979.

Por ello en esta comunicación nos detendremos en precisar qué hay de común en esas expresiones y cómo debe ser entendida la de patrimonio común de la humanidad, que es la más conocida y utilizada, referida al patrimonio cultural subacuático, precisando en este ámbito cuál es su alcance y verdadero sentido. Y concluiremos analizando si hoy puede hablarse de la existencia de un derecho al acceso y disfrute del patrimonio cultural subacuático y su posible encuadramiento entre los derechos humanos, concretamente entre los llamados derechos culturales.

El concepto de patrimonio común de la humanidad. Origen y evolución

El concepto de patrimonio común de la humanidad, aunque tiene ya varios decenios de existencia, sin embargo todavía no se ha consolidado y transmite altas dosis de incertidumbre. Se viene aplicando a ciertos bienes, espacios e intereses que no son susceptibles de apropiación ni por parte de los Estados ni de los individuos y cuya conservación interesa sin embargo tanto a unos como a otros. El origen de esta expresión hay que situarlo en el Derecho del Mar y, concretamente, en las propuestas surgidas en los años sesenta del pasado siglo en orden a regular los aprovechamientos de los fondos marinos situados más allá de la jurisdicción de los Estados⁴. Pero el avance importante de este concepto se produjo gracias a la Resolución de la Asamblea General de las Naciones Unidas 2749 (XXV) de 17 de diciembre de 1970, en la que se declaraba solemnemente que la Zona internacional de los fondos marinos situados más allá de los límites de la jurisdicción nacional y sus recursos eran patrimonio común de la humanidad, y se establecían los principios que habrían de regular esos fondos marinos y oceánicos y su subsuelo fuera de los límites de la jurisdicción nacional.

Dado el acuerdo prácticamente unánime alcanzado en el seno de la Asamblea General y teniendo en cuenta el carácter no obligatorio de esa resolución, se hacía preciso que un convenio internacional asumiera estos planteamientos a fin de que los mismos alcanzaran carácter obligatorio. Y fue finalmente la CNUDM, que comenzaba durante esos años a negociarse, la que asumió en su articulado el principio de patrimonio común de la humanidad referido a la Zona y a sus recursos (art. 136). El resto de los principios en que se asentó tal pronunciamiento eran los siguientes: 1) prohibición del ejercicio de soberanía y de derechos soberanos sobre la Zona y sobre sus recursos⁵ por parte de los Estados, y su corolario era que ni la Zona ni esos recursos podían ser objeto de apropiación por los mismos; 2) utilización de la Zona para fines pacíficos, de conformidad con la Carta de las Naciones Unidas; 3) la exploración y explotación de la Zona y sus recursos debían efectuarse proporcionalmente/racionalmente en beneficio de todos los Estados y particularmente en beneficio de los Estados más desfavorecidos, es decir, los que estaban en vías de desarrollo; 4) realización de la investigación científica marina y protección del medio ambiente marino en la Zona en beneficio de toda la humanidad; y 5) establecimiento de un organismo internacional encargado de gobernar y gestionar todas las actividades de aprovechamiento de tales recursos efectuadas en la Zona. E interesa destacar que la entrada en vigor del Acuerdo de 1994 mediante el que se desarrollaba la Parte xi de la CNUDM, verdadero tratado internacional que modificó dicha Parte xi, no cambió los planteamientos mencionados, por lo que la Zona y sus recursos han seguido siendo patrimonio común de la humanidad hasta hoy.

Desde el campo del derecho del mar, este concepto ha sido transportado a otros campos tan distintos como el del espacio ultraterrestre y los cuerpos celestes, el del medio ambiente y la

⁴ Con antecedentes en la Declaración Truman de 1945, resultan de interés las propuestas del presidente de EE. UU. Lyndon B. Johnson de 1966, del embajador de Malta ante las Naciones Unidas Arvid Pardo de 1967 y la resolución de la Asamblea General de las Naciones Unidas 2574 D (XXIII) de 15 de diciembre de 1969, mediante la que los Estados asumían el compromiso provisional o transitorio de abstenerse de explotar los recursos de la Zona mientras no se estableciese un régimen aplicable a la misma.

⁵ Por recursos de la Zona entiende el artículo 133 los recursos minerales sólidos, líquidos o gaseosos, incluidos los nódulos polimetálicos.

biodiversidad, el de los derechos humanos y las libertades fundamentales y también el del patrimonio cultural, si bien su aplicación a ámbitos tan dispares ha acarreado que este concepto se haya desdibujado con respecto a cómo fue concebido en el Derecho del Mar, y muestra de ello ha sido la aparición de diferentes regímenes jurídicos según el ámbito concernido e, incluso, cabe hablar en algunos de estos ámbitos de ausencia de verdadero régimen jurídico. Aun así, tradicionalmente se viene manteniendo que en todos estos casos se trata de bienes y lugares no apropiables por ningún Estado, que su utilización o aprovechamiento procede únicamente con fines pacíficos y que los mismos han de hacerse teniendo en cuenta no solo a las generaciones actuales sino también a las futuras (conforme al principio de sostenibilidad, que procede del campo del medio ambiente). Y hoy podemos afirmar que este principio/noción de patrimonio común de la humanidad puede ser enfocado desde dos vertientes que sin embargo aparecen entrelazadas: la de un interés colectivo de todos los Estados en su existencia y preservación y, en el mismo sentido, la de un interés concurrente de todos los habitantes del planeta (perspectivas estatal e individual).

Resulta interesante en este momento mencionar la Declaración de Castellón de 1999 sobre las Nuevas Perspectivas del Patrimonio Común de la Humanidad⁶, en la que se relacionaban los elementos que en ese momento (repito, en 1999) cabía incluir en el concepto o noción de patrimonio común de la humanidad. Entre tales elementos se incluía el fondo del mar situado más allá de los límites de la jurisdicción nacional, los recursos biológicos del alta mar, la Antártida, el espacio ultraterrestre, la Luna y los otros cuerpos celestes, el espectro de frecuencias radioeléctricas y otras órbitas privilegiadas, los elementos del medio ambiente en la medida en que conciernen a todos los pueblos (aire, agua, suelo, flora y fauna), la diversidad biológica, el clima global, los recursos alimenticios esenciales para la supervivencia, los derechos del hombre y las libertades fundamentales, el genoma humano, el patrimonio cultural y natural y, por fin, las obras del espíritu de interés universal cuando pasen a ser de dominio público.

En fin, hoy día resulta generalmente admitida por los autores la inclusión del patrimonio cultural entre esos elementos que integran la noción de patrimonio común de la humanidad, si bien tal afirmación debe matizarse adecuadamente. Y en esta inclusión hay que reconocer la labor realizada por la Unesco desde su misma creación, pues en su Constitución menciona como uno de los fines de esta organización internacional la conservación y la protección del «patrimonio universal de libros, obras de arte y monumentos de interés histórico y científico»⁷, que ciertamente cabe considerar como la noción que generó de manera directa el concepto de patrimonio cultural como patrimonio común de la humanidad (Tello, 2012: 46). Posteriormente, con la aprobación de una gran cantidad de instrumentos, la Unesco ha confirmado su inicial predisposición a considerar el patrimonio cultural como una suerte de patrimonio común de la humanidad, si bien sin una unidad de criterio, pues las convenciones y declaraciones aprobadas en su seno han abundado en el concepto de manera confusa y desordenada.

El patrimonio cultural y el patrimonio cultural subacuático, integrantes del patrimonio común de la humanidad. Sentido de esta expresión en el ámbito cultural

Es verdad que en el ámbito del patrimonio cultural son varios los tratados internacionales que utilizan esa expresión de patrimonio común de la humanidad o expresiones similares para refe-

⁶ Esta Declaración fue elaborada como consecuencia de las jornadas celebradas en esa ciudad mediterránea española entre los días 12 y 14 de junio de 1999 y organizadas por la Unesco. Estas jornadas o coloquios tenían como objetivo realmente ampliar la noción de patrimonio común de la humanidad a las obras del espíritu humano de valor universal excepcional en tanto en cuanto pasasen a ser de dominio público.

⁷ Artículo I.2 c de la Constitución de la Unesco, aprobada en Londres el 16 de noviembre de 1945.

rirlos a determinados bienes culturales, tanto tangibles como intangibles, e incluso recientemente a las variadas expresiones culturales, exponentes de la diversidad cultural existente en nuestro planeta. Ya hemos citado las Convenciones Unesco de 1972 sobre la Protección del Patrimonio Mundial, Cultural y Natural y de 2005 sobre la Protección y la Promoción de la Diversidad de las Expresiones Culturales, pero, siguiendo a Scovazzi (Scovazzi, 2008: 3-144), también son dignas de destacar la Convención de La Haya de 1954 para la Protección de Bienes Culturales en caso de Conflicto Armado, la de París de 1970 sobre las Medidas que Deben Adoptarse para Prohibir e Impedir la Importación, la Exportación y la Transferencia de Propiedad Ilícitas de Bienes Culturales, el Convenio de UNIDROIT de 1995 sobre los Bienes Culturales Robados o Exportados Ilícitamente, la Convención Unesco de 2001 sobre la Protección del Patrimonio Cultural Subacuático y la Convención de 2003 para la Salvaguardia del Patrimonio Cultural Inmaterial. Como es sabido, todas ellas constituyen los pilares en que se asienta hoy la defensa del patrimonio cultural en el plano internacional, y resulta interesante examinar hasta qué punto ha llegado a enraizar en ellas el concepto de un patrimonio cultural de la humanidad. Sobre este extremo cabe apreciar en todas estas convenciones una evolución a lo largo del tiempo, pues si bien en los primeros tratados se defiende un patrimonio cultural fundamentalmente de tipo nacional, en los últimos años ciertamente se ha ido abriendo paso con más claridad la concepción de un verdadero patrimonio cultural de la humanidad.

Centrándonos en la Convención de 2001 sobre protección del patrimonio cultural subacuático, la misma considera este tipo de patrimonio «como parte integrante del patrimonio cultural de la humanidad y elemento de particular importancia en la historia de los pueblos, las naciones y sus relaciones mutuas en lo concerniente a su patrimonio común» (Preámbulo), motivo por el que todos los Estados partes «preservarán el patrimonio cultural subacuático en beneficio de la humanidad» (art. 2.3). Se trata de uno de los tratados internacionales en materia cultural que de manera más clara se pronuncia sobre la pertenencia del patrimonio cultural subacuático al patrimonio cultural de la humanidad y de este al patrimonio común de ella, e igualmente manifiesta que la protección y preservación del mismo supone o representa un beneficio para la humanidad. Y queremos llamar la atención sobre el hecho de que este convenio, a diferencia de algunos de los otros mencionados, no indica ni directa ni indirectamente que los bienes que integran el patrimonio cultural subacuático pertenezcan al patrimonio cultural nacional de alguno de los Estados concernidos⁸, por lo que surge la pregunta de si tales bienes sumergidos son patrimonio cultural de la humanidad «directamente» y no por su pertenencia previa a un patrimonio cultural nacional. Desde luego, el hecho de que: 1) la inmensa mayoría de objetos sumergidos sean pecios o restos de naufragios, 2) la innegable dificultad en muchos casos de averiguar la identidad de los mismos, y 3) ser tales pecios y restos el resultado de accidentes de navegación en los que cualquier buque de cualquier pabellón podía acabar naufragando en cualesquiera aguas del océano, son todas ellas consideraciones que parecen abonar una respuesta afirmativa a aquella pregunta. Sin embargo, la óptica tradicional desde la que ha sido examinada esta cuestión en el ámbito del patrimonio cultural es la de que cada Estado posee su propio patrimonio cultural, y solo por agregación de los mismos o cuando determinados bienes de ellos sobresalen por su importancia o valor, es cuando se puede hablar de un patrimonio cultural de la humanidad. Y desde esta perspectiva el patrimonio cultural subacuático no contiene o goza de características diferentes que puedan constituir una excepción en relación a dicho planteamiento tradicional.

Por otro lado, no conviene olvidar tampoco la preocupación constante existente durante las negociaciones en que esta Convención no se separara de los postulados de la CNUDM, pre-

⁸ Por ejemplo, el ribereño, el del pabellón de los restos o el que tenga algún vínculo cultural y arqueológico con los mismos. Y ello al margen de la propiedad o titularidad, cuestiones en las que esta Convención no entró, como es sabido.

ocupación e incertidumbre que todavía hoy alcanzan a un importante número de Estados, que por el momento no la han suscrito por dicho motivo. Y decimos esto porque los pronunciamientos reseñados de la Convención Unesco tuvieron muy en cuenta las prescripciones de esa otra Convención, de que la Zona y sus recursos son patrimonio común de la humanidad (art. 136) y de que los objetos arqueológicos e históricos hallados en la Zona se reservarán y se dispondrá de ellos en beneficio de toda la humanidad (art. 149). Conviene en este asunto, por tanto, que nos detengamos en la CNUDM.

Una primera lectura de este último artículo permite deducir que se incorpora al régimen jurídico de esos objetos arqueológicos el mismo principio que rige en la Zona con carácter preferente: el de que la Zona y sus recursos son patrimonio de la humanidad. Sin embargo, una lectura más pausada del precepto nos obliga a formularnos al menos dos cuestiones. Una primera, si son equiparables las expresiones *patrimonio común de la humanidad*, que en efecto el artículo 136 predica de la Zona y sus recursos, y la de que los objetos arqueológicos e históricos serán conservados o se dispondrá de ellos *en beneficio de toda la humanidad*, que es lo que dice el artículo 149, frase por cierto también utilizada en el 140.1⁹. En segundo lugar, si estos objetos arqueológicos e históricos son en realidad recursos de la Zona.

Respecto a la primera, ¿el hecho de que estos objetos deban ser destinados en beneficio de toda la humanidad nos permitiría afirmar que en efecto los mismos son patrimonio común de la humanidad? Y en caso de una contestación afirmativa, ¿en qué sentido son patrimonio común de la humanidad? Para contestar adecuadamente a estos interrogantes resulta necesario invertir el planteamiento de aquellas dos cuestiones, y comenzar preguntándonos si el patrimonio cultural submarino es un recurso de la Zona.

Por recursos entiende la Convención (ya lo hemos apuntado antes, artículo 133 a) «todos los recursos minerales sólidos, líquidos o gaseosos *in situ* en la Zona, situados en los fondos marinos o en su subsuelo, incluidos los nódulos polimetálicos». Vista la claridad con que se expresa la Convención de Montego Bay, forzoso es concluir que de ninguna manera puede afirmarse que los objetos arqueológicos e históricos sean recursos de la Zona, como ya advertía en 1989 Goy (1989: 758) y posteriormente señalaron Balmond (1992: 87) y Caflisch (1999: 76). En España es de este parecer Aznar Gómez, que precisa, para dar consistencia a este aserto, que el empleo en el artículo 149 de la voz *objetos*, en lugar de *recursos*, avala esta posición (Aznar, 2004: 136). En consecuencia, por recursos hay que entender exclusivamente los naturales¹⁰, pues solo ellos pueden ser explotados económicamente, como luego veremos. Por tanto, si los objetos que conforman el patrimonio cultural submarino no son recursos, en el sentido del artículo 133 de la convención, y si tampoco son, obviamente, Zona (entendiendo por tal el espacio marino al que nos estamos refiriendo), la conclusión no puede ser otra que dichos objetos no son de ninguna manera patrimonio común de la humanidad, a menos que exista otro sentido diferente a como esta expresión es utilizada para referirla a la Zona de los fondos marinos y oceánicos más allá o fuera de los límites de la jurisdicción nacional.

En efecto, en relación con dichos recursos naturales (que son los minerales) se está aplicando la noción de patrimonio común de la humanidad con la finalidad de que los beneficios que puedan derivarse de su explotación en la Zona lleguen a alcanzar a la totalidad de los Estados, pues-

⁹ Art. 140.1: «Las actividades en la Zona se realizarán, según se dispone expresamente en esta Parte, en beneficio de toda la humanidad, independientemente de la ubicación geográfica de los Estados, ya sean ribereños o sin litoral, y prestando consideración especial a los intereses y necesidades de los Estados en desarrollo [...]».

¹⁰ Conforme a la Convención, estos recursos son exclusivamente los minerales. Sin embargo en los fondos marinos también existen recursos biológicos, entre los cuales hay que mencionar los recientemente denominados recursos genéticos, ubicados en realidad en todos los espacios marinos.

to que: a) la evolución del Derecho del Mar en los últimos cincuenta años no permite que en otros espacios marinos sea posible repartir los recursos contenidos en ellos, dado el progresivo aumento de la jurisdicción de los Estados ribereños; y b) el contexto histórico-político existente en los años sesenta y setenta del pasado siglo, de nacimiento de nuevas naciones y de lucha de estas y de otras atrasadas por la subsistencia, aconsejaba el establecimiento de un nuevo orden económico internacional y en consecuencia el reparto de los aprovechamientos de la Zona y de los nuevos bienes que en ella se encuentran, que son económicamente evaluables, no se olvide, entre todas las naciones.

Sin embargo, el concepto de patrimonio común de la humanidad aplicado a los bienes culturales se fundamenta en otras consideraciones. Por un lado, los bienes culturales (en suma, el patrimonio cultural) son patrimonio común de la humanidad porque suponen el legado que las generaciones presentes transmiten a las futuras y ese legado ayuda a comprender lo que los distintos estadios de la civilización han supuesto en el progreso de la humanidad. Y ello con independencia del lugar en donde se encuentren los bienes culturales. Por eso lleva razón Balmond cuando afirma que si en el concepto de patrimonio común de la humanidad utilizado en el Derecho del Mar los recursos de la Zona, como patrimonio común, son analizados desde una perspectiva *ratione loci*, la protección de ese patrimonio de la humanidad constituido por los objetos culturales se fundamenta *ratione materiae* (Balmond, 1992: 86-87).

Por otro lado, si el patrimonio común constituido por los recursos de la Zona pertenece colectivamente a todas las naciones, corolario de lo cual es la no apropiabilidad de los mismos por ningún Estado, aquel patrimonio cultural mundial reclama y obtiene una protección internacional en cuanto que primeramente es patrimonio nacional, cuyo valor, al sobrepasar el del Estado al que pertenece, llega a ser, por su excepcionalidad, universal, y empleamos ahora la terminología de la Convención Unesco de 1972, paradigmática en este asunto. En una palabra, este patrimonio, así concebido, responde a la suma de los patrimonios culturales nacionales de los Estados, como también hemos apuntado antes. Por último, el patrimonio común de la humanidad, aplicado a los recursos de la Zona, implica, analizado el contexto político-histórico en que surgió el concepto, que los beneficios de la explotación de los mismos son de innegable naturaleza económica y, por tanto, pueden ser objeto de reparto. En este preciso sentido el artículo 140 dispone que las actividades en la Zona se realizarán en beneficio de la humanidad en su conjunto. Planteamiento que no cabe hacer en absoluto cuando se trata de bienes u objetos arqueológicos, por muy situados en la Zona que se encuentren. Ello nos obliga a interpretar adecuadamente la otra expresión utilizada en el artículo 149, a la que antes nos referíamos: «[...] serán conservados o se dispondrá de ellos *en beneficio de toda la humanidad*».

La pregunta que hay que hacerse es si esta última expresión, que es idéntica a la empleada en el artículo 140.1, tiene el mismo alcance en uno y otro artículo (el 149). La respuesta debe ser negativa sin duda, puesto que no admiten parangón los beneficios que reportan las actividades llevadas a cabo en la Zona en relación con los recursos de la misma, con los que ofrecen los objetos históricos y arqueológicos encontrados en dicho espacio marino.

El beneficio producido por el ejercicio de las actividades mencionadas en el artículo 140.1 de la Convención de Montego Bay es fundamentalmente económico, como ya hemos dicho con anterioridad¹¹, y el parágrafo 2 de ese mismo artículo lo deja claro: «La Auto-

¹¹ Según se desprende de la lectura del artículo 140, que lleva por rúbrica «Beneficio de la humanidad», tal expresión hay que entenderla vinculada a los intereses y necesidades de todos los Estados, pero fundamentalmente de los que se encuentran en vías de desarrollo y de los pueblos que todavía no han logrado la independencia o un régimen de autonomía reconocido por las Naciones Unidas. Desde luego se trata de beneficios principalmente de tipo financiero o económico, como decimos, aunque puedan existir otros, por ejemplo, los derivados de la preservación del medio marino (artículo 145) o de los avances científicos (artículo 143), si bien estos obviamente no pueden ser objeto de reparto o distribución.

ridad dispondrá la distribución equitativa de los beneficios financieros y otros beneficios económicos derivados de las actividades en la Zona [...]. Sin embargo, el beneficio a que se refiere el artículo 149 hay que entenderlo referido a la posibilidad de que todos los seres humanos puedan aprovecharse de unos bienes que son enriquecedores culturalmente y están en disposición de favorecer su formación y su comprensión del devenir de la especie. En palabras de Francioni, en relación con los objetos históricos y arqueológicos el artículo 149 viene a decir que «existe un interés general de la comunidad internacional en su conservación y disfrute» (Francioni, 2009: 28), de lo que a su vez se deduce que la posibilidad de atribución de ese beneficio recae o concierne directamente a los individuos, no a los Estados. En realidad, y desde este punto de vista, la propiedad de esos bienes u objetos llega a ser irrelevante, de tal manera que el patrimonio sumergido es patrimonio de la humanidad con independencia de a quién se atribuya su titularidad y, por ello mismo, incluso del espacio marino en el que sean encontrados esos objetos arqueológicos. Y en esto coincide plenamente, como no podía ser de otra manera, el patrimonio cultural sumergido con el que no lo está.

Y solo resta por decir, en este asunto, que cuando la Convención Unesco afirma que el patrimonio cultural subacuático debe ser preservado en beneficio de toda la humanidad (art. 2.3), con ello se está remitiendo, en efecto, a la CNUDM, concretamente a la interpretación de su art. 149 que hemos dejado apuntada. Y habrá que añadir que si bien el artículo 149 CNUDM tiene un ámbito de aplicación reducido circunscrito a los objetos arqueológicos e históricos hallados en la Zona, sin embargo la Convención de 2001 refiere el beneficio de toda la humanidad, como no podía ser de otra manera, a todos los bienes subacuáticos, se encuentren en el espacio marino en que se encuentren.

Dicho todo lo cual, y conforme indicábamos antes acerca de la doble vertiente del concepto de patrimonio común de la humanidad, la atribución de ese beneficio a la humanidad entera de que tratan ambas convenciones, responde a y lo que significa es que en la preservación de los bienes sumergidos están interesados tanto los Estados, que tienen un interés colectivo o generalizado en tal preservación (todos los Estados), como los individuos (todos los individuos), que posiblemente tengan, no ya un interés, sino un auténtico derecho a gozar y disfrutar de tales bienes culturales. Seguidamente analizaremos esto.

El enlace entre el patrimonio común de la humanidad, en su vertiente cultural, y los derechos humanos. ¿Existe un derecho al acceso y disfrute del patrimonio cultural subacuático, como derecho humano?

Decíamos que la protección del patrimonio cultural subacuático, de cualquier patrimonio cultural en suma, tiene su razón de ser en ese beneficio que para toda la humanidad (Estados e individuos) esa protección comporta. Y ahora conviene preguntarse si ese interés de los individuos en dicha protección supone en realidad un derecho de cualquier ser humano a que el patrimonio cultural sea protegido y poder consiguientemente beneficiarse de él.

Porque desde la perspectiva de los Estados, la cuestión del beneficio que a estos proporciona el patrimonio cultural parece más sencilla: todos los Estados están interesados en que su patrimonio cultural nacional sea protegido, pues responde a la seña de identidad del propio Estado, algo en lo que este siempre estará interesado, pues en gran medida va en ello su subsistencia. Esto es algo que debe predicarse con carácter general de todo el patrimonio cultural nacional, pero desde luego en mayor grado cuando determinados bienes culturales del propio patrimonio cultural alcanzan un valor excepcional. En estos casos, el prestigio del Estado concernido será sin duda mayor.

Pero también los Estados están interesados en proporcionar esa protección porque sus ciudadanos tienen el derecho a beneficiarse del patrimonio cultural, es decir, un derecho a que el Estado del que se es nacional les proporcione la posibilidad de formarse, por un lado, y por otro les permita tanto gozar de determinados bienes culturales cuya contemplación/fruición resulta gratificante para el espíritu como, en suma, de realizar o promover cualquier manifestación cultural que les reafirme en su identidad y pertenencia a una sociedad o grupo. Desde este punto de vista, la suscripción de tratados y pactos internacionales por los Estados en esta materia del patrimonio cultural persigue, como faceta principalísima de la protección de este, que los Estados asuman la obligación de comprometerse en esa protección. Obligación, por tanto, ante la comunidad internacional y ante los propios ciudadanos, que podrán acudir a instituciones u órganos internacionales si el Estado incumple sus obligaciones de preservación del patrimonio cultural o de cualquier manifestación cultural.

Pero igualmente los individuos tienen un interés en conocer el pasado y la historia de la especie (y también las manifestaciones actuales de otras culturas) a través de los bienes y expresiones culturales pertenecientes al patrimonio cultural de otros Estados y, muy especialmente, a través de los que representen un valor universal. Desde esta perspectiva se entiende perfectamente que el patrimonio cultural¹² venga siendo considerado últimamente como un elemento del patrimonio común de la humanidad, entendido este último término en su vertiente de todos los individuos.

Pues bien, ese derecho de los ciudadanos o de los individuos, del que estamos hablando, presenta caracteres que le aproxima a los derechos del hombre, como son su universalidad (todos los individuos tienen este derecho, sean nacionales de un Estado u otro) o su inseparabilidad de la persona (cualquier persona, por serlo, tiene este derecho). Por eso determinados tratados en materia cultural vienen últimamente subrayando esta cercanía, como las Convenciones para la salvaguardia del patrimonio cultural inmaterial y la de protección y promoción de la diversidad de las expresiones culturales, que la sientan de una manera explícita¹³. Y, desde luego, si hay un punto de relación entre la protección del patrimonio cultural y los derechos humanos, este viene representado por los llamados derechos culturales (Abouddahab, 2008: 254).

En los últimos decenios viene siendo común admitir entre los derechos y libertades fundamentales de todo ser humano a los derechos culturales¹⁴, aunque posiblemente se trate de los derechos del hombre menos desarrollados. Desde luego, la inclusión de los derechos culturales entre los derechos humanos viene reconocida tanto en declaraciones y tratados de ámbito universal como regional. La Declaración Universal de los Derechos Humanos (ONU, Nueva York, 1948) no los cita con ese nombre, pero sí los reconoce en sus artículos 26 y 27, apuntando las cinco manifestaciones o, propiamente, derechos que se integran en ese concepto: el derecho a la educación, el derecho a tomar parte libremente en la vida cultural de la comunidad, el derecho a gozar de las artes, el derecho a participar en el progreso científico y en los beneficios de todo tipo del mismo, y el derecho a la protección de los intereses morales y materiales que a cada uno puedan corresponder por razón de las producciones científicas, literarias o artísticas

¹² Cada vez es más necesario entender patrimonio cultural en sentido amplio, comprensivo tanto del patrimonio material como inmaterial, e igualmente comprensivo de todas aquellas manifestaciones culturales emanadas de cualquier grupo social.

¹³ Dice el Preámbulo de la Convención de 2003: «Refiriéndose a los instrumentos internacionales existentes en materia de derechos humanos, en particular a la Declaración Universal de Derechos de 1948, al Pacto Internacional de Derechos Económicos, Sociales y Culturales de 1966 y al Pacto Internacional de Derechos Civiles y Políticos de 1966». Y el de la de 2005: «Encomiando la importancia de la diversidad cultural para la plena realización de los derechos humanos y libertades fundamentales proclamados en la Declaración Universal de Derechos Humanos y otros instrumentos universalmente reconocidos».

¹⁴ El artículo 5 de la Declaración universal sobre la diversidad cultural (Unesco, 2001) establece: «Los derechos culturales son parte integrante de los derechos del hombre, que son universales, indisolubles e interdependientes [...]».

de que sea autor (el derecho moral de autor es propiamente un genuino derecho fundamental como derecho emanado directamente de la personalidad). En este mismo sentido, el Pacto Internacional de Derechos Económicos, Sociales y Culturales (ONU, Nueva York, 1966) reproduce en sus artículos 13 y 15 los planteamientos de esos artículos de la Declaración antes mencionados, pero ya con carácter obligatorio para los Estados¹⁵.

Al margen de los otros derechos culturales, el derecho a tomar parte libremente en la vida cultural de la comunidad es conceptuado hoy como el derecho a participar en la vida cultural, tanto de la propia comunidad como de otras diferentes¹⁶, y engloba al derecho a gozar de las artes. Y precisamente en este derecho cultural es en donde cabría recoger como una facultad del mismo la de acceso y disfrute del patrimonio cultural, en ese sentido amplio del que antes hablábamos, comprensivo tanto de los bienes culturales, materiales e inmateriales, como de las expresiones e identidades culturales diversas. Aunque también sería posible considerar esa facultad como un derecho cultural nuevo e independiente de los otros recogidos en los arriba citados pactos y declaraciones, que cabría considerar actualmente en fase de formación (Scovazzi, 2008: 11).

Esta de los derechos culturales es una materia en evolución y formación en los últimos años, a la que los autores están dedicando su atención. El régimen jurídico de los derechos culturales por diversos motivos todavía no se ha establecido ni desarrollado ni en instrumentos internacionales ni en los ordenamientos internos (con la excepción del derecho a la educación), y uno de esos motivos radica en la falta de consenso en el concepto de cultura, algo fundamental para que sobre el mismo pueda construirse todo ese aparato normativo. Pero hoy sí es posible ya considerar que, enraizado en estos conceptos de patrimonio cultural de la humanidad y de beneficio de toda la humanidad, es defendible y factible un derecho humano de acceso y disfrute del patrimonio cultural. La protección del patrimonio cultural y, especialmente, del patrimonio cultural subacuático gozaría, tras las reformas legales pertinentes, de un empuje considerable y definitivo¹⁷.

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¹⁵ Otros instrumentos internacionales como la Declaración Americana de los Derechos y Deberes del Hombre (1948, art. XII y XIII), la Carta Africana sobre los Derechos Humanos y de los Pueblos (1981, art. 17) o el Protocolo Adicional a la Convención Americana sobre Derechos Humanos en Materia de Derechos Económicos, Sociales y Culturales, Protocolo de San Salvador (1988, art. 13 y 14), abundan, con expresiones parecidas, en esos mismos pronunciamientos.

¹⁶ Así lo denomina el Pacto Internacional de Derechos Económicos, Sociales y Culturales de 1966, art. 15.1 a.

¹⁷ También sobre la base del respeto a los derechos humanos la protección del patrimonio cultural subacuático tiene igualmente un campo por explorar en la salvaguarda de los restos humanos. Véase nuestra obra *El régimen jurídico del patrimonio cultural subacuático. Aspectos de derecho interno y de derecho internacional, público y privado*. Ministerio de Defensa de España, 2013, pág. 433.

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Designating a Unesco List of Best Practices of Access to underwater cultural heritage

La designación de una lista de la Unesco de mejores prácticas de acceso al patrimonio cultural subacuático

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Abstract: This paper deals with the importance of responsible public access and social participation in the protection and management of the underwater cultural heritage. The text also presents the debates of the Unesco governing bodies of the 2001 Convention on the protection of this heritage and the recommendation of the Unesco Scientific and Technical Advisory Body (STAB) to identify and promote Best Practices of enabling access to it.

Key words: Unesco, 2001 Convention, underwater cultural heritage, best practice, public access, values-led management.

Resumen: el presente artículo subraya la importancia del acceso público responsable y de la participación social en el ámbito de la gestión y protección del patrimonio cultural subacuático. Igualmente el texto presenta los debates de los órganos rectores de la Convención de la Unesco de 2001 sobre la protección de este patrimonio así como de la recomendación del Consejo Consultivo Científico y Técnico (STAB) para identificar y promover mejores prácticas que habiliten su acceso.

Palabras clave: Unesco, Convención de 2001, patrimonio cultural subacuático, mejores prácticas, acceso público, gestión basada en valores.

*«Through interpretation, understanding;
through understanding, appreciation;
through appreciation, protection.»*

Freeman Tilden
Interpreting our Heritage



Figure 1. The temporal exhibition «Mar y Memoria del Puerto», organized by ARKA and CENTEX (Centro de Extensión del Consejo Nacional de la Cultura y las Artes) helped understanding the significance of the the underwater cultural heritage of Valparaíso Bay (Chile), as well as the work of the archaeologists, to the public. © ARKA/Diego Carabias.

Introduction

Only what is known and valued by society is sought by it to be protected. Underwater cultural heritage, the yet too «invisible» heritage, has thus still a long way to go to get society caring and valuing it. Ignorance of this heritage and misunderstanding of what it means prevents society still much too often from wondering whether it is safe. Especially shipwrecks are still too often perceived as lost treasure, instead of as heritage to be preserved.

Responding to this concern, paragraph 10 of Article 2 of the 2001 Unesco Convention on the Protection of the Underwater Cultural Heritage (hereinafter the 2001 Convention) on objectives and general principles states that «responsible non-intrusive access to observe or document in situ underwater cultural heritage shall be encouraged to create public awareness, appreciation, and protection of the heritage except where underwater cultural heritage access is incompatible with its protection and management».

While the number of countries that have ratified this Convention increases¹, not enough measures are yet adopted to implement its text fully and as appropriate. One of the most important consequences of this lack of implementation, which is still to be observed, is the low number of measures taken to make this heritage known and accessible to all members of society.

Communicating about the significance of submerged heritage to more people through media, publications, public access and interpretation can increase awareness of its importance in society and thereby increase the demand for its protection and study. It is through understanding, that society values and gives significance to cultural heritage, whilst seeking its protection and conservation by developing different means to reach these goals, as well as its enjoyment. Once society enjoys cultural heritage, it will seek its understanding, ensuring also its ultimate protection (Tilden, 1977; Manders/Van Tilburg/Staniorth, 2012).

¹ There are 55 States Parties to the 2001 Unesco Convention on the Protection of the Underwater cultural Heritage as for 10th August 2016 (the status of ratifications can be consulted in the following website: <http://www.Unesco.org/eri/la/convention.asp?KO=13520&language=E&order=alpha>).

This need for more visibility and access to knowledge and the actual heritage is accompanied by a need for more participation. Management systems, as applied by many countries to cultural heritage on land, include the involvement of different social actors in its diverse phases. These same systems, however, are yet rarely applied to the underwater cultural heritage, where the public is yet too often excluded from management. By law, many countries prohibit the access to underwater cultural heritage to the normal public and keep site locations secret. If archaeology is mainly social, as it interprets the past to the present-day society, influencing present-day societies by contributing to its education, commitment, strengthening of identities and public contestations, would it not be logical if not even obligatory to then also involve the different social groups in a direct or indirect way in the management and evaluation of underwater cultural heritage, i.e. to allow the public cooperation with archaeologists, cultural managers and policy makers, to be consulted and to access the heritage?

Some countries have done ground-breaking work in this regard. Much too many however have gone rather the contrary way. This situation results not only in the lack of awareness of what submerged heritage means, why it is important to all of us, and how it is related to other forms of heritage, but it is also a cause to the problem how societies in many States perceive it.

The scientific community has to carry its share of the guilt. The separation, which archaeologists, academia, and cultural institutions create when they distinguish land cultural heritage from underwater cultural heritage, has caused in many instances the adoption of different normative approaches that result in a variety of management challenges. It can also cause controversial ways of dealing with underwater cultural heritage.

Cultural heritage has to be understood as integral body and interconnected in all forms of cultural expressions, taking into account context and environment for study, preservation, and presentation purposes².

Underwater archaeology is, in essence and in purpose, as social as land archaeology. It is within the society that archaeology should be understood. The social and public component of the cultural heritage has to be taken into account from the very first moment of the planning of any activity directed at it up to the identification of every one of the management phases of a cultural site. Underwater archaeology and the management of the underwater cultural heritage are disciplines that need to be reshaped by modern contemporary policy and that need to adapt to society demands at the same time as they need to have a social and educative role added to the scientific and historical one (Flatman, 2007a; 2007b).

In April 2013, the Scientific and Technical Advisory Body to the 2001 Unesco Convention (hereinafter the STAB) warned that the implementation of the 2001 Convention could not be successful if public access was not taken into account. It opened the debate about the need to encourage best management practices leading to the public access and accessibility of underwater cultural heritage.

The following will underline the importance of responsible public access to underwater cultural heritage for increasing the social value and appreciation of this heritage and, therewith,

² This is also seen in the definition of underwater cultural heritage given by the 2001 Unesco Convention. Whereas this definition is widely accepted and used by most of cultural administrations and cultural stakeholders, one could argue that the mere fact of defining the boundaries of underwater cultural heritage could constrain its management. Concepts like that of maritime archaeological landscapes for instance, initiated by Christer Westerdhal in 1991, show us that maritime archaeology is a discipline with a theoretical and scientific framework - always in expansion, shaped and adapted to the views and actions of the society wherever it evolves.

its safeguarding by communities within the framework of the 2001 Unesco Convention. The text will also present the most recent debates of the Governing Bodies of the Convention concerning the practicalities of establishing a Unesco List on Best Practices for Access to the submerged heritage.

Accessibility & Public Awareness

The 2001 Convention underlines already in its introduction the importance of public awareness and access as one of the major issues to achieve the protection of this heritage. The fascination that the general public has shown by the archaeological remains found under water, whether coming from romantic conceptions of lost treasures and sunken ships, stories of mythical lost cities or from historical interest, is an indicator of the predisposition of society towards seeking a better understanding of the values and meanings that it bears. This attraction and curiosity have shaped in many instances the approaches to the management of the concerned cultural remains, even if not yet enough.

The Convention text goes on «noting [the] growing public interest in and public appreciation of underwater cultural heritage» and stating the conviction of States Parties of «the public's right to enjoy the educational and recreational benefits of responsible non-intrusive access to *in situ* underwater cultural heritage».

This statement is further developed in Article 2 paragraph 10 of the Convention, which not only encourages the observing public access to the actual underwater archaeological sites preserved *in situ* when the conditions of the access do not compromise the fragile stability of the site, but also allows the visitor to have access for documentation purposes, «except where underwater cultural heritage access is incompatible with its protection and management». Here the Convention is already introducing the concept of social participation for certain non-intrusive activities that could contribute to the management and public awareness of the heritage itself.

Public access is again encouraged by Rule 7 of the Annex of the Convention³, which is dedicated to all activities directed at underwater cultural heritage. This entails that any activity aiming at providing public access to any submerged archaeological site would require meeting and following all directives described in the Annex of the Convention.

Responsible public access contributes to raising public awareness as well as to reinforcing the way society values and appropriates itself the significance of the underwater cultural heritage. In the 2001 Convention this is directly connected to Article 20, which obligates States Parties to establish all «practicable measures to raise public awareness».

In addition to *in situ* access one should also consider how different scientific, cultural and aesthetic values of the underwater cultural heritage are made accessible to the public through *ex situ* platforms. A site can carry a huge amount of information about the past that is not necessarily easily understood and explained in a diving visit. At the same time, the individual attracted to this type of heritage, who could perceive its values and enjoy it, could possibly not always be equipped with the appropriate physical means or capacities to go under water and visit it.

³ Rule 7 states that «Public access to *in situ* underwater cultural heritage shall be promoted, except where underwater cultural heritage access is incompatible with protection and management».



Figure 2. Unesco Exchange day on the future of the 2001 Convention on the Protection of the Underwater Cultural heritage, Paris, May 2013 © Arturo Rey/Unesco.

To the traditional ways of presenting and disseminating underwater cultural heritage and its values *in situ*, can and should thus be added equally valuable forms of access, such as museum exhibitions, documentaries or publications. Moreover, we can add a series of new initiatives that have only developed recently, such as those permitting virtual access. Land-based heritage access thus substantially contributes to valorizing underwater cultural heritage as integral part of the world's heritage.

Due to virtual access leaving an underwater site *in situ* does not mean anymore that it cannot be «visited» by the public. This does not mean, however, that recovery should not be considered any more, but the advance of technology should be taken into account as additional access option.

A potential List of Best Practices within the 2001 Unesco Convention

In May 2013 Unesco organized an exchange day on the future of the 2001 Convention and the management of the underwater cultural heritage, preceding the 4th session of the Meeting of States Parties, highest governing body of the Convention (Fig. 2). During this exchange day, which was attended by the delegations of Member States to Unesco as well as by experts, the need of States to develop means of public education and sensitization concerning the importance and values of the underwater cultural heritage was stressed. In fact, if it is true that the number of countries that are ratifying the 2001 Convention is increasing as it was expected, it is

also true that the level of commitment of States Parties varies from one region to another, and that overall, a lack of public involvement and understanding is yet to be observed.

Taking note of these worrying observations, States Parties to the Convention debated, during the following intergovernmental meeting, on the absence of not only capacities to meet the commitments taken over by them when ratifying the Convention, but also on the need to adopt new management models in which society would be present through a participative management approach and in which responsible public access was enhanced. The States Parties requested to the following meeting of the STAB to propose methods to raise social visibility and inclusion in the management of the underwater cultural heritage, as happens already in different management models of some World Heritage Sites for instance.

The 12 experts that constitute the STAB, the advisory body of the 2001 Convention, immediately discussed this issue in their 4th session, also in May 2013. In fact, among the functions of the STAB counts the provision of assistance in the protection of the underwater cultural heritage to the States Parties, as well as the proposal of standards of means to promote best practices in site protection and management (Article 1 of the Statutes of the STAB).

4th and 5th meeting of the Scientific and Technical Advisory Body

This 4th meeting of the STAB, bearing in mind the remarks of the States, considered the different existing experiences in which the submerged heritage is made accessible and contributing to social understanding. The benefits, that this responsible public access has for the local community, in economical and sustainable development terms (Rey, 2014), were also pointed out.

An especially interesting account was given on a Croatian initiative that involves local island inhabitants in the management of sites. The local community was informed about the importance of the archaeological sites lying off their shores and about their potential for the sustainable development of their region. Local diving centers were then given licenses for diving in the protected heritage-areas or even keys to metal cages covering Roman shipwrecks in return for fees and reports on the situation of the sites or of new discoveries. The public access on one hand and the sustainable development contribution on the other hand resulted in ultimately 80 submerged sites that were protected and preserved *in situ*, and made accessible in direct cooperation with the island inhabitants as well as with 50 local diving centers (Unesco, 2013: 3).

NGOs⁴ accredited to work with the governing bodies of the 2001 Convention related further experiences in the field concerning the establishment of dive trails, educational initiatives and similar activities.

Following the examples of other Unesco Conventions, the STAB proposed to study the possibility of establishing a List of Best Practices for underwater cultural heritage sites regarding public access as one of the key actions to engage more governments and competent authorities to make the «invisible» heritage finally visible. The main aims of this initiative would be the promotion of public awareness and involvement, the appropriate implementation of 2001 Convention and protective national legal framework, the increase of scientific research and capaci-

⁴ These Accredited NGOs are (as for 3 March 2015): Association for the Development of Maritime Archaeology (ADRAMAR), Arkaeos, Society for Historical Archaeology (SHA), Nautical Archaeology Society (NAS), Joint Nautical Archaeology Policy Committee (JNAPC), Institute of Nautical Archaeology (INA), German Society for the Promotion of Underwater Archaeology (DEGUWA), Centre for International Heritage Activities(CIE), Australian Institute for Maritime Archaeology (AIMA), Advisory Council on Underwater Archaeology (ACUA) and the International Committee for Underwater Archaeology (ICUCH).

ty-building, the development of appropriate conservation methodologies and the cooperation among appropriate stakeholders (local, national and international).

Three key factors for the development of the potential list were defined.

The first factor was that of *legislation*: all projects and initiatives towards the conservation and public presentation of underwater cultural heritage could only be viable if an adequate legal framework supported them. In this line, the 2001 Convention provides specific guidelines in its Annex, but it is up to every State Party to promote and implement them in an effective manner.

The second factor was *access*: if a site is easily accessible –either by *in situ* or *ex situ* access– it will not only raise awareness among the general public of the site, but of underwater cultural heritage in general. Public access was defined as the best way to promote underwater cultural heritage and to make sure it is understood as being as important as heritage on land.

The third factor was defined as the need for an *educated public*: if a wider audience becomes aware of underwater cultural heritage, and the many dangers facing it, a sense of «peer pressure» and shared responsibility and ownership will impede the pillaging of submerged sites. In order to heighten the sense of public ownership of underwater heritage, transparency, access and inclusivity must be the main guiding principles when dealing with local communities and the general public, at all times (Unesco, 2013: 3-4).

Protection and preservation of underwater sites comes as a priority before public access, as stated in Article 2 and Rule 7 of the Convention. If any project proposal to make a site accessible could endanger the stability of the site and its environment (and also its values and significance) it should be stopped without reservations. This priority to preservation should however be followed by a discouragement of secrecy. Knowledge of submerged sites, as well as the explanation of any activity directed at it should be made public whenever possible. The next step would then be to involve society in the decision-making process about site management. Only in some specific cases, in which the exposure of a site to the public could threaten its protection, secrecy could be temporarily considered until appropriate protection measures and actions have been put in place.

The STAB, gathered in its following 5th session in Paris in June 2014, continued debating on the issue of the List as an initiative that would potentially achieve major public and governmental involvement with the underwater cultural heritage. Questions debated were among others if best practices should involve only access to *in situ* underwater cultural heritage or should they extend to virtual or museum access and other forms of access, if a best practice example should be limited in time and how implementation should be monitored. The meeting finished with the adoption of Recommendation 3/STAB 5 in which the STAB:

«*Recommends* to consider as Best Practice all initiatives, taken in exemplary manner and in conformity with the Convention, permitting the public at large access to knowledge about the underwater cultural heritage, in particular:

Responsible **non-intrusive access to observe or document *in situ*** underwater cultural heritage, such as provided through dive trails, submarine visits or glass bottom boat visits;

Responsible **public access on land**, such as provided by museums, exhibitions and interpretative trails; and

Access, **such as provided by publications, virtual or digital applications**, websites or other means».



Figure 3. The *Mary Rose* is a sixteenth century Tudor ship, sunk in 1545. It was discovered in 1971 and after 11 years of archaeological work was eventually raised and conserved. Today, a unique museum presents its remains and cargo to the public in Portsmouth (England) while the final stages of conservation are carried out. © Arturo Rey/Unesco.

Responsible public access initiatives

Some existing examples of public access initiatives could possibly be counted in future under best practices, such as those highlighted by the STAB.

The archaeological park established over the sunken Roman city of Baiae and Portus Julius (Italy), where visitors can appreciate the remains of buildings, mosaics and statues through either scuba dives, glass-bottomed boats or snorkeling (Stefanile, 2012), could be mentioned.

Also open underwater archaeological excavations, like at the Roman shipwrecks of Bou Ferrer (Juan/Cibecchini/Miralles, 2013) or Cap del Vol, where engagement with diving clubs and federations show success (Aguilar, 2013), or the underwater museum in the archaeological site of Baiheliang, in China, where some of the oldest hydrological inscriptions, recording 1 200 years of changes in the water level of the Yangtze River can be seen submerged after the construction of the Three Gorges Dam (Ge Xiurun, 2011) could be included.

Museums showing archaeological remains from under water, like the shipwrecks of the *Mary Rose* (Fig. 3) and the *Vasa* (Dobbs, 2011; Olsson, 2011) and the Spanish National Museum for Underwater Archaeology ARQUA (Azuar, 2009) are also important examples of how public access can contribute to sustainable economies as well as to bring the submerged heritage to the community.

Eventually programmes, where the community is taken to the site «without getting wet», are worth mentioning. Initiatives in which the underwater site *in situ* is dried out and visited through guided tours while excavations go on, like the French exploration ship of *La Belle*, sunk in Matagorda Bay in 1686, in the USA (Brusseth/Turner, 2013: 95-105) visited by around 25 000 people, are a way of approaching the heritage and the work of the professionals to the public.

The building of replicas –as the San Juan project⁵ in Spain or the Hermione⁶ project in France–, the controlled displacement of archaeological remains to more accessible locations and the development of virtual visits are also activities that can make the public appreciate and understand the underwater cultural heritage.

Discussion

Other Unesco Best Practices Lists

The establishment of a special designation for best practices in cultural heritage site management is nothing new for Unesco. Whereas a list could certainly expose heritage to new political or touristic pressures not foreseen when dealing with it, lists have shown to be a way of giving visibility to certain sites or practices as well as a means to get policy makers and governments involved in the management and protection of cultural heritage.

The Convention for the Safeguarding of the Intangible Cultural Heritage (adopted in 2003) established for instance a Register of «Best Safeguarding Practices» with a wider perspective of sharing successful experiences in the management and preservation of the living heritage. Different initiatives, programmes and projects are selected for best reflecting the Convention's goals and principles according also to specific criteria⁷. One example activity incorporated to this best practices register is, for instance, the project named «Safeguarding the carillon culture: preservation, transmission, exchange and awareness-raising» in Belgium⁸.

Another list that recognizes the application of best practices is that of the Convention Concerning the Protection of the World Cultural and Natural Heritage (adopted in 1972) or better known as the World Heritage Convention. In 2012, on the occasion of the 40th anniversary of this Convention, the World Heritage Committee requested an initiative of recognition of Best Practices in the management of World Heritage sites⁹. World Heritage properties that had proven to develop innovative and original ways of managing the sites in accordance with the Convention could send their applications to the Committee in order to be registered and recognized. One of the best practices to be recognized by the Committee was the capacity-building programme of the historic city of Vigan, in the Philippines¹⁰.

⁵ The San Juan project, directed by Albaola Foundation, attempts to reconstruct the *San Juan*, a 16th century Basque whaling ship sunk off Red Bay, Canada. Its archaeological remains appear in the current logo of the 2001 Unesco Convention.

⁶ «The Hermione» is a project directed by L'association Hermione-La Fayette resulted in the reconstruction of a replica of the famous ship *L'Hermione* that took La Fayette to take part in the Independence War in the USA, in 1780.

⁷ www.Unesco.org/culture/ich (consulted on 28 February 2015).

⁸ The programme to safeguard carillon culture exists in seventy-six cities and villages of Belgium and in thirty countries worldwide. The primary objectives are to preserve the components of historic carillon culture and to ensure the continuity and sustainable development of carillon music as a living heritage that fosters cultural identity and social cohesion. It was incorporated to the register of Best Safeguarding Practices in 2014.

⁹ www.whc.Unesco.org/en/recognition-of-best-practices/ (consulted on 28 February 2015)

¹⁰ The Historic Town of Vigan in the Philippines was chosen as a best practices example in 2012 for achieving with limited resources, a good integration of the local community in many aspects of the sustainable conservation and management of the property and with an interesting multi-faceted approach to the protection of the site.

In these two registers what is being recognized and included in the list is not just a specific part of the management plan but any initiative, activity or programme that can be defined as successful and sustainable and that contributes to achieve the goals of the Conventions concerned, following specific criteria. Practices, from the inclusion of people in site management, the establishment of innovative policies to the responsible public access and the regulation of tourism, can be recognized within these systems.

How a best practice case is eventually selected? The process through which a best practice is included in these registers (and that presumably would be used in the same way in the case of the underwater cultural heritage) starts with the definition and implementation of the best practice programme and continues with its submission to Unesco Secretariat. A committee of experts and State representatives evaluate these applications – in the case of the 2001 Convention that would be the STAB if not decided otherwise and that would be proposing the registration of the successful practices on the List by the Meeting of States Parties.

By means of a reporting system these practices could then be monitored and have their selection compromised if they cease to meet the criteria.

Public access as part of the management process?

Establishing a list on best practices under the 2001 Convention would be a positive initiative in order to engage society and governments at the same time as getting more visibility and more involvement of stakeholders in the protection of the underwater cultural heritage. But this heritage, its environment and the different actors interacting with it, whereas in general comparable to other cultural expressions on land, need certain management specificities that differ from other archaeological sites.

Non-intrusive public access to underwater archaeological sites, as well as to their interpretation (and the interpretative means and theoretical approaches used by the archaeologists), are necessary in order to give to the society what belongs to it, their heritage. Nevertheless, by creating a specific list on public access initiatives are we not risking shifting political attention to those archaeological sites that present more adequate conditions to become attractive to the public rather than protecting those that are more threatened? Shall we permit classification of best practices for public access when previous activities directed to the site did not observe the rules of the Annex of the Convention? Who monitors the applications of best practices and how?

These and many other questions require some reflection before Unesco engages in establishing an underwater cultural heritage list of best practices of public access. If, on the one hand, a list could be very constructive in terms of social involvement and valorization, on the other hand, it could also be a cause of stress to the archaeological sites as it could lead to threatening their preservation if appropriate commitment and stewardship by archaeologists, heritage managers and competent authorities are not granted in the long term. It is crucial in this sense that archaeologists work hand in hand with cultural managers and competent authorities in the decision making process and establishment of management plans.

On 6 March 2014 the Director-General of Unesco, Irina Bokova, sent a letter to all States Parties to the 2001 Convention requesting them to provide comments and suggestions on the preliminary selection criteria, the procedures to be applied, the role of the Meeting of States Parties and of the STAB in the process as well as on the scope and nature of the information States should provide for any site to be considered. In May 2015, the 5th Meeting of States Parties debated that all best practices should be included in addition to public access following the recommendations of

the 5th meeting of the STAB, and invited States Parties to provide examples demonstrating these. The STAB was requested to work further on criteria for other types of Best Practices. The STAB will evaluate the examples provided by the States Parties¹¹ and will report to the next session of the Meeting of States Parties, scheduled to take place in 2017 at Unesco Headquarters. The STAB also considered, at its 6th meeting, that the Annex to the 2001 Convention should be considered as the main criteria framework to evaluate the examples of Best Practices proposed by the States¹².

Values-led management approach for the underwater cultural heritage

In the last decades there have been two main approaches to cultural heritage management: the conventional approach and the values-led approach. The traditional or conventional management approach has its main focus on the conservation of material culture for the enjoyment of future generations. Public access comes at the end of the management chain and society does not have access to the decision making process. This system is still widely adopted worldwide although the values-led approach, with a more adaptable scope, is gaining greater acceptance due to its capacity to deal with the growing complexities of heritage management. Although the 2001 Unesco Convention provides a blanket protection to all underwater cultural heritage submerged for at least 100 years and therefore States parties shall provide for its protection regardless of its significance, values-led approaches are widely used when approving management plans and prioritizing sites and resources.

The values-led approach is a response to the recognition of the increasing complexity of heritage. This approach evolved specially from the drafting of what is known as the Burra Charter¹³, a set of guidelines for cultural heritage management developed and adapted by ICOMOS Australia since 1979, and further strengthened by the works of James Semple Kerr in 1982 when he published his «Conservation Plan». This movement basically focuses on the values that stakeholders and experts give to the sites, forming an assessment of its significance as the basis for developing management strategies. Relevance is based on the potential significance of archaeological sites for society, who attributes values to heritage (Unesco, 2013b: 24-25).

The submerged heritage is, in most cases, multicultural, involving in its study and management the interests and values of several nations and modern-day societies. A shipwreck sets off from one country, sailing to another, calling at different ports in between loading and unloading its cargo to eventually sinking off the shores of a different one. Cargos and crews were also from different places, bearing with them traces of their cultures, forming a specific and varied onboard society. At the same time, linked to this multiculturalism, the underwater cultural heritage is inserted into the territory. The space is shared with the community that uses it, the natural environment, and the current interaction between them both. This makes the management of cultural resources more and more complex, with more factors to take into account at the same time as close coordination between maritime archaeologists, heritage managers and representatives of the community becomes crucial for its safeguarding.

Most of the cultural heritage management plans are normally summing up elements of both the conventional and the values-led approach, making a clear transition towards a more social participative position, in which the public's views and opinions are part of the decision making process. In the case of the underwater cultural heritage very few countries have developed this approach (i.e. English Heritage or the Dutch Agency for Cultural Heritage). Most of the

¹¹ Resolution 4 of the 5th Session of the Meeting of the States Parties to the 2001 Unesco Convention.

¹² Resolution 5 of the 6th Meeting of the Scientific and Technical Advisory Body to the 2001 Unesco Convention.

¹³ For more information on the Burra Charter and on its latest updates: <http://australia.icomos.org/publications/charters/>.



Figure 4. Fishermen from Terra Bomba, Cartagena de Indias (Colombia) helping evaluating the underwater cultural heritage of the community © Fundación Terra Firme.

States Parties to the 2001 Convention have conventional approaches to the management systems of their underwater cultural heritage, which marks a big gap with those systems applied to their cultural sites on land.

In 2006 the Ministry of Culture of Colombia financed a programme of awareness rising in Tierra Bomba Island, Cartagena de Indias. This area was selected due to its big underwater archaeological record and the big existing gap between the local communities, who understood this heritage as a resource of commercial benefit, and the authorities, who wanted to put in place different protective management systems. This initiative, directed by Erigaie Foundation, Terra Firme Foundation and the National Museum, established participative plans where all concerned social actors, governmental representatives and academic experts participated in a horizontal way (Fig. 4). This helped establishing an understanding of the heritage values within the community, where the different local actors had an important role in decision making. They were active subjects of the management, proposing and defending plans seeking not only the preservation of their heritage but also the benefit of the community. The management plan was designed from the community itself.

In this example, the community of Tierra Bomba went beyond the definition of underwater cultural heritage and started valorizing other cultural elements associated to it as their traditional fishing techniques, their navigation knowledge, their traditional naval construction, or their coastal environment. They started seeing the maritime landscape as a whole, with cultural and natural heritage understood as an integral part of their daily life, without margins between land and sea (Cairo/García, 2010: 4).

Placing the public access at the end of the management chain would certainly give visibility to the underwater cultural heritage, but make social appropriation of the heritage as well as sustainability difficult. If, on the contrary, values are identified when managers and archaeologists evaluate the site, with the participation of different social actors, the management plan will find stronger acceptance as we have seen in the example of Tierra Bomba.

Underwater cultural heritage sites should not be understood as pieces of museum's collections, but rather as a part of environmental and cultural contexts. They cannot be protected in isolation from land-use planning considerations or from the concerns of the communities that, even indirectly, may have a link to it.

Public access, which is a result and a cause of the major visibility given to the submerged heritage, should pass from being an isolated step designed at the end of a conventional management system, to be a component of the whole planning process. The «access» has to be understood as the approach to the knowledge, to the evaluation assessment of the site, to its needs and threats, to the actions taken to study it and protect it and to the results obtained in research activities directed to it¹⁴.

A best practices list within the framework of the 2001 Convention focusing on public access should evaluate the inclusion of the social component and the sustainability of public participation in the potential programme, initiative or activity submitted by the States Parties. A monitoring and reporting system should be also established with the contribution of competent authorities and all stakeholders.

Concluding remarks

Unesco and its partners can substantially contribute to guiding States in establishing policies in accordance with the 2001 Convention at the same time as setting up the mechanisms that allow stakeholders and concerned local actors to shape the management system and public use of their underwater cultural heritage. Enhancing public access is a major challenge to get underwater cultural heritage recognized and appreciated.

Although there are still many more considerations to be debated among the governing bodies of the 2001 Convention before a list of best practices could be established, a values-led management approach, sustainability and public involvement should be three important axes to evaluate possible recognition of best practices for the management of the underwater cultural heritage. Preservation of the underwater cultural heritage should always be a priority which is not only a moral obligation, but also an economic and a public factor.

As the ratification rate of the 2001 Convention increases, we need to stronger focus on also fostering its implementation and make submerged heritage «visible» to the society. We, as archaeologists and cultural professionals, need to look more and more to society as a starting point and final addressee of our actions on the heritage, since underwater cultural heritage is all about society, whether it is one of the past, present or future. Best practices should be understood generally as «all types of activities, projects, programmes or management initiatives within the framework of the 2001 Convention that promote the inventory, scientific study, preservation and public access of the UCH, establishing a participative and inclusive approach with different stakeholders».

¹⁴ Rule 17, 35 and 36 of the Annex to the 2001 Convention already states the need to disseminate and to make public as soon as possible project proposals, management plan and results of any activities directed to the underwater cultural heritage.

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Is the 2001 Unesco Convention on the Protection of the Underwater Cultural Heritage effective?

La Convención de la Unesco de 2001 sobre la Protección del Patrimonio Cultural Subacuático ¿es efectiva?

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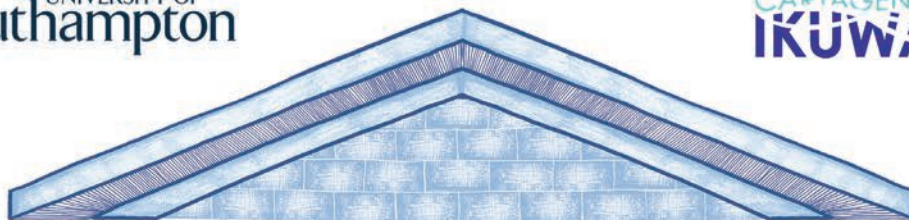
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Abstract: The analyses of the 2001 Unesco Convention for the Protection of Underwater Cultural Heritage to date have been from a purely legal perspective and have invariably used a «top down» approach, studying the wording of the convention itself, the negotiating process behind it, and its relationship to other international laws. This study takes a «bottom up» approach, identifying how it affects the work of archaeologists and the underwater cultural heritage itself. In order to achieve this, the legislation and regulations produced by ratifying states to implement the Convention are being collected and analysed. The procedures they create will be assessed through the examination of case studies and the use of questionnaires, and improved ways to implement the Convention will be suggested based on the findings.

Key words: Unesco, Underwater cultural heritage, International law, heritage protection.

Resumen: los análisis de la Convención Unesco del 2001 sobre la Protección del Patrimonio Cultural Subacuático han sido hechos únicamente desde la perspectiva legal y de manera invariable han sido abordados «de arriba hacia abajo», estudiando la redacción, los procesos de negociación que están detrás, y su relación con otras leyes internacionales. Este estudio propone una aproximación «de abajo hacia arriba», para ver cómo afecta a los arqueólogos y al patrimonio cultural sumergido en sí. Para poder lograr esto, la legislación y las regulaciones de los países participantes que constituyen la Convención están siendo reunidas y analizadas. Serán evaluados los procedimientos que han creado a través del examen de los estudios de cada caso y la implementación de sus cuestionarios, asimismo serán sugeridos procedimientos para un mejor desarrollo de la Convención basado en los hallazgos.

Palabras claves: Unesco, Patrimonio Cultural Subacuático, derecho internacional, protección del patrimonio.



Is the 2001 UNESCO Convention on the Protection of the Underwater Cultural Heritage effective?

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INTRODUCTION

The 2001 UNESCO Convention on the Protection of the Underwater Cultural Heritage came into force in 2009. In the 5 years since then it has gathered momentum, with 48 States having now ratified or accepted it.

However, to date there has been neither an overarching study of how the Convention is being implemented by its States Parties, nor any indication of whether the mechanisms created internationally or domestically as a result of the Convention are succeeding in protecting underwater cultural heritage (UCH).

It is therefore necessary to ask, 'Is the Convention effective?', and to construct an answer that both demonstrates how the Convention is being implemented, and determines whether it is causing improved protection of UCH.

WHAT DO WE MEAN BY EFFECTIVE?

To determine whether the Convention is effective, we need to be clear on what exactly 'effective' means. In fact three different concepts of 'effectiveness' will be used to help measure the impact the Convention is having. Each concept serves as a starting point for analysing the succeeding one.



Figure 1: The Convention currently has 48 States Parties, shown here in red.

EXPECTED OUTCOMES

At the end of the study we should be able to answer the following questions:

- To what extent, and in what ways, is the Convention being implemented?
- What parts of the Convention, and more specifically, which precise methods of implementation are causing behavioural changes in relevant actors?
- What behavioural changes are leading to better protection of the UCH?

From these it should be possible to suggest guidelines to implementation based on the most effective implementation methods observed, helping new (and old) ratifying States to better protect underwater cultural heritage.

Legal Approach

Are the Convention's obligations being met and relevant programs initiated?

This is a measure of the Convention's implementation and can be investigated by looking for a number of indicators whose presence or absence will demonstrate the level of compliance with the Convention in each State Party.

However, widespread compliance with the Convention's obligations does not mean that the Convention is achieving its aims. Conversely even low compliance with the Convention does not preclude the possibility that it has encouraged activities which help solve the problems facing UCH. So we need to look further than just this rather cursory legal method.

Behavioural Approach

Is the Convention causing changes in the relevant behaviour of relevant actors?

If the Convention and its implementing measures succeed in changing the behaviour of certain actors (maritime archaeologists, conservators, heritage managers and 'commercial' maritime archaeologists) it will be behaviourally effective. This can be investigated through qualitative surveys and interviews of these actors.

It is essential to determine whether any behaviour has changed, and to show a causal connection between this change and the Convention. But even if the Convention has caused changes in behaviour, we also need to know whether these changes benefit UCH.

Purposive Approach

Is the Convention eliminating or alleviating the problems that prompted its creation?

This is what this study must ultimately attempt to discern. It is difficult to do this directly as it would be almost impossible to get the relevant data about the actual condition of UCH, and it would also be difficult to ascribe any changes to the functioning of the Convention, making this approach difficult to meaningfully apply.

But, through looking at the Convention's levels of compliance, and whether we think any changes in behaviour it causes are positive or negative for UCH, we may be able to begin to tell whether the Convention is solving the problems it was created to solve.

HOW CAN YOU HELP?

I would love to hear your thoughts on the Convention. Has it changed archaeological practice in your State? How is it impacting your job? Is the underwater cultural heritage now better protected? Please e-mail, tweet or talk to me!



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GESTIÓN Y PROTECCIÓN *IN SITU*

MANAGEMENT AND *IN SITU* PROTECTION

La tutela del patrimonio arqueológico subacuático en Andalucía

The guardianship of underwater archeological heritage in Andalusia

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Resumen: el Centro de Arqueología Subacuática de Andalucía abrió sus puertas en el año 1997 ante la necesidad de proceder a una correcta gestión y tutela del Patrimonio Arqueológico Subacuático de Andalucía, planteándose como objetivo prioritario su protección. Consciente de que la protección de este patrimonio pasaba por tener un conocimiento global del mismo, optó por centrar sus esfuerzos en la ejecución de un proyecto de Carta Arqueológica que permitiera establecer medidas concretas de protección y conservación, así como el diseño de estrategias de investigación. Los resultados obtenidos han permitido alcanzar diversos objetivos: garantizar la protección jurídica de estos espacios; minimizar el posible impacto que, los distintos proyectos que se pretendan desarrollar en áreas subacuáticas determinadas, puedan ocasionar sobre el Patrimonio Arqueológico Subacuático favoreciendo la cooperación entre las distintas administraciones implicadas; establecer medidas para luchar contra el expolio; y desarrollar proyectos de investigación y difundir sus resultados.

Palabras clave: patrimonio arqueológico subacuático, carta arqueológica, protección, investigación, difusión.

Abstract: The Underwater Archaeology Centre of Andalusia opened in 1997 due to the need to correctly manage and preserve the Underwater Archaeological Heritage of Andalusia, the main goal set was its protection. Aware that the protection of this heritage necessarily involved global knowledge thereof, the Centre decided to focus all its efforts on executing a base project, an Archaeological Map project, a tool that would enable the establishing of specific protection and preservation mechanisms and the design of research strategies. The results obtained have en-

abled the achievement of several objectives: guaranteeing the legal protection of these spaces; minimizing the potential impact that the various projects that intend to develop in certain underwater areas, can cause on Underwater Archaeological Heritage fostering cooperation between the various authorities involved; establish measures to combat the looting; and drawing up projects and disseminated their results.

Key words: Underwater archaeological heritage, archaeological map, protection, research, dissemination.

Andalucía, localizada en la zona más meridional de la península ibérica, es una comunidad autónoma española que cuenta con unos 1 100 km de costa repartida entre el litoral atlántico y el mediterráneo, a la que deben sumarse las aguas continentales (ríos, lagos...). Esta circunstancia, unida a su estratégica situación geográfica, al papel hegemónico detentado por España durante amplios periodos de su Historia moderna, generó un intenso tráfico marítimo no exento de avatares, lo que dio lugar a que se produjeran numerosos naufragios. Estas condiciones han dado lugar a que, en la actualidad, dispongamos de un importante patrimonio arqueológico subacuático que debe ser protegido y conservado.

Ante la necesidad de establecer los mecanismos necesarios que permitieran proceder a una correcta tutela de este patrimonio localizado en estas aguas, la Consejería de Cultura de la Junta de Andalucía se planteó la necesidad de crear un centro especializado. Nació así, en el año 1997, el Centro de Arqueología Subacuática de Andalucía (CAS), que se integró como un centro especializado de la Consejería de Cultura en el Instituto Andaluz del Patrimonio Histórico (IAPH), concretamente en su sede de Cádiz, en el edificio del Balneario de la Palma y el Real.



Figura 1. Localización de Andalucía en España.

Los objetivos con los que se creó el Centro van encaminados a la investigación, protección, conservación y difusión del Patrimonio Arqueológico Subacuático (PAS) de la Comunidad Autónoma de Andalucía, así como a la formación de profesionales en esta disciplina.

Desde su apertura uno de los propósitos principales que perseguía era la protección de este patrimonio. Sin embargo, se fue consciente de que se partía de una realidad negativa: el escaso conocimiento que se tenía del mismo lo que evidenciaba la dificultad de proteger aquello que se desconoce. Por ello se optó, tomando como base las recomendaciones establecidas por los organismos encargados de la protección del patrimonio arqueológico en general y del subacuático en particular, por centrar los esfuerzos en un proyecto de base –Proyecto de Carta Arqueológica–, encaminado a la localización, identificación y evaluación de los yacimientos localizados en aguas andaluzas, analizando los factores de riesgo que inciden o puedan incidir, en un futuro, en su conservación.

El objetivo global era elaborar un catálogo de yacimientos lo más exhaustivo posible, que se integrase en las diferentes bases de datos y Sistemas de Gestión del Patrimonio Cultural que, a lo largo del tiempo, se han generado en Andalucía: Arqueos, Sipa y en la actualidad el Sistema de Gestión del Patrimonio Histórico de Andalucía (Mosaico). No se debe olvidar que estas herramientas básicas de gestión permiten establecer medidas concretas de protección y conservación del PAS, además de convertirse en una base indispensable tanto para la programación racional de futuras actuaciones arqueológicas como para el diseño de estrategias de investigación como se podrá comprobar en las siguientes páginas (García/Alzaga, 2012: 257-274).

Los resultados obtenidos con este proyecto de actualización del inventario arqueológico han permitido, en los últimos años, alcanzar algunos de los objetivos con los que se había planteado la Carta Arqueológica Subacuática:

- Se tiene conocimiento de la existencia, en aguas andaluzas, de 90 yacimientos arqueológicos, con una cronología que abarca desde la Protohistoria hasta la Edad Moderna y Contemporánea. De la misma forma, se han analizado diversas fuentes documentales, labor que ha proporcionado los datos necesarios para tener constancia de la existencia de unos 1039 naufragios históricos en aguas andaluzas. Esta información documental se ha volcado en una base de datos denominada DOCUSUB la cual, puesta en relación con otros parámetros, ha formado parte del Sistema de Información Geográfica, SIGNauta, que se encuentra compuesto por seis subsistemas: la documentación histórica sobre naufragios, información oral sobre posibles pecios, siniestros marítimos, obra pública, ordenamiento jurídico administrativo y medio físico, dentro del cual se incluye la cartografía histórica (Alonso *et alii*, 2007: 26-41).
- Desde el punto de vista de la protección se ha trabajado en la salvaguarda de estos yacimientos ante la ejecución de actividades legítimas tal y como establece la Convención para la protección del patrimonio cultural subacuático promulgada por la Unesco en el año 2001 y ratificada por España en el año 2005. Para ello se ha procedido a dotar al patrimonio arqueológico del máximo nivel de protección jurídica mediante la inscripción en el Catálogo General del Patrimonio Histórico, con la categoría de Bien de Interés Cultural, de 56 Zonas Arqueológicas Subacuáticas¹ y la declaración de 42 Zonas de Servidumbre Arqueológica² (García/Alzaga, 2008: 129-143).

¹ Zona Arqueológica: espacios en los que se conoce la existencia de restos arqueológicos de interés relevante.

² Zona de Servidumbre Arqueológica: espacio en el que se presupone (gracias a información documental, hallazgos casuales...) la existencia de estos restos pero se desconoce su ubicación exacta.

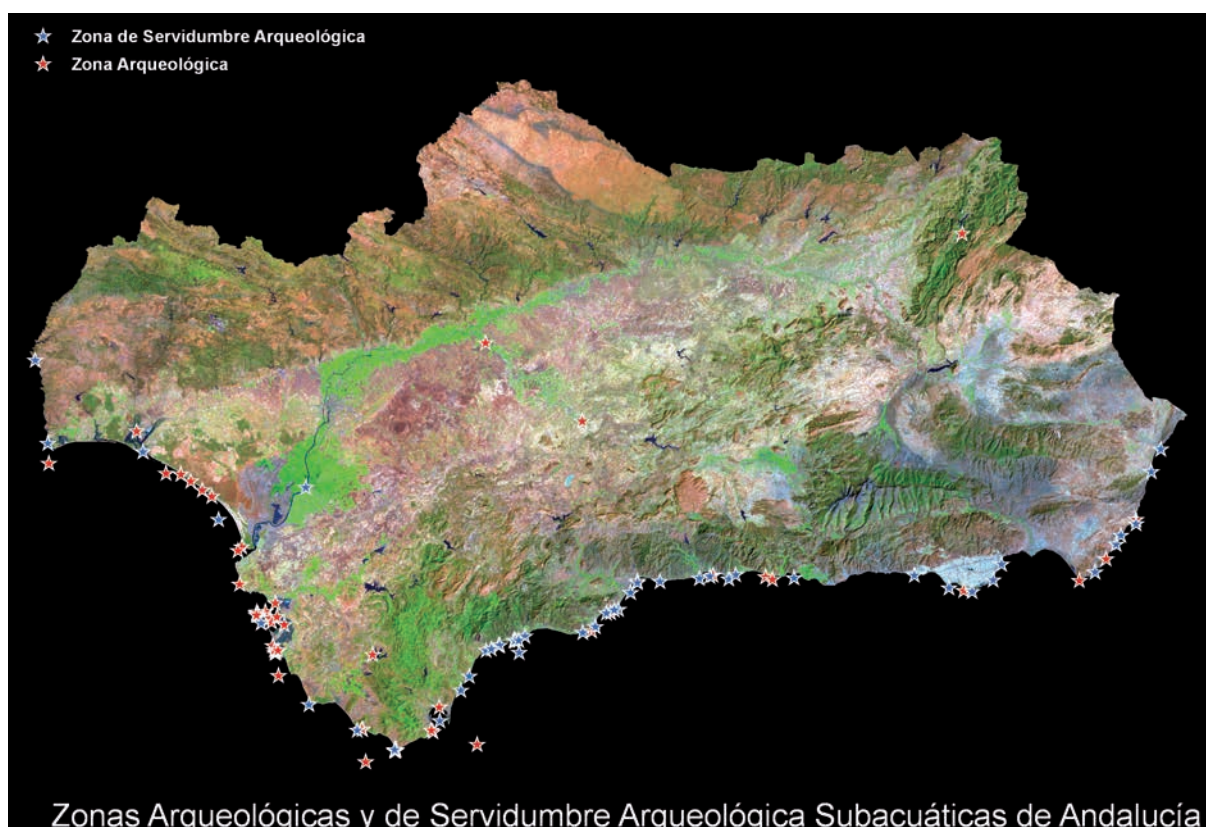


Figura 2. Distribución general de Zonas Arqueológicas y Zonas de Servidumbre Arqueológica (Dirección General de Bienes Culturales e Instituciones Museísticas).

Este nivel de protección garantiza que cualquier proyecto de obras en el medio acuático deba ser, conforme a la Ley, previamente autorizado por la Administración competente en materia de cultura. Entre estas obras nos referimos a: construcción de gaseoductos, parques eólicos marítimos, creación de nuevos puertos deportivos, regeneraciones de playas, etc., o grandes transformaciones portuarias efectuadas en las dos últimas décadas las cuales han conllevado el desarrollo de proyectos que han supuesto la ampliación de canales de navegación, ejecución de dragados, construcciones de diques, muelles o terminales de contenedores.

La importancia de este nivel de protección radica en que estas obras plantean actividades concretas –dragados, cimentaciones, rellenos, vertidos, etc.–, que conllevan elementos generadores de impacto como movimiento de tierras o alteraciones en los sustratos. Estos impactos a su vez provocan distintos grados de afección sobre los bienes arqueológicos pudiendo causar la distorsión perceptual de los mismos al ocultar o imposibilitar el acceso a los bienes, su alteración parcial e incluso su destrucción.

En Andalucía, el proceso de control de estas obras de infraestructura comenzó en el año 1982 momento en el que, en la ciudad de Cádiz, se controló el relleno de la Punta de San Felipe. Sin embargo, estas primeras acciones se trataban de una mera recuperación de bienes arqueológicos, por lo que esta protección establecida y el desarrollo de la Carta Arqueológica ha ayudado al avance de los procedimientos preventivos, de tal forma que en la actualidad, siguiendo la legislación vigente, las distintas administraciones e instituciones trabajan conjuntamente para desarrollar los proyectos de obra de tal forma que su ejecución y desarrollo no repercutan de forma negativa en el patrimonio natural y cultural. Para ello, y tras el análisis particular de cada

uno de los proyectos, se procede al establecimiento, siempre que se considere necesario, de las cautelas arqueológicas oportunas, con objeto de minimizar el posible impacto que se pueda producir: prospecciones geofísicas, comprobación de anomalías detectadas, prospecciones por medio de arqueólogos-buceadores, realización de una red de sondeos arqueológicos distribuidos a modo de retículas, controles arqueológicos de los movimientos de tierra, etc. (Martí, 1994: 117-132; Alzaga/García, 2013: 1040-1052).

El establecimiento de cautelas, por lo tanto, puede llevarse a cabo tanto por el conocimiento adquirido sobre un patrimonio arqueológico real, como por la información que se posee sobre un patrimonio potencial proporcionado por las fuentes documentales consultadas.

Por otro lado, en los últimos años la creciente explotación comercial del patrimonio arqueológico subacuático y la disponibilidad de tecnología punta que ha facilitado el acceso al mismo, ha generado un aumento de actividades ilícitas que tienen por objetivo la venta, la adquisición o el trueque de este patrimonio.

La actuación anteriormente señalada, la protección jurídica, supone un paso importante. No se debe olvidar que, por sí misma, no comporta una protección total del bien patrimonial por lo que esta medida debe ser complementada con diversas acciones enmarcadas dentro de las recomendaciones establecidas en la Convención para la Protección del Patrimonio Cultural Subacuático.

Para ello se han centrado los esfuerzos en:

- Impulsar la política de formación dirigida a las Fuerzas y Cuerpos de Seguridad del Estado, que tuvo sus inicios en el año 2001, y cuyos resultados se pueden traducir en diversas actuaciones policiales encaminadas a la protección del patrimonio arqueológico subacuático, entre las cuales se puede destacar la conocida como Operación Géminis.
- Efectuar visitas de inspección a yacimientos para detectar evidencias de expolio. Hay que señalar que, en la mayoría de las ocasiones, estas visitas se realizan ante la notificación por parte de particulares (profesionales de esta disciplina, buceadores, pescadores...) de posibles acciones de expolio en una zona concreta y que, en ocasiones, se han llevado a cabo en colaboración con los Grupos Especiales de Actividades Subacuáticas de la Guardia Civil.
- Llevar a cabo campañas de alerta SOS con las que se solicitaba la participación ciudadana en la defensa de un patrimonio que nos pertenece a todos. La campaña de sensibilización forma parte del proyecto Archeomed, en el que además de España participaron otros países como Italia, Francia, Portugal, Malta, Marruecos y Argelia. Con esta iniciativa comunitaria Interreg IIIB MEDOCC se pretendía impulsar y desarrollar acciones encaminadas al estudio y valoración del patrimonio cultural marítimo común en los países ribereños del Mediterráneo. Entre las acciones enmarcadas dentro del proyecto se encontraba el establecimiento de los mecanismos necesarios para lograr concienciar a los ciudadanos de la fragilidad del patrimonio subacuático, un patrimonio por desgracia sometido al grave problema del expolio y la destrucción, por lo que se consideraba indispensable la colaboración ciudadana encaminada a paliar este grave problema, bien alertando a las autoridades competentes ante la realización de un hallazgo casual (para lo que se recomienda no remover los restos o bienes hallados y comunicarlo de forma inmediata), o aportando información que consideren de interés para la protección de estos bienes. A nivel nacional, en el desarrollo de esta campaña contó con la participación del Ministerio de Cultura y las Comunidades Autónomas de Cataluña, Andalucía y la Comunidad Valenciana.
- Incrementar, en el marco del Plan Nacional de Protección del Patrimonio Cultural Subacuático, las medidas de control y vigilancia de estos espacios a través de la incorporación de los mismos en el Sistema Integral de Vigilancia Exterior (SIVE).

El SIVE es un sistema operativo que, sobre un soporte técnico, aporta la información obtenida en tiempo real a un Centro de Control que imparte las órdenes necesarias para la interceptación de cualquier elemento que se aproxime al territorio nacional desde el mar.

Otro de los objetivos que se quería conseguir con el Proyecto de Carta Arqueológica era avanzar en la investigación por medio de la ejecución de proyectos conforme a las recomendaciones recogidas en el anexo de la Convención para la Protección del Patrimonio Cultural Sumergido. Así, entre los proyectos acometidos desde el Instituto Andaluz del Patrimonio Histórico por medio de su Centro de Arqueología Subacuática son de destacar:

- Proyecto Trafalgar: El 21 de octubre de 1805 frente al cabo de Trafalgar se enfrentaron, en el marco de las guerras napoleónicas, la flota inglesa y la combinada franco-española. El combate naval se saldó con la victoria inglesa y con el naufragio de 15 navíos perteneciente a la escuadra combinada.

El proyecto se planteó con el objetivo de localizar y estudiar los restos de estos navíos, obteniéndose datos, tanto documentales como arqueológicos, que permiten adscribir los yacimientos de Chapitel y Camposoto con los restos de los navíos *Bucentaure* y *Fougueux* respectivamente (Gallardo/Márquez, 2005: 86-92; Rodríguez/Rieth/Lacoste, 2010: 94-107; Rodríguez/Alzaga/Márquez, 2013: 593-601; Rodríguez *et alii*, 2013: 575-592).



Figura 3. Fotomosaico Pecio de Camposoto (Fondo gráfico IAPH).

- Proyecto de urgencia Matagrana: estudio de los restos de un navío que, tras fuertes temporales, quedaron al descubierto en la playa de Matagrana (Huelva).

Tras los estudios llevados a cabo se pudo constatar que los restos hallados se correspondían con los de un mercante cuyas pautas de construcción responden a modelos de tradición inglesa de la segunda mitad del siglo XVII a principios del siglo XVIII (Rodríguez/Izaguirre/Rieth 2013: 610-626).



Figura 4. Pecio de Matagrana (Fondo gráfico IAPH).

- Proyecto Libs: proyecto de colaboración, liderado por el Laboratorio Láser del Departamento de Química Analítica de la Universidad de Málaga, plantea el diseño y adaptación de un sistema transportable y sumergible que, por medio de la espectrometría de plasmas inducida por láser (LIBS), permita la identificación química *in situ* de materiales arqueológicos subacuáticos sin necesidad de extraerlos a la superficie y con un impacto mínimo sobre el bien patrimonial. Es un Proyecto de Excelencia subvencionado por la Consejería de Economía, Innovación y Ciencia de la Junta de Andalucía (Guirado/Fortes/Laserna, 2015: 182-188).
- Proyecto Delta: las cautelas arqueológicas establecidas para el proyecto de construcción de la Nueva Terminal de Contenedores de Cádiz han hecho posible la localización de los restos de tres navíos.

Este proyecto, en colaboración con la empresa arqueológica adjudicataria de la obra Tanit Gestión Arqueológica, ha permitido documentar, hasta el momento, los restos de dos de estos pecios –a los que se han denominado Delta I y Delta II–, adscribibles cronológicamente a los siglos XVII y XVI respectivamente (Higueras-Milena/Gallardo/Ruiz, 2013: 256-266).

- Igualmente se ha considerado indispensable investigar sobre las causas de degradación de los materiales arqueológicos subacuáticos, llevándose a cabo proyectos tanto en los propios yacimientos –con el desarrollo de un sistema de desconcreción puntual y controlada en objetos de hierro sumergidos sin necesidad de su extracción–, como en el laboratorio.

En este último caso, se han ejecutado actuaciones encaminadas a la estabilización de materiales arqueológicos de procedencia subacuática, como ha sido el caso de los tratamientos necesarios para la estabilización de madera arqueológica por medio de la plastinación de la misma, proyecto que se llevó a cabo junto con el Departamento de Anatomía y Embriología Humana de la Facultad de Medicina de Cádiz. Su objetivo se centraba en lograr sustituir el agua del interior de las maderas de procedencia subacuática por aceite de silicona. Este sistema ha sido aplicado con éxito sobre maderas de época romana procedentes de una excavación realizada en la ciudad de Huelva, así como sobre materiales orgánicos procedentes de los sondeos arqueológicos realizados en los yacimientos localizados en el transcurso del Proyecto Trafalgar (Bouzas/Castro/Zambrano, 2008: 108-119).



Figura 5. Plastinación zapato Pecio de Camposoto (Fondo gráfico IAPH).



Figura 6. Curso de fotografía subacuática (Fondo gráfico IAPH).

Todos estos trabajos se han ido mostrando a la sociedad a través de un programa de transferencia y difusión favoreciendo actitudes de participación en su defensa y disfrute a través de:

- Exposiciones temporales como «Los Naufragios de Trafalgar», «Historias bajo el mar» o «La restauración de las cerámicas de la Ballenera».
- Conferencias a distintos niveles.
- Productos didácticos creados con el fin último de dar a conocer a la sociedad esta disciplina científica, entre los cuales se pueden destacar el cuaderno *Matarile* o el proyecto «Sumérgete en la arqueología subacuática» que, mediante la visita virtual a un centro de arqueología subacuática, muestra la metodología y técnicas empleadas para localizar, identificar, conservar, proteger y difundir el patrimonio histórico localizado bajo las aguas. En ambos casos, se trata de productos ideados desde el Centro de Arqueología Subacuática y que pudieron ver la luz gracias a la financiación de la Fundación Española para la Ciencia y la Tecnología (Ministerio de Ciencia e Innovación).
- Talleres y visitas guiadas al Centro de Arqueología Subacuática³.
- Publicaciones.

Finalmente, no debe olvidarse que en la actualidad es de vital importancia garantizar la formación técnica y científica de los profesionales de esta disciplina. En este sentido, desde el Instituto Andaluz del Patrimonio Histórico se trabaja anualmente en la preparación de una

³ <http://www.iaph.es/web/canales/arqueologia-subacuatica/sumergete/> [Acceso: 15-01-2015].

oferta formativa de calidad que, entre otros aspectos, contempla el patrimonio arqueológico subacuático tratando que, en la gran mayoría de los casos, los cursos cuenten con un componente eminentemente práctico. De esta forma, se han impartido cursos sobre Arquitectura naval; prospección arqueológica subacuática; técnicas de dibujo arqueológico subacuático; fotografía subacuática; conservación y restauración de patrimonio arqueológico subacuático; estabilización de materiales orgánicos de procedencia subacuática mediante impregnación con polisiloxanos, etc.

En definitiva, no se debe olvidar que la gestión integral de este frágil patrimonio se convierte en un elemento indispensable para su adecuada y correcta preservación, englobando siempre las medidas adecuadas de protección, investigación, conservación, formación y difusión a distintos niveles.

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«Sailing heavy weather». Underwater Cultural Heritage Management in Italy

«Navegando con mal tiempo». Gestión del Patrimonio Cultural Subacuático en Italia

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Abstract: Underwater cultural heritage management in Italy, as the overall cultural heritage management, despite of the creation and development of several large-scale projects, is in a stuck situation since several decades. Political incapacity to identify a systematic and long term program, bureaucratic difficulties and legislative black-outs, on various levels and sectors (institutional, academic, private), make it difficult to plan and organize long term and far-sighting activities and lastly, the chaotic structuring of the management discipline hinders a necessary collaboration between stakeholders. National and local Ministerial Institutions, Universities, Private organizations and enterprises as well as the communities appear sometimes unconnected and in contrasting positions. Contrary, a complex and *longue durée* activity, as cultural heritage management should be, needs programming, systemic approach, cooperation and sharing.

Key words: Management of Italian underwater cultural heritage, Italy, cooperation, Ministry of Culture, University.

Resumen: la gestión del patrimonio cultural subacuático en Italia, así como la gestión general del patrimonio cultural, a pesar de la creación y del desarrollo de varios proyectos de gran envergadura, se encuentra en una situación atascada desde hace varias décadas. La incapacidad política para identificar un programa sistemático y de largo plazo, las dificultades burocráticas y legislativas, en los distintos niveles y sectores (institucional, académico, privado), hacen que sea difícil planificar y organizar las actividades a largo plazo y ya definitivamente, la estructuración caótica de la disciplina de gestión dificulta una necesaria colaboración entre las partes interesadas. Instituciones nacionales y locales, universidades, organizaciones y empresas privadas, así

como las Comunidades, a veces aparecen desconectadas y en posiciones contrarias. Contrariamente, una actividad compleja y de *longue durée*, como la gestión del patrimonio cultural, necesita de programación, enfoque sistémico y cooperación.

Palabras clave: gestión del patrimonio cultural subacuático, Italia, cooperación, Ministerio de Cultura, universidad.

Introduction

At the dusk of the twentieth century, Piero Alfredo Gianfrotta (1998a; 1998b) offered a sharp and close examination of Italian underwater archaeology in the twenty years that followed the death of Nino Lamboglia (recognized as the father of the discipline in Italy) in 1977. The present examination starts from that analysis, though time has passed and some situations have changed. In fact we stress, as Gianfrotta did almost twenty years ago, that Lamboglia's teaching and legacy should be kept and constantly re-evaluated and that, following Lamboglia's footprints, the Italian discipline should restart and get a new outburst, in order to be aligned with the good experiences and practices now being produced and followed in several countries.

Italian underwater archaeology is today sailing heavy weather, and the bearings to uncover the due course should be searched for in the wit and model of the man who, over half a century ago, marked the path for a new born discipline with the optimism and stable intents that allowed him to apply difficult choices; as an example, his decision to stop the *Artiglio's* bucket on the Roman shipwreck off Albenga stigmatizing the tremendous results of the «salvage frenzy» taking over on the «best intentions» of the commercial salvage firm SORIMA (Pallarés, 1997-1998). In this situation, while the media were attacking archaeologists for not recovering the whole cargo of amphoras, archaeologists kept standing in defense of their possibly unpopular but absolutely scientifically sound decision.

This consideration does not want to be a simple nostalgia for a lost Golden Age, but the starting point of a reflection on the present situation. Today, paradoxically, in a more favorable context, with an increasing number of well-trained and professional archaeologists able to dive and work underwater, with the improvements and with the advantages put forward by technological innovations, the Italian underwater archaeology system appears to have lost its original frame of mind. Although situations like the one in Albenga do not happen nowadays, the feeling is that underwater cultural heritage management (as overall cultural heritage management in Italy), needs to be rethought over a more systematic imprint and with a major focus on cooperation and collaboration.

Historical Background

The first experiences in Italian underwater archaeology were produced with Spain and France. Their shores and their coastal waters represented, for many years, the prominent proscenium for the experimentation of methodological aspects for the new born discipline. Simultaneously to the advancements produced in the eastern Mediterranean by George F. Bass, the western Mediterranean witnessed –thanks to the commitment of scholars like Nino Lamboglia and Fernand Benoit– the application of advanced techniques and stratigraphic methods in the underwater environment (Pallarés, 1997-1998).

A crucial turning point in Italy, as Gianfrotta correctly highlighted (1998a; 1998b), was represented by the finding and recovery of the Riace Bronzes and the ensuing «fever» for new

and sensational discoveries. The search for glaring discoveries, by «advocational» and –even more blameable– by certain «practitioners», brought to a sensationalistic drift of underwater archaeology laying the foundations, we agree, for a deranged «discontinuity» (Gianfrotta, 1998a: 2; 1998b: 2-9), taking Gianfrotta –once again– to affirm how «it needs to be specified that in Italy no shipwreck exists that has been fully excavated; following two excavation seasons, the works stop jumping to other rather promising locations» (authors' translation). Fortunately, the active commitment to the drafting phase, and then the adoption and ensuing ratification (see below) of the 2001 Unesco Convention for the Protection of the Underwater Cultural Heritage (hereafter 2001 Unesco Convention; see Secci, 2011) in Italy, has strongly mitigated such sensationalistic drift.

The reasons for a stalemate

From the National Workshop in Underwater Archaeology held in 1996 at the Certosa di Pontignano, Siena (Volpe, 1998, see particularly the introduction and the roundtable), comes out a picture of Italian underwater archaeology not far apart from today's situation. Workshop participants highlighted for the first time and in a clear manner the issues related to the management framework and those strictly related with a lack of academic training for new generations of underwater archaeologists, which appears still evident nowadays.

From an administrative point of view, the framework of the Ministry for Cultural Heritage and Activities and (now) Tourism (MiBACT), particularly for underwater archaeology, after the decline and closing of the Servizio Tecnico per l'Archeologia Subacquea (STAS; see Volpe *et alii*, 2014) –a ministerial central body for expert advice in the field (son of the fever that followed the discovery of the Riace Bronzes)– appears highly fragmented and lacking a series of officially shared and accepted protocols and guidelines, following the examples of the Unesco Manual for Activities directed at Underwater Cultural Heritage (Maarleveld/Guérin/Egger, 2013), for the moment only available in English and French, or the Spanish Libro Verde (AA.VV., 2010); something similar, but also considering the specific legislative contexts of Italy, should be prepared in a quick time, in order to allow an unvarying development of the discipline on the whole Italian territory.

In spite of a very long legislative tradition on the protection of cultural heritage, with the first law enacted in 1939 –very innovative for that time, and widely considered as one of the best in the world–, the problematic Italian legislative apparatus, often deemed odd and «Byzantine», participates in creating difficulties to the sound and flowing management of underwater cultural heritage. The continuous modifications occurred to the Law 42/2004 *Codice dei Beni Culturali e del Paesaggio* (hereafter Codice) since its entry into force in 2004, are but one example. As well as the political contradictions of a country that, although proactive part in the drafting phase of the 2001 Unesco Convention, accepted its principles (annexed rules) in the 2004 Codice (art. 94), but formally ratified the convention only in 2010.

The legislative apparatus has been further complicated by the Constitutional Reform (Law 18 October 2001, n.º 3), where the amendments to articles 114-133 of the Italian Constitution attempting to reform the relationship between central and peripheral levels of government into a more federate fashion have unfortunately resulted in a detachment between the *exclusive legislation* (depending on the State) and the *concurrent legislation* (between State and Regional governments) on the legislative-administrative competences relating to cultural heritage –specifically and respectively, protection and public interpretation–, which attempting to pursue the principle of subsidiarity (vertical and/or horizontal), resulted in a «juxtaposition» (often ideological) between macro models of reference, «state» vs. «regions», «centre» vs. «periphery» and «practitioners» vs. «politicians», whilst as Cammelli (2009) has perfectly stressed:

«the point is to re-construct general principles that should become common independently from who is factually operating [...] the laborious but probably only outlet lays in the integration in a multiple system of a series of common parameters pertinent to the regulation, efficiency, funding schemes, recruitment and training of professionals [...]. Such shared ground [...] represents the only ground on which a cooperation between institutional levels and administrative systems can effectively become profitable. A mixed system, nor centralized nor abandoned to the self-government by the local systems, where State and territorial bodies have distinct roles but shared principles, rules and... little shared virtues» (author's translation).

The legislative-administrative issues strictly tie with a certain predisposition of the Italian archaeological discipline to result impenetrable (or too slowly permeable) to theoretical-methodological developments appearing in countries with a similar tradition and cultural *milieu*. This does not mean that Italian underwater archaeology should uncritically enclose theoretical and methodological developments produced elsewhere but, instead, it is a suggestion for a more proactive reflection on various aspects of the discipline, accounting for progresses obtained elsewhere.

A clear example is the delay often observed in the acquisition and exploitation of the potentialities inherent in the landscape archaeological approach, or the title «new technologies» applied to techniques and methods, such as acoustic remote sensing, that are all but new in the International panorama and instead participating in the disciplinary development since almost its birth. Even more unintelligible are the efforts (even economical) generated to train scholars on the understanding of remote sensing tools functioning without an appropriate infrastructure (in terms of hardware) enabling them to fully exploit tools potentials.

To these aspects ties what possibly appears one of the main limits of the Italian management framework. The concept of collaboration and cooperation between various stakeholders –foreseen and suggested by the above mentioned Codice and Constitutional Law–, appears a well drafted principle but, apart from some deserving exceptions, yet to be commonly applied. In such a poor collaborative environment –although eminent exceptions exist–, the variations between the different areas of the peninsula become even more clear. Such differences often derive from different sensibilities among appointed territorial officers, creating once again, a heterogeneous approach possibly ascribable to a limited central coordination, posing limits to the full and unvarying development of the discipline on the whole country.

In such a view, the idea of a Superintendency for the Sea –often proposed but never seen out (Stefanile, 2014: 169-170)– having jurisdiction on the whole Italian territory could result in a winning choice for strengthening and aligning underwater archaeology in Italy. A Superintendency not acting as a *deus ex machina* or as a sole actor but operating, instead, to grant disciplinary cohesion, applying a formal and shared (by all stakeholders) set of protocols, standards, procedures and best practices, so as to have the «periphery» (local administrations, Universities and other actors) and the «centre» (Ministry) management parties speaking the same language, practising the same rules while founding their actions on common parameters. This does not imply a flattening of research, does not deny the freedom of research but, instead, allows a complex discipline –as underwater archaeology– to fully develop on a National level on the basis of common grounds.

It is sad to note that, even in the recent, heavy reorganization of the territorial Superintendencies, promoted in 2014 and still in progress at the moment, practically zero has been the interest shown by the government towards the problems of underwater archeology. In a country with more than 7000 km of coastline, now one of the State Parties of the 2001 Unesco Conven-

tion, in a political season that points strongly on renewal and reform, albeit in a climate of cuts and spending review, the lack of interest towards the underwater heritage is a sign of a serious situation.

This is sad especially considering the very high density of underwater archaeological sites located during the Archeomar (see www.archeomar.it with related bibliographic references) campaigns (and during subsequent surveys, still in progress, with the support of the Navy), probably the last Italian big project with a national vision and an appropriate funding: a project that has delivered hundreds of sites and data to Superintendencies and Territorial Offices struggling with continuous, paralyzing, difficulties and emergencies.

Technical and Academic training drawbacks

Another issue that creates problems to underwater archaeology and archaeologists is represented by the certification of Underwater Technical Operator (OTS), a sort of commercial diving certificate, required to work in underwater sites, particularly in harbor environments. On the one hand, the excessive costs of this certification often disheartens archaeologist from acquiring the license; on the other hand, the peculiar training of these courses, arisen for technical work in off-shore platforms and the like, has nothing or little to do with an archaeological excavation. For this reason, from many sides and many voices it has been proposed a «scientific diving certification» procuring skills and competences useful for the various scientific disciplines that find in the water environment one of their main research areas (i.e. marine biology, geology and geomorphology of submerged landscapes), allowing meanwhile to acquire an adequate training for developing research in the water following strict safety standards. Hybrid experiences such as the OTAS courses or the «OTS for archaeologists» courses have supplied with good opportunities but have also bypassed a problem that needs to be solved upstream (with a specific legislation, possibly foreseeing a scientific diving certification).

In the nearly total absence of university programs fully dedicated to underwater archaeology, the few existing on the national territory –mostly caused by a reckless university reform– find many difficulties in training underwater archaeologists able to direct underwater excavations. For an essentially historical reason, archaeological training in Italy often appears still grounded to a historic-artistic approach, which highly hinders –compared to other European situations– the variety of acquired competences needed to confront with the current discipline. Sub-disciplines such as international legislation on UCH, ethics and theory in archaeology, UCH management (including the aspects related to conservation/preservation, public outreach and access), remain almost always out (or little scrutinized) by the syllabus offered within university curricula. This is surely due also to a severe structuring of the topics' offering at university, as they are charted by the Ministry of Education, University and Research, with limited opportunities to vary or adapt topics to an ever developing discipline (Volpe, 2013; Volpe, 2014; Zucca, 2013).

Positive evaluations that followed the 1996 Conference, relating to the establishment of the first university program in underwater archaeology and the observation (from several sides) of a marked necessity to implement training offer in the field has been, in the last 15 years, mostly disregarded. Responsibilities (if any), we believe, must be searched for in a University reform that ties the establishment of new post-graduated courses to specific and high-demanding prerequisite such as, for example, a numerical ratio among the teaching body, the Scientific-Disciplinary sectors, and the number of enrolled students. Oddly, the Bologna agreements aimed at uniforming on a European basis far apart university systems has instead produced the reform and the stiff grids that prevent the establishment of accomplished university programs in underwater archaeology.

It can be meaningful to remark also that a –sometimes– conflictual relation between protection Institutions (Superintendencies) and Research Institutions (Universities) contributes to hinder a coherent disciplinary development. An exemplary case in this sense could be the so called *circolari Malnati* (Circolare 16 March 2011, n. 3; 4 January 2012, n. 53 and 4 December 2012, n. 24), where it has been speculated a dual regime suggesting the archaeological research as prerogative to the Ministry (MiBACT) alone, while universities were left with the juridical exercise denominated «archaeological research grant» (Volpe, 2013; Zucca, 2013).

Towards the future

Andrea Carandini and Piero Guzzo (1999, in Volpe, 2013), respectively working in academia and in an archaeological Superintendency –in a relevant cultural debate titled «Academia in the archaeological heritage protection system»–, stated how the rivalry between universities and Ministry represents a battle of the have-nots that harms the efficient protection of the cultural heritage, representing instead an exercise that impose to both institutions a true collaborative intercourse (Volpe, 2013).

«The Christian God helps to explain the concept of heritage management, that is assumed as Triune, articulating in understanding, protection and enhancement of the resource. Superintendencies practice management in its three aspects. But only heritage protection is, and must remain, exclusive jurisdiction of the Superintendencies [...]. Universities must support Superintendencies in understanding the resource (through research), and territorial governments must participate in the enhancement of the resource that, without understanding and protection, will be nonsense. Understanding of the resource is the premise for any management, [...], but the knowledge collected by Universities does not speak yet to the one collected by Superintendencies, whereas summed up together will allow for a more analytical understanding» (A. Carandini, in Volpe, 2013; author's translation).

Underwater Archaeologist Giuliano Volpe (2013: 307), former Dean at the University of Foggia and currently President of the Superior Council for Cultural Heritage at MiBACT, suggested a series of proposals for relaunching the management of cultural heritage and landscape, affirming how:

«Role and structure of the Ministry should be rethought, brought back to the originally techno-scientific character, with a nimble centre, assigned to implement management orientation, coordination/collaboration and rigid supervision, and peripheral operative units based on real and close collaborations on a local level, between all the parts of the public system. Collaborations no longer tied to temporary good relations between individual scholars and the Superintendent or the local officer, but instead inserted in a consistent and oriented management system».

The management and coordination roles recalled by Volpe could be well addressed by a National Superintendency of the Sea through a series of legislation proposals, rules, guidelines, procedures and regulations (on specific aspects of the archaeological exercise) which could grant UCH management an unvarying development within national generic but commonly accepted parameters based on the most up-to-date and accepted international standards; those recognizable in International charters, conventions and recommendations (Secci/Spanu, 2015; see also Secci, 2011: 116-120).

In a management system which aims to a full accomplishment, the value of the public outreach and access phases can not be underrated, in order to make cultural heritage truly

valuable for communities. The last aim of cultural heritage management, in addition to resource protection, is to actively contribute –on various levels and to various aspects– to the socio-cultural growth of the reference community and of humanity as a whole. An accomplished UCH management allows for a «Harmonic Motion of *Utilitas Publica*» (Secchi/Spanu, 2015), where cultural heritage truly becomes a useful tool for a socio-cultural growth of society.

Underwater Archaeological Parks, Maritime Museums and public access activities as underwater cultural heritage trails all foster fertile mechanisms for both the territory and related communities (Melotti, 2007; Canoro/Izzo, 2015). Nonetheless, such initiatives have to be «guided», «oriented» and «coordinated» following common rules that will allow to maximize results, obviously accounting for territorial dependent variables and for the intrinsic characteristics of the site or resource to be publicly interpreted. In this regard, it is clear the fragmentation of a system that is unable to network. Maritime museums (or museums of the sea) –more than once suggested and supported by Luigi Fozzati as fundamental institutions for a country like Italy, where each coastal village has its own maritime tradition– rise in a chaotic and anarchic way, often for private or avocational initiative and always lacking overall coordination, often resulting in worthless and costly duplications. Taking Naples as an example, against twenty-six centuries of sea-faring activities and a relevant maritime heritage such as the shipwrecks in Piazza Municipio or the Borbonic fleet, the city still lacks a true Maritime Museum. It only exists the laudable but inadequate experience of the Museum in Bagnoli, which represents a private enterprise by a philanthropist totally autonomous from managing institutions.

Similarly, the commitment to protect and enhance the common heritage, through marine parks and underwater trails with the positive experiences of Baia (Canoro/Izzo, 2015; Stefanile, in press, with references to past and present activities in the site) and the Sicilian trails, contrast with the tens of coastal, intertidal and submerged sites literally abandoned, encircled by abusive urban speculations and wild moorings, whose access is totally uncontrolled with all the risks and possible damage that this situation brings with it.

Conclusions

The awareness of a problem is the first step to its solution: with the present contribution we intended to bring forward a complicated tableau, and a prompt to pass through a stalemate increasingly embarrassing. From the swamp, we believe, it is possible to rise by recognizing the set of problems and by working hard to overcome them, but also through the communion of intents, major premise for whatever turn. A fragmentary nature of Italian underwater archaeology is also visible in the practitioners' association, that should instead mobilize the whole category. It is frankly unimaginable the search for a common effort for a community of few tens of practitioners that succeed in scattering in at least four associations: AIASub, the veteran of the associations, probably had to rise the instances of its members and is instead even drowning for the edition of the Conference proceedings, awaiting four years for the publication (and that, when and if published, will be irremediably obsolete), FAS, AIOSS and ANASub. Four groups to contend few, very few memberships, and sporadic meetings where everyone is hastening to present its own project instead of halting and reflecting on how to launch a common route.

To conclude, we believe that underwater archaeology and underwater cultural heritage management in Italy will benefit only from a major coordination and collaboration between involved institutions and individuals, as we agree with Albert Einstein that exist only three laws in jobs: «Out of clutter find simplicity. From discord find harmony. In the middle of difficulty lies opportunity».

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Fifty years of underwater archaeological research on the Egyptian Red Sea coast

Cincuenta años de investigación arqueológica subacuática en la costa egipcia del mar Rojo

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Abstract: Commercial activity on the Egyptian Red Sea coast is known from as early as the Old Kingdom but flourished in the Graeco-Roman period, in particular from the 3rd century BC until the early 3rd century AD. These centuries correspond to the establishment of ports connected to the Nile Valley by routes through the Eastern Desert, which followed the main orientation of dry valleys. According to the classical geographers, six main ports were founded under the Ptolemies and their activities intensified during the Roman period. These facts have led some missions to conduct land excavations at different sites, for example Berenice and Myos Hormos (Quseir el-Qadim). Meanwhile, from 1970 until 2010, many other missions have undertaken underwater surveys and excavations on the Egyptian Red Sea coast in order to expand information on the maritime history of the region.

Key words: Classical geographers, port, shipwreck, Sadana, Quseir.

Resumen: la actividad comercial en la costa egipcia del mar Rojo es conocida desde el Imperio antiguo, aunque florece en época Greco-Romana, en particular entre el siglo III a. C. y el comienzo del siglo III d. C. Estos siglos corresponden al establecimiento de los puertos costeros relacionados con el Valle del Nilo a través de las rutas del Desierto Oriental que seguían los antiguos cauces de ríos secos. Según los geógrafos antiguos, habría hasta seis puertos fundados por los ptolomeos cuyas actividades fueron intensificadas durante el periodo romano. Estas evidencias llevaron a varias misiones arqueológicas a dirigir excavaciones en diversos yacimientos como por ejemplo Berenice y Myos Hormos (Quseir ElQadim). Mientras tanto, desde 1970 hasta 2010, muchas otras misiones emprendieron prospecciones y excavaciones subacuáticas en la costa egipcia del mar Rojo, teniendo como objetivo completar la información de la historia marítima de la región.

Palabras clave: geógrafos clásicos, puerto, pecio, Sadana, Quseir.

Introduction

In antiquity, the Red Sea was considered as the main maritime trade route between the Indian Ocean and Europe. This trade appears to have flourished from the earliest times. The first written proof dates back to the time of King Sahure (2444-2433 BC), 5th dynasty, Old Kingdom, who encouraged trade with the Land of Punt (Vernus/Yoyotte, 1988: 140). In the Middle Kingdom, other trips to Punt were organised, according to textual evidence and excavations in 2006-2007 at Marsa Wadi Gawassis on the Red Sea (Fattovitch/Bard, 2009: 90). During the New Kingdom, the reliefs and the associated texts in the temple of Hatshepsut at Deir el Bahari (1473-1458 B.C.) record a naval expedition to Punt with details of the region (Bard/Fattovitch, 2007: 17). It was, however, from the Ptolemaic and Roman periods, from the 3rd century BC, until the end of the 2nd and beginning of the 3rd centuries AD that this commercial route was at its busiest. These centuries correspond not only with increased trade but also with the establishment of some ports connected to the Nile valley by routes that followed wadis across the Eastern Desert. The detailed and systematic exploration of these coasts during exploratory missions sent by the first Ptolemies led to the identification of the best sites, from a navigational point of view given the restrictions imposed by a sea reputed to be very dangerous, and as regards the land routes that were to link these ports with the Nile valley (Elsayed, 2001).

While the existence of these ports was attested by the classical geographers, they have left very little information regarding the exact location, layout and organisation of these ports. But they were particularly interested in this region (Salles, 1988: 75). Among those authors one might mention:

- Herodotus: visited Egypt in 450 BC and is the first historian to have written of the Red Sea.
- Diodorus of Sicily: visited Egypt in 59 BC and described the Egyptian coasts of the Red Sea in his third book.
- Strabo: the famous geographer, born in Amasia in 54 BC, spent much of his life between Rome and Asia Minor and stayed for several years in Egypt. He wrote a total of 17 books, the 17th being dedicated to Egypt at a time when his friend Ælius Gallus was governor of the country in the reign of Augustus (27 BC-14 AD). It is in this book that Strabo mentions the existence of two gulfs: one called Aelantes, to the north-east (Gulf of Aqaba), at the extremity north of which sat the town of Aelana, while the other, called the Arabian Gulf, to the north-west, on the side of the Gulf of Suez, held the town of Arsinoe at its head. Strabo also cites the names of two ports on the Red Sea: Myos Hormos, opposite which were three islands, two covered with olive trees, and Berenice located in the gulf of Acathartus, presently Foul Bay. He also mentions the name of Ophiodes Island, today Zabargad. In addition, Strabo refers to routes across the Eastern Desert towards the Nile. He mentions two in particular: the first departing from Myos Hormos and reaching Coptos in the Nile valley and the second running from Berenice to Coptos. The Eastern Desert in its entirety is called Isthmus (Ball, 1942: 13, 53, 68).
- Pliny the Elder: born in Como in 23 AD and died in 79 AD during the eruption of Vesuvius. His major work in 36 books is entitled the Natural History. In Book vi, Pliny mentions the Red Sea and the two gulfs located to the north of it. One of these is the Gulf of Suez, then called Heroopolis, and the other is the Gulf of Aqaba, then called Aelantis.
- *The Periplus Maris Erythraei*: this work is considered one of the principal sources of information on the ports of the Red Sea and Indian Ocean. The author's name is unknown; however, it was probably written between 50 and 80 AD by a Greek merchant living in

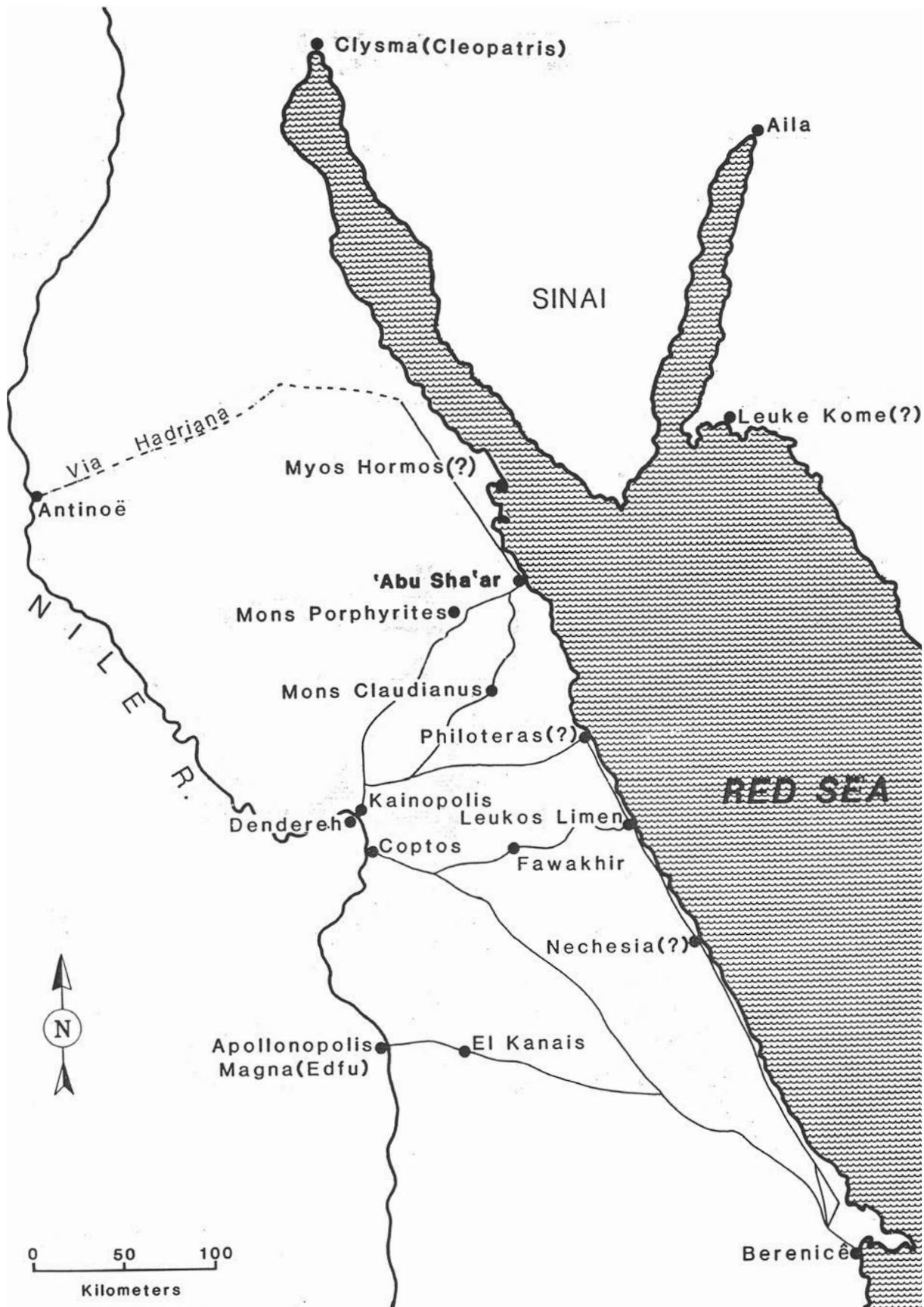


Figure 1. Ancient ports on the Egyptian Red Sea littoral (after Sidebotham, 1992: 13).

Egypt and most likely at Alexandria. He indicates two main navigation routes from the Red Sea ports of Egypt. The first follows the African littoral while the other, after leaving the Red Sea, turns eastwards to India. The book in question is composed of 66 short chapters, in which are described the coasts of the Red Sea and of Africa beyond the straits of Bab el-Mandeb, the south and west littoral of the Indian peninsula, to its frontiers, and it notes the ports and suitable sites for boats to anchor and engage in small-scale trade. Some 28 principal ports are mentioned:

- Two for the Egyptian Red Sea,
- Nine for Africa and beyond Bab el-Mandeb down the east coast of the continent,
- Six for the region of Arabia including the east coast of the Red Sea,
- Two for the Arabian Gulf,
- One for the Makra coast,
- Seven for India,
- One for China.

The great majority of these ports are accurately described (Casson, 1989: 5).

- Claudius Ptolemy: a famous astronomer and cosmographer, appears some 60 years after the *Periplus*. He was born in Pelusium in Egypt, or perhaps at Ptolemais in the Thebaid. His outstanding work is the *Geography* in eight books. Ptolemy dedicated Book IV to Africa and Chapter 4 is a sort of travel journal of the Red Sea in which he correctly locates the entrance to Bab el-Mandeb (Kammerer, 1929: 35).

Arab geographers, such as El-Idrisi around 1154, also wrote about the geography of the Red Sea. Lastly, travellers of the modern era from the 16th century onwards have also discussed the Red Sea and its ancient ports. The first was Juan de Castro in 1541, who talked of the ancient port of Berenice: thereafter, Jean-Baptiste D'Anville in the 18th century, Giovanni Belzoni in 1818, Wilkinson in 1835 and Gollinescheff in 1890 (Coudy, 1910).

According to the classical geographers, there were six main ports on the Egyptian coast of the Red Sea: Arsinoe, Myos Hormos, Philoterias, Leukos Limen, Nechesia and Berenice (Fig. 1). Most of these were founded under the Ptolemies and saw an increase in activity under the Romans. At the same time, it is difficult to be precise, given the often contradictory documents that the ancient geographers have left us, of the location of the principal ports that are mentioned in the written works.

Throughout the centuries that followed, the ports on Egypt's Red Sea coast remained at the heart of maritime trade between East and West. In the recent period, however, they have found themselves within a military zone and it is only very lately that this area has opened up to archaeological excavations. Several missions on different archaeological sites from 1976 at Marsa Gawasis until now have been undertaken on land, including those of Delaware University from 1994 until 2014 at Berenice and Southampton University at Myos Hormos (Quseir el-Qadim) from 1999 until 2003.

One must also imagine the intensity of maritime traffic in the ancient periods. The currents, the permanent north wind, and the reefs lying just below the surface of the sea, will have caused havoc with shipping, and numerous wrecks must be spread across the bottom of the Red Sea. And yet there have not been many such finds and no archaeological campaigns have been conducted in a systematic manner in order to search for these ancient shipwrecks. One of the main reasons for this has been the fact that these zones were often under military control and thus not easily accessible (Elsayed, 2012).



Figure 2. Part of the Sharm el-Sheikh shipwreck cargo (after Raban, 1971: 150).

Underwater archaeological discoveries on the Egyptian Red Sea coast

We should mention that the underwater surveys were generally conducted opposite the above mentioned archaeological sites, the period from 1968 until 2010 witnessed numerous other missions engaged in surveying and underwater excavation on the Egyptian Red Sea coast in order to expand our knowledge and to fill in the gaps in the maritime history and archaeology of the region (Elsayed, 2012).

The Association for Underwater Research in Israel (AURI)

A group of Israeli archaeologists conducted a survey between 1968-1973 on the eastern coast of south Sinai during the Israeli occupation of the peninsula. They discovered about 20 underwater archaeological sites: only three of them were excavated under the direction of the underwater archaeologist Avnar Raban. The first site was the shipwreck of Sharm el-Sheikh, dating to the 17th century and excavated from 1968-1970. The second was the Mercury shipwreck in 1971 and the third was the Na'ama Bay shipwreck in 1973.

The Sharm el-Sheikh shipwreck

It was discovered in 1968, at a depth of 8 m and 80 m from the shore, by two amateur divers searching for seashells. The AURI sent a research group, which recorded hundreds of small vessels, mostly jugs and bottles. In 1969, a salvage expedition was organised over six weeks to protect the site from damage. As a result of this, the remains of the ship were revealed and more than 1000 items of pottery of different types (Fig. 2), and 20 different Turkish pipes dating to the 17th century were rescued¹. The hull of the shipwreck was documented; it represents the bottom of the vessel (50 m long × 13 m wide)

The Mercury-carrier shipwreck

Five km north-east of Sharm el-Sheikh, the mercury-carrier shipwreck was discovered by a Swiss tourist, Sapp Winkler. At a depth of 30 m, he saw huge spherical jars and several bronze bowls. The AURI was involved to relocate the site and arrange a research project. It was not a well preserved wreck. The jars were found scattered on a very steep slope and most of the cargo and the ship were covered and incorporated into the rock. In 1972 a salvage excavation was mounted to gather a maximum of objects while causing a minimum of damage. Once the site was documented and mapping completed, pottery vessels, a fragment of glass and part of a wooden beam were lifted. During the excavation, small liquid bubbles were found, a sample of which was taken to the surface and proved to be pure mercury². More of this material was also found in the bottom of some of the bronze bowls, hence the name the mercury-carrier. The main cargo was mercury, which was on its way to gold³ mines in Arabia or Africa (Raban, 1973: 179-183). Two metal anchors of the ship were found. After studying the artefacts, the shipwreck was dated to the late 14th or early 15th century AD (Raban, 1990: 303-305).

The Na'ama Bay shipwreck

Other shipwrecks have been discovered by the AURI, including the Na'ama Bay shipwreck. It was found 2 km north of Sharm el-Sheikh, between 12 to 20 m deep and dates to between the 12th and 14th century.

Another shipwreck, known as the Lone Mushroom from the 17th century, was situated 7 nautical miles west of Ras Mohamed, at 20 m depth. Neither was well preserved (Raban, 1990: 299-302).

Lastly, between 1967 and 1974, a survey was conducted around the island of Jezirat Fara'un, in the gulf of Aqaba, both in the water and on the island. The search revealed two stone jetties near the shore, a concentration of pottery at the west at a depth of between 7 and 9 m, and a small harbour on the west side of the island (Flinder, 1977: 127-139).

Amphorae of Fury Shoal, Ras Banas – Berenice

In November 1991, an Italian photographer, Pierfranco Dilenge, was enjoying a cruise when he made the marvellous discovery of a shipwreck in the area of Ras Banas at Satayeh reef during a

¹ In 1978 after the peace agreement, the finds from the Sinai coasts returned to the Egyptian antiquities service (http://www.antiquities.org.il/article_eng.aspx?sec_id=27&subj_id=232 [Accessed: February 24th 2015])

² The main mercury mines were in Teima, northern Hijaz, and in Cyprus.

³ The mercury was used as a melting and purifying agent in the gold manufacturing process.

night dive, in the region of Berenice⁴. This place is a complex of reefs and stony coral outcrops known as Fury Shoal⁵ with a variety of different reef formations. The discovery site was at the bottom of a small sheltered area about 7 to 10 m deep and the amphorae lay more or less grouped together at the foot of the reef on a sandy bottom. Two brothers from Milano, named Bicciato, obtained authorisation to work on the site. It was a Roman shipwreck and the keel was buried in the sand. The amphorae were Dressel 2-4 type of the 1st century AD. The concretions on some held them fixed to the bottom while others had spectacular stone coral formations. This vessel may have been transporting wine across the Red Sea, perhaps destined for India (Mouton, 1996: 94-95).

The mission of the Institute of Nautical Archaeology-INA Egypt

The shipwrecks survey of 1994

INA-Egypt, an American mission, conducted a survey in 1994 on the Egyptian Red Sea coast and excavated a 17th century shipwreck from 1995 to 1998. Because of the threat to the sunken



Figure 3. Different types of juglets at 24 m depth (photo, Mohamed Elsayed).

⁴ Berenice, is the southernmost of the Egyptian Red Sea ports, it was founded by Ptolemy II in the early 3rd century BC and named it after his mother. Strabo(17.1.45), Pliny the Elder (NH 6.26.123) and the Nicanor ostraca archive suggest peak activity in late 1st century BC- 1st century AD. It became the homeport of the Roman fleets heading south towards the coasts of Africa and in the direction of Eudaimon, present-day Aden, which was the main trade centre on the Indies route and end-point of caravans coming from the east (Sidbotham, 1992: 20-21).

⁵ In 2010 Southampton University and Alexandria University with cooperation of SCA conducted a scientific survey of this region.

heritage through the dramatic increase of sport diving, the INA-Egypt decided to undertake a survey of the Red Sea coast in order to record all information on what can be considered as a non-renewable resource before it was lost forever (Haldane, 2000a; 2000b). For five weeks in 1994, the mission reported wreck sites and anchorages during an official survey in an area between Quseir in the south and Hurgada in the north (about 200 km long), as well as in south Sinai. Seventeen of the sites produced archaeological material. The most significant of these sites date to the Ottoman period. The first site of the survey was the modern harbour of Quseir, which provided a collection of late 17th and early 18th century clay pipes, cups and jars from a depth of 5 m. The second was Quseir el-Qadim located 8 km north of the modern city of Quseir. An iron anchor dated to the 18th century was recorded on the south side of the harbour.

Other important sites were investigated at Marsa Gasus (Spy Harbour) and Marsa Gawasis (Harbour of Spies). The first site produced only the broken base of jar, a 3 metre-long iron anchor and a smaller iron grapnel anchor. The second site produced nothing despite the Pharaonic remains on land discovered by Dr Abd Elmonem Abd Elhalim Sayed in 1978. Both sites have a sandy bottom, so a remote sensing survey was more productive than a visual survey. The survey continued to the north at Hurgada where local divers had reported many wrecks in the area. A keg amphora trapped on the seabed by a hard coral layer around its base was recorded. Another survey was conducted in front of the fortress of Abu Sha'ar, 20 km north of Hurgada. Excavations were led by Steven Sidebotham of the University of Delaware but nothing was found. The most important discovery reported by Egyptian sport divers was the 17th century shipwreck at Sadana Island to the south of Hurgada.

Sharm el-Sheikh was the last part of this survey. Here we explored Tiran Island and visited the reported site of a shipwreck, where only some pottery was found, similar to the local wares which had been found in Quseir harbour. Some other sites were located that had been recorded by Avner Raban and other Israeli archaeologists in 1970, such as Na'ama Bay, Sharm



Figure 4. One metres high storage jars or zilla moved from the shipwreck at 24 m depth (photo, Mohamed Elsayed).

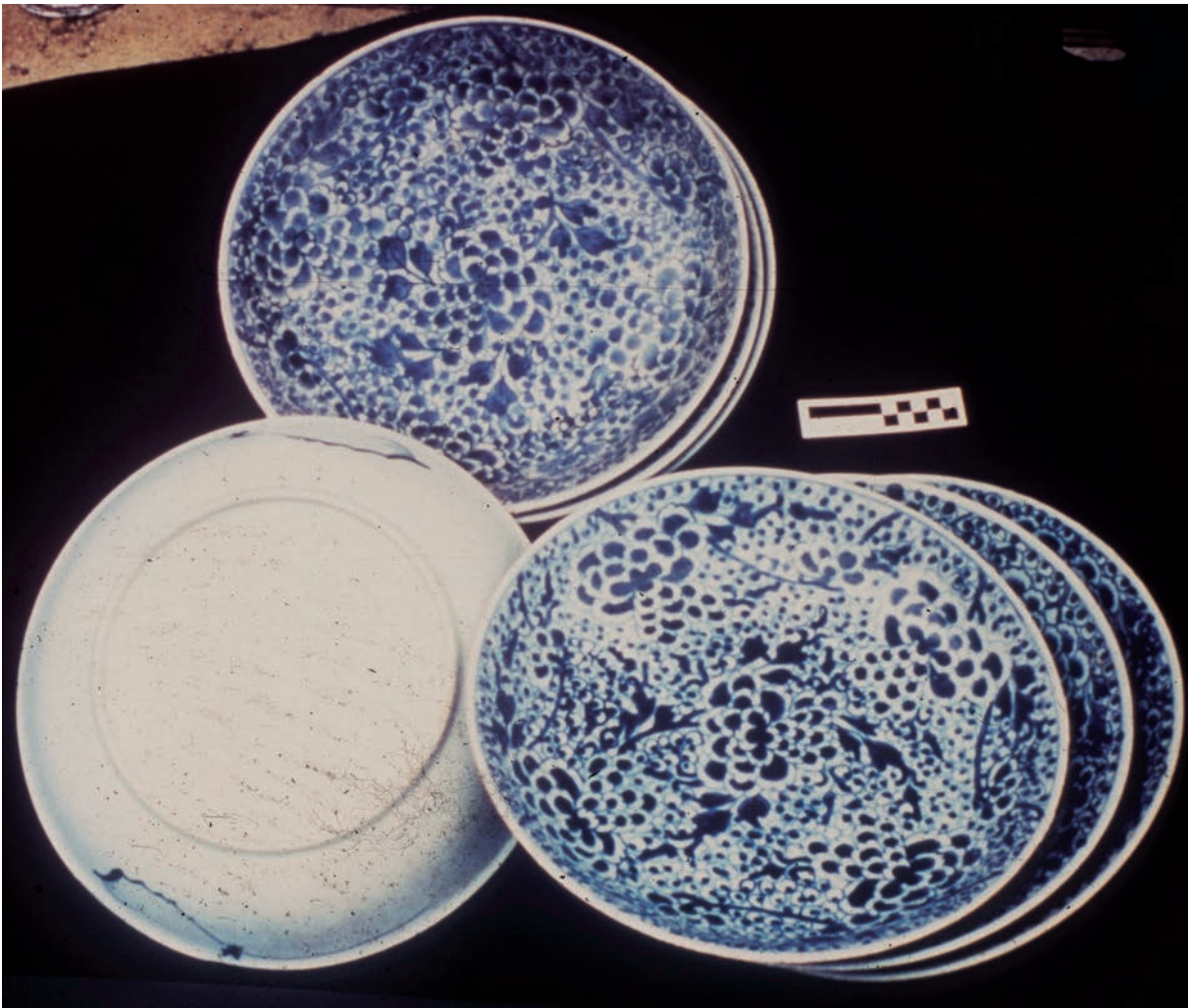


Figure 5. Porcelain dishes from the Sadana shipwreck (photo, INA 1995).

el-Moya and Sharm el-Sheikh, which is now the military harbour for the area. Potsherds were found in the first two coves, and while seeking the exact location of the 17th century shipwreck at Sharm el-Sheikh discovered by Avnar Raban, some broken jars, discarded ballast stones, a clay pipe and scraps of porcelain were found.

The Sadana Island shipwreck

As mentioned before, the Sadana Island shipwreck was discovered in 1994 south of Hurgada during the INA survey with help from some Egyptian sport divers who wanted to protect the shipwreck from looters. An unknown group had dived on the wreck in 1991 and worked illegally without permission from the Supreme Council of Antiquities, leaving concrete blocks and white plastic labels behind. One of the Egyptian sport divers described the location of the site. There then followed three days of diving by the INA to determine the extent and the nature of the shipwreck. It was excavated in 1995 with the cooperation of SCA to protect the artefacts from dispersal and destruction and to provide archaeologist with a crucial link to the first and oldest worldwide trade network. Complete records of a previously undocumented hull type were gathered in an attempt to understand its technological origins and its social context (Haldane, 1996; 1994: 1-4).

The shipwreck site covers 50 × 25 m along the sandy sloping base of a coral reef at a depth of between 27 and 42 m (Haldane, 1996c: 853-863). A stack of three grapnel anchors 4 m long marked the bow, 30 large storage jars called in Arabic *zilla* (Fig. 4) dominated the centre of the site and, in the stern, a large pile of small earthenware water jars and water pipe bowls. More than 320 porcelain objects were recorded and raised in 1995, representing a special class of export wares created by kiln centres in China for the Middle Eastern market (Fig. 5). Twenty different object types were noted, 140 dishes measuring 34.4 cm and 37.8 cm in diameter, in addition a variety of plates, cups, small and large bowls and a single triangular-section bead were documented. More than 100 *kullal* (Juglets) were excavated (Fig. 3), 20 types of them are similar thin, grey/brown fabric. Those raised represent only 10% of the existing *kullal*. One small section of the area showed that there are at least five layers of juglets over a field approximately 7 × 6 m. More than 160 earthenware objects were excavated in 1995, including tobacco pipes, a *kursi* (charcoal holder of a water pipe) glazed and unglazed bowls, spouted containers with small mouths, transport amphorae, bottles, pitchers, and *kullal* with a filter at the junction between neck and body. More than 10 different shapes and decorative types of *kullal* were discovered in 1995 and these *kullal* bear strong similarities to those excavated from the Sharm el-Sheikh shipwreck discovered by Avnar Raban in 1970. Other finds include some copper objects and three types of glass bottles, two of which fall into the category of case bottles.

Beside these discoveries, the wreck presented a rich variety of organic remains, such as wooden jars and bottle stoppers, as well as an amount of charcoal, coconuts, aromatic resin, pepper, coriander and coffee. These products are among the most frequently cited spices in Ottoman archival documents. They served not only as spices but also as medicines.

Concerning the hull, we must mention that the shipwreck construction shared some features with the Sharm El-Sheikh wreck discovered by Raban in 1970, but it was an undocumented tradition. Thus, the ship is extremely important, because it was not built according to standard European methods. The seasons of 1996 and 1998 were devoted to the study of the hull. Many questions were asked about the origin of the construction of the ship. Was it Indian or Egyptian? It is not European, as it does not resemble Dutch, Portuguese, or English ships active in the Indian Ocean. It is even unlike what is known of Indian Ocean sewn ships of the time. Also, the wood is not a reliable indicator of the origin. The excavations were stopped definitively after the season of 1998 because of the budget. The excavation should be continued in order to explore the nature of the ship, its cargo and its crew, and to ensure that this part of Egypt's nautical heritage will be correctly investigated and preserved.

Lastly, all artefacts discovered in the Sadana Island shipwreck were transported to Alexandria's Maritime Museum where a new laboratory for wet objects is being prepared with the assistance of the Supreme Council for Antiquities. After restoration the artefacts were conserved in the Maritime Museum (Haldane, 1995; 1996a; 1996b; 1996c; 1997a; 1997b; 1999; Haldane, 1998).

Quseir shipwreck

The history of this discovery begins in 1995 during the excavation season on Sadana Island shipwreck⁶. Mark Maurice, then a member of Subex Diving centre at Hurgada and Quseir, announced that he had located the remains of a wreck at Quseir⁷ at a depth of 65 metres, saying that a very

⁶ In 1995 the mission obtained some information about a poorly preserved roman period wreck in the deep water in the same harbor of Quseir Al-Qadim.

⁷ Given the depth of the Red Sea and the difficulty in finding shipwrecks, specially of the Roman period, the only two recognised of this era remain those of Fury Shoal and of Quseir

thin layer of coral covered the whole cargo and he provided a photo of the wreck and a drawing of the neck of a Campanian amphora type dating to the 1st century AD. In February 1996, the INA-Egypt visited the wreck and noted that the ship had struck the reef on the southern side of the marsa. Its cargo of amphorae was somewhat scattered by the difference in level of the reef, but the largest part of this cargo was intact and held in the sediment. It is possible that this vessel sank on its outbound voyage towards India and that it belonged to one of the fleets launched by Augustus⁸ to take power and control of trade in the Indian Ocean.

In 2000, INA-Egypt undertook a few dives in preparation to excavate the site, however, because of the depth; the wreck could only be excavated using much specialised diving equipment including trimix breathing gas (helium, oxygen and nitrogen) and thus well-trained archaeologists. When used at a depth of 65 metres, compressed air will only allow a diver to work for a very short time each day, about five to seven minutes per diver once a day. INA-Egypt concluded that it could not excavate the wreck in such conditions. Since 1996, a British company has expressed interest in supporting the Quseir shipwreck excavation project, but it pulled out because of financial and technical constraints (Haldane, 2000b).

The mission of In Situ Archéologie Itinérante and the SCA (Supreme Council of Antiquities)

In 2001 the French group In-Situ, in cooperation with the Department of Underwater Antiquities, undertook a survey in the southern part of Egypt's Red Sea coast, from south of Safaga until Marsa Alam (230 km) in search of ancient shipwrecks. They conducted land and underwater surveys in several sites, starting from Marsa Gawassis (Harbour of Spies), 20 km south of Safaga, Marsa Gassus (Spy Harbour), Myos Hormos/Quseir Al-Qadim, Mangrove Bay south of Quseir, Marsa Gabel Elroussas (10 km north of Marsa Alam), Marsa Nakari (20 km south of Marsa Alam), Marsa el-Nabaa el-Soghayar (30 km north of Marsa Alam), Marsa Shagra, Marsa Wadi Assila, and the exterior of Marsa Alam port. The 15 days of survey revealed interesting results in two sites, the first one is outside the port of Marsa Alam, where we discovered two amphorae at a depth of 15 metres that it could not be identified because of coral concretions. The second site was at Marsa Shagra, at 32 metres depth in the south of the bay, where an iron anchor from the 18th century AD was found. However, the survey area needs more investigation, especially using sophisticated material, like side scan sonar and sub-bottom profiler.

The mission of Southampton University, Alexandria University-CMA and SCA

In 2010, the underwater survey conducted by Southampton University in cooperation with Alexandria University-Centre for Maritime Archaeology (CMA) and the Supreme council of Antiquity (SCA) from Marsa Alam to Ras Banas revealed very interesting results. The aims were to discover ancient shipwrecks from the Roman period and to document all the discoveries. Three interesting sites were documented. The first site was Fury Shoal, which was discovered in 1991. There were some scattered Dressel 2-4 type amphorae and some Egyptian amphorae at a depth of 8 metres. The second site was Abou Fandira, where some Dressel 2-4 type amphorae and 2 iron anchors were discovered. The last site was Sernaka Island, where some archaeological evidence was discovered, like a stone anchor and a *pithos* type amphora⁹.

⁸ Augustus sent 120 ships in one year to sail from Myos Hormos («Port of the Mouse», now Quseir el-Qadim) on the Red Sea directly to India.

⁹ A report in arabic were written about this survey in 2010 by the General Department of Underwater Antiquities.

All of these discoveries showed the importance of the region and we must plan for a longer mission to document the underwater archaeological heritage, which is threatened by sports divers.

Conclusion

These missions have not yet provided full enough results in order to come to definitive conclusions except the INA mission on the Sadana shipwreck. Most of the shipwrecks that have been discovered date no farther back than the 17th century and there are only two known wrecks from the Roman era, those of Fury Shoal and of Quseir, and these were discovered by diving enthusiasts. They will, nonetheless, help to increase our knowledge of the flourishing trade of the early 1st century. A study of these shipwrecks and finds which have been discovered along the Red Sea coast might suggest that there are still wrecks to be discovered, while respecting a general plan for the survey and excavation of the Egyptian coast of the Red Sea. There is much more to be discovered about this crucial sea that provides a link from the Indian Ocean via river and canal to the Mediterranean Sea.

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Coastal construction projects and rescue archaeology: a first approach to the case of Horta Bay (Faial Island, Azores, Portugal)

Proyectos de construcción costera y arqueología de rescate: una primera aproximación al caso de la bahía de Horta (Isla Faial, Azores, Portugal)

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Abstract: The construction of a new port terminal to the north of Horta Bay, on Faial Island, between 2009 and 2013, included the modification of a 170 000 m² submerged area, through the construction of a 320 m long dock and the dredging of a maneuvering basin. This project was preceded by an Environmental Site Assessment (ESA), which resulted in the definition of several mitigation measures, implemented before, during and after the construction works – the survey, excavation and removal of previously discovered archaeological materials and the monitoring of the dredging works. This approach allowed us to identify and preserve remains related to Early Modern navigation, including the 18th century shipwreck site Baía da Horta 1 (BH-001), probably the remains of a British merchant ship involved in Atlantic trade. This paper presents the strategies used in the different phases of the archaeological work.

Key words: Rescue archaeology, Early Modern archaeology, Azores, Portugal.

Resumen: entre 2009 y 2013, la construcción de un nuevo terminal portuario al norte de la Bahía de Horta, en la Isla de Faial, llevó a la modificación de un área de más de 170 000 m², incluyendo la construcción de un tajamar y muelle, así como el dragado de un área de maniobra y de zanjas para los cimientos de tajamares. Las actuaciones de minimización del impacto sobre el patrimonio cultural subacuático se desarrollaron en diversas fases (sobre el terreno entre 2008 y 2013), antes, durante y después de la obra. En este artículo se aborda la estrategia adoptada para la intervención arqueológica, que permitió identificar y salvaguardar vestigios que documentan distintos aspectos de la navegación en la Época Moderna, entre ellos el yacimiento Bahía da Horta 1 (BH-001), que se corresponde con el sitio del naufragio de un buque mercante de la primera mitad del siglo XVIII, posiblemente de nacionalidad inglesa, que operaba en el Atlántico.

Palabras clave: arqueología de rescate, arqueología moderna, Azores, Portugal.

Introduction

Coastal engineering works are one of the threats to underwater cultural heritage preservation (Adams/Holk/Maarleveld, 1990; Grenier/Nutley/Cochran, 2006). In Portugal, such projects have gained special importance in the last decades, and most of the times involve deep changes in the coastline or in the seabed, related with the construction of docks, jetties or the dredging of ports, channels or waterways. The potential for considerable negative impacts on heritage is obvious. Well known cases happened during the 2nd half of the 20th century, for instance, the dredging works carried out on the Arade River (Algarve). Several shipwrecks and other underwater remains of maritime activities were utterly destroyed back then (Castro, 2005).

From 1997 onwards, a new political and cultural framework and the introduction of specific laws for underwater archaeology (Alves/Castro, 1999: 159-162) led to significant changes. Territorial management politics started to include the assessment of impacts on maritime heritage, in the

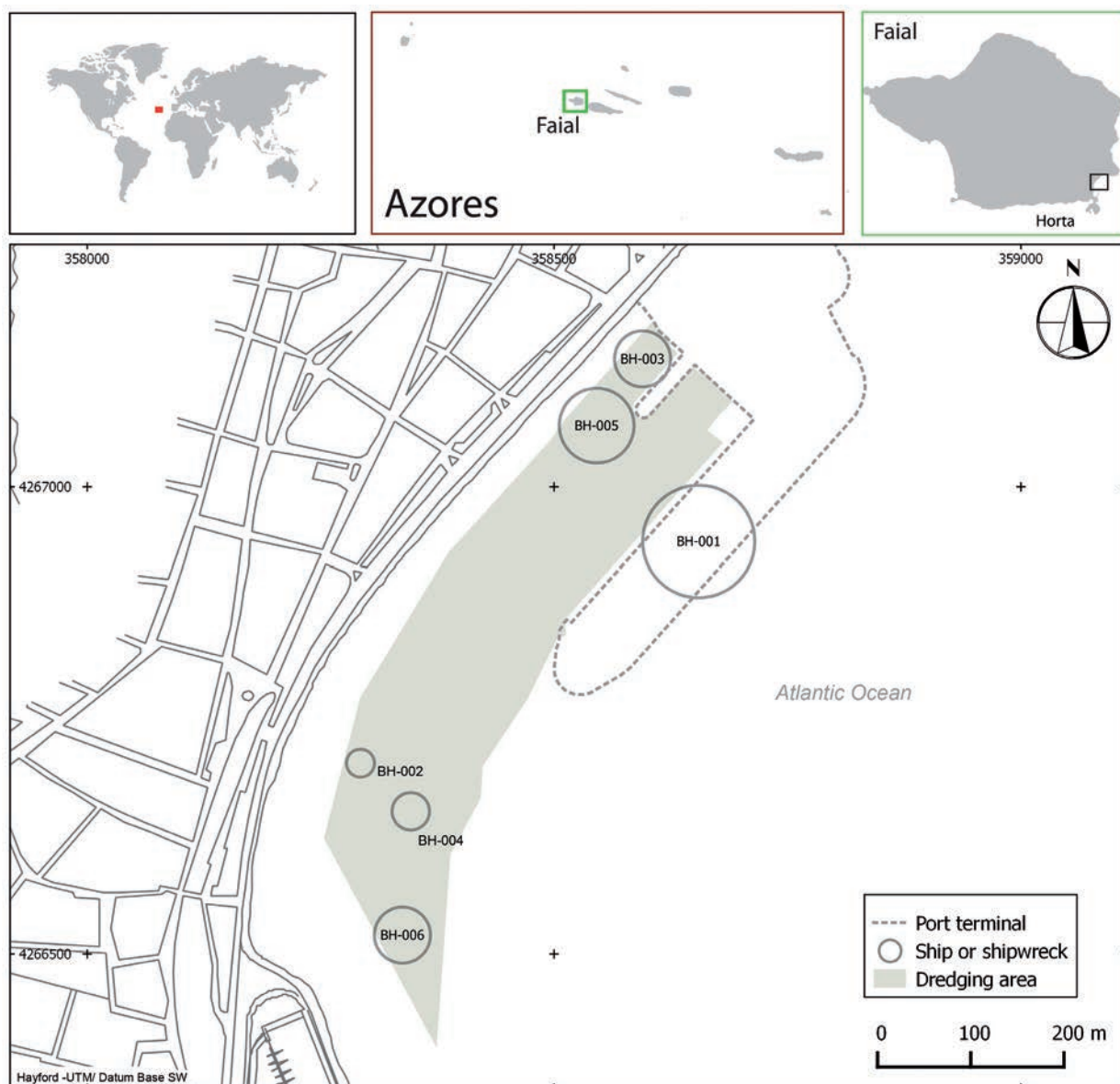


Figure 1. The location of the most relevant sites recorded during the archaeological project, in relation to present-day coastline.

scope of environmental impact assessment studies, and to apply the resulting survey and protection measures pertaining to remains affected by coastal works, both in the Continent and on the Islands. In consequence, several surveys and excavations in underwater environments were carried out: the shipwreck sites Angra C and D on the Azores (Garcia/Monteiro/Phaneuf, 1999: 211-232) or Aveiro F and Aveiro G, in the municipality of Ílhavo (Bettencourt, 2009), to name but a few. However, a serious scientific debate on the strategies and specificities of the management of interventions in the scope of major coastal works in the Portuguese territory is still needed.

The archaeological monitoring of the «Projecto Integrado de Requalificação e Reordenamento da Frente Marítima da Cidade da Horta – 1.^a Fase» (Rehabilitation and Renewal of the Seafront of Horta), promoted by the Azores Government, enabled the Portuguese Center for Global History (CHAM) to develop a large-scale preventive archaeology program in recent years. A submerged area of some 170 000 m² is undergoing major changes, between depths of 2 and 12 m. The Project includes the construction of a 320 m long dock and the dredging of a maneuvering basin and the docks' foundations (Fig. 1).

This paper constitutes a first approach to the strategies adopted so far, which can be divided into four stages, from the survey to the publication and dissemination of results.

The intervention – strategy and results

Environmental Site Assessment (ESA)

The Environmental Site Assessment phase (ESA), carried out in 2008, included a global assessment of the underwater cultural heritage potential on the project area (Bettencourt *et alii*, 2008: 482-485), a study developed in two stages.

The first stage included the desk-based assessment and revealed the growing strategic importance of the Horta harbor from the 17th century onwards, when it began to be frequented by vessels sailing the sea routes connecting England to its North and Central American colonies. Above all, those ships needed to resupply and repair minor damages, but wouldn't disregard the commercial advantages of trading supplies and manufactured goods for regional products like Pico wine, which was in considerable demand, for instance in Pennsylvania, Maryland or Bermuda (Duncan, 1972: 153-156). From the 18th century onwards, Horta also was a logistic base for American whaling and by late 19th century became a mooring knot for the submarine cables. Both situations had deep economic and social repercussions on the Island of Faial (Costa, 2011).

During this phase, maritime activities mostly took place in Horta Bay, in the Project's work area, a natural harbor sheltered from winds from virtually all quadrants (Instituto Hidrográfico, 2000: 10-10). Nevertheless, written sources record around thirty potential shipwrecks, mostly from the 19th century, making this an extremely delicate archaeological area (Bettencourt *et alii*, 2008: 482-485).

The second stage consisted on the full characterization of the area, through visual and metal detector surveys, position fixing and evaluation of all contexts or objects found. Several finds were located, mostly with low archaeological value. However, the archaeological survey also resulted in the discovery of four iron cannons and an elephant tusk, in the same area where divers from the University of Azores and the Azores Government previously recovered three elephant tusks and other objects. As a consequence, the assessment of that area by means of a trial excavation was recommended (Bettencourt *et alii*, 2008: 482-485).

Interventions before the direct impact of the works

During April and June 2009, this mitigation measure was implemented, prior to the beginning of the maritime construction works. The trial excavation confirmed the presence of a shipwreck site (BH-001) of unknown extension in the future dock area. Despite the fact that maritime construction works were already beginning, excavation of the areas with the highest density of finds was proposed (Fig. 2).

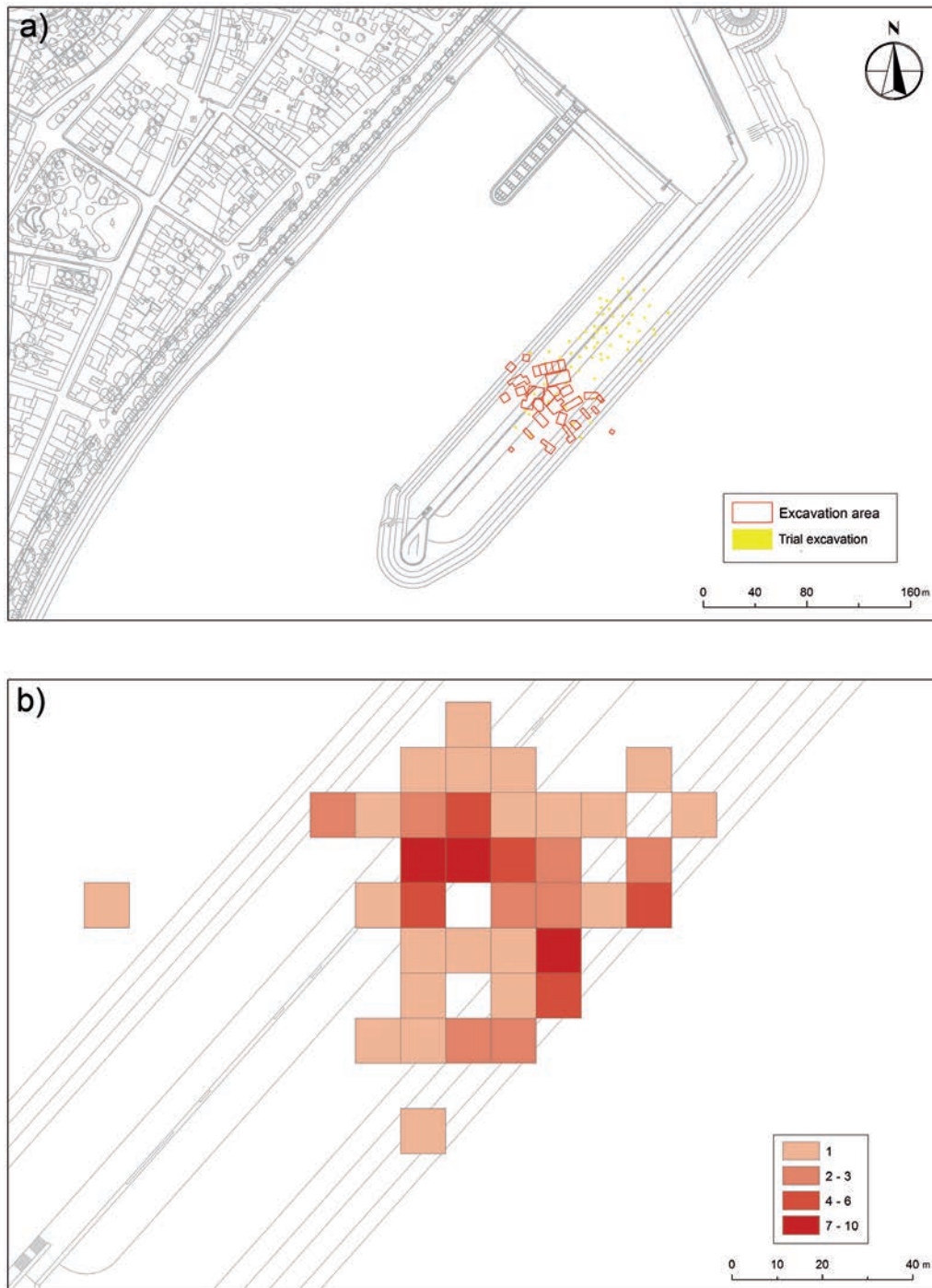


Figure 2. a) Trial and excavation areas in BH-001; b) Elephant tusks distribution. The site covers an area with undetermined boundaries, but not less than 120 m from south to north and 150 m from east to west, at depths between 8 and 11 m.

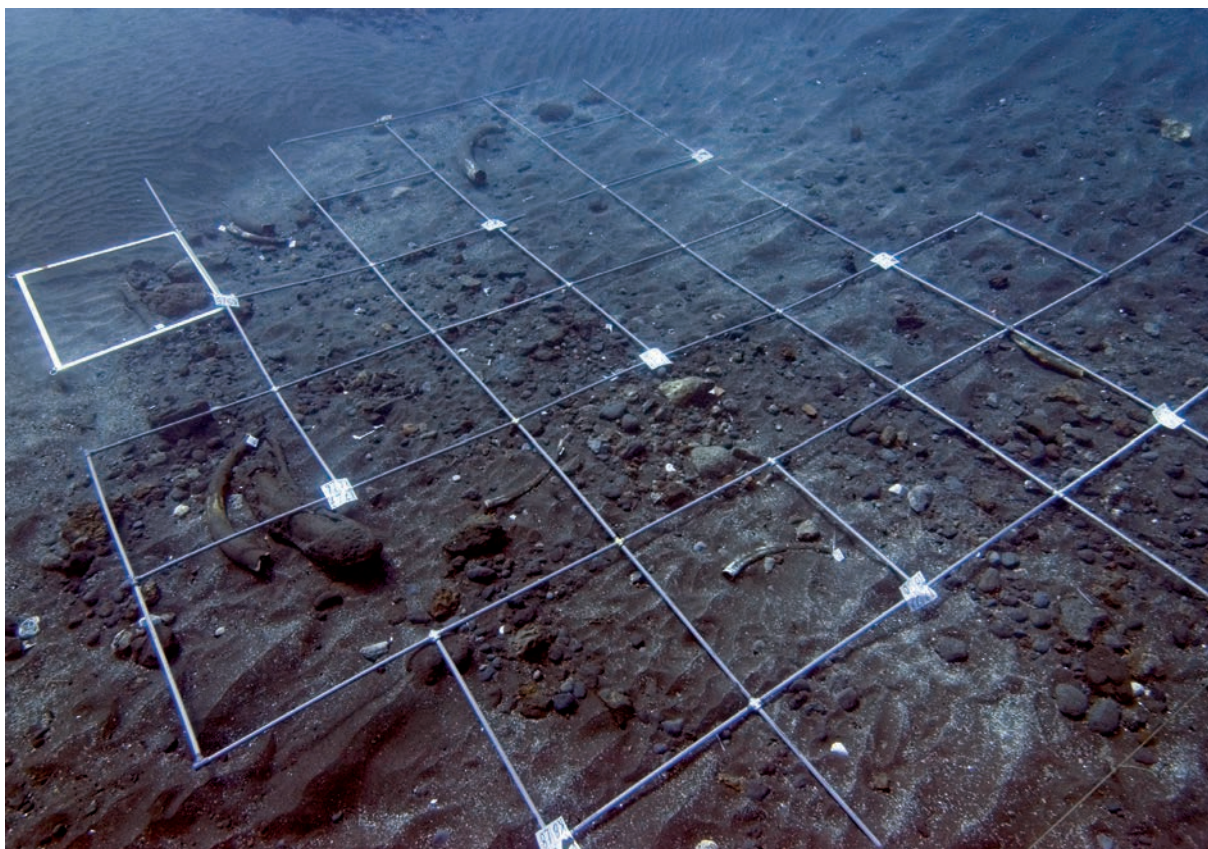


Figure 3. The scattered remains of BH-001 (1 m² excavation grid). Most materials were buried under 1 m of sand, between gravel and stone blocks. Materials from the 16th to the 20th centuries were also recovered in this area; they are either related to maritime activities or were transported from land between floods and subsequently reworked by undulation.

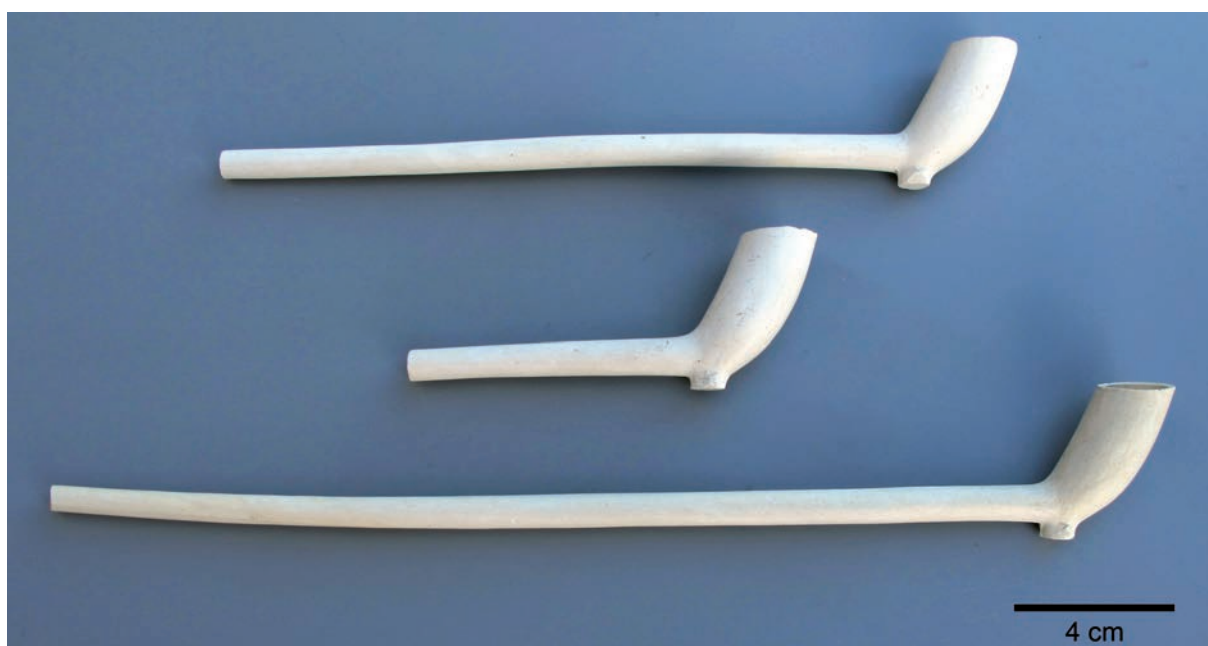


Figure 4. Clay pipes from BH-001. They correspond to an English type produced between 1700 and 1770. Most were marked with the molded initials RM, a letter on each side of the heel, the mark used by a member of the Manby family of pipe makers during the first half of the 18th century.

The archaeological works were carried out between June and July, September and October 2009. A very scattered shipwreck site was recorded (Fig. 3), with a diverse assemblage, which includes parts of the ship's equipment, guns and ordnance (four cannons, two weapons, iron and lead ammunitions and a sword sheath), working tools or personal objects related to a shipwreck, all in a very complex context due to the presence of objects introduced in the archaeological record by other maritime activities. The cargo of more than 100 elephant tusks and a collection of English clay pipes are particularly important finds (Fig. 4). Along with onion bottles and the only coin found, these remains suggest that BH-001 corresponds to a British merchant ship from the first half of the 18th century, which touched the African coast in her last voyage, before being lost in Horta (Bettencourt/Carvalho, 2011: 139-152).

Dredging monitoring

The third phase of the archaeological project consisted in the monitoring of dredging works, performed by a small front shovel dredge, and proved to be crucial to increase our knowledge of Horta Bay's underwater cultural heritage, resulting in 280 further heritage records (Fig. 5).



Figure 5. a) Dredging operations by a front shovel dredge b) Dredging operations by a trailing suction dredge in the area outside the harbor; c) a cannon, when discovered in BH-003 area during the archaeological monitoring of the shovel dredging. In the case of the suction dredger, archaeological monitoring was totally ineffective.

They document four centuries of navigation in Horta Bay. Those finds include, for example, Aveiro/Ovar ceramic productions that played an important role in supplying the Atlantic islands until the 17th century; several 19th century finds, when Horta became an important port of call for American and British ships; or even artefacts from the 20th century, related to naval operations and to the last regular maritime passenger transportation to and from Portuguese mainland.

This phase also required specific mitigation measures in several areas. The discovery of new tusks related to the «ivory wreck» justified new excavation areas, which allowed us to record more deposits related to this shipwreck (BH-001).

In another area (BH-003), several iron cannons were discovered, deeply buried in the sand beach that shaped this coast until the mid-20th century. In this case, the chosen methodology involved the use of a magnetometer and sub-bottom profiler surveys, followed by the trial excavation of the most visible targets. This work was not conclusive, because the survey area showed a high incidence of anomalies related with contemporary remains, among which the submarine cables and part of an iron mast, both from the 19th century. Moreover, further dredging in this area revealed the existence of other cannons, which seem to be part of yet another scattered shipwreck site. The trial excavation did not uncover substantial remains, beyond some lead bullets, weights or a buckle, which indicates extensive salvage taking place after the wreck. The still undergoing analyses of the cannons indicate the Armstrong design used by the British Navy, suggesting that the vessel might have operated in the second half of the 18th century.

In 2012, the Azores Government decided to change the dredging depth, thus extending the intervention area. Against all expectations, this new phase was approved by the environmental authority without prior assessment of the new area. However, our previous knowledge allowed us to restrict the dredging operation, because an archeological site (BH-004) was known to exist in the area, since 2010. In order to meet the timetable fulfillment agreement with the dredging company and, at the same time, ensure the implementation of a subsequent mitigation measure, a protection area was created around BH-004.

During this new phase, the dredging operations were performed by a trailing suction dredge in the area outside the harbor (Fig. 5). In only two weeks, this vessel dredged a larger sediment volume than the total reached during the previous two years of the dock construction. As expected, the archaeological monitoring was totally ineffective, resulting in the discovery of only four artefacts caught in the dredge head. Further implementation of mitigation measures in BH-004, which consisted of a trial excavation, failed to detect new deposits related to this shipwreck, but led to the discovery of a trail of timbers that led to the identification of a new ship, partially destroyed by the suction dredge. The discovery of this site required new specific mitigation measures, implemented in 2013, namely recording and protection of the remains. This new site corresponds to a ship built with some American timbers, featuring copper alloy nailing and sheathing, typical of 19th-century shipbuilding (Fig. 6).

Dissemination

Since the beginning of this project, it was clear that performing a mitigation plan would have to include a dissemination strategy. Thus, the research, scientific publication and conservation of the artefacts are included in the measures required by the ESA. Our team is responsible for the research and publication, while the Horta Museum stores the finds and will be responsible for their conservation.

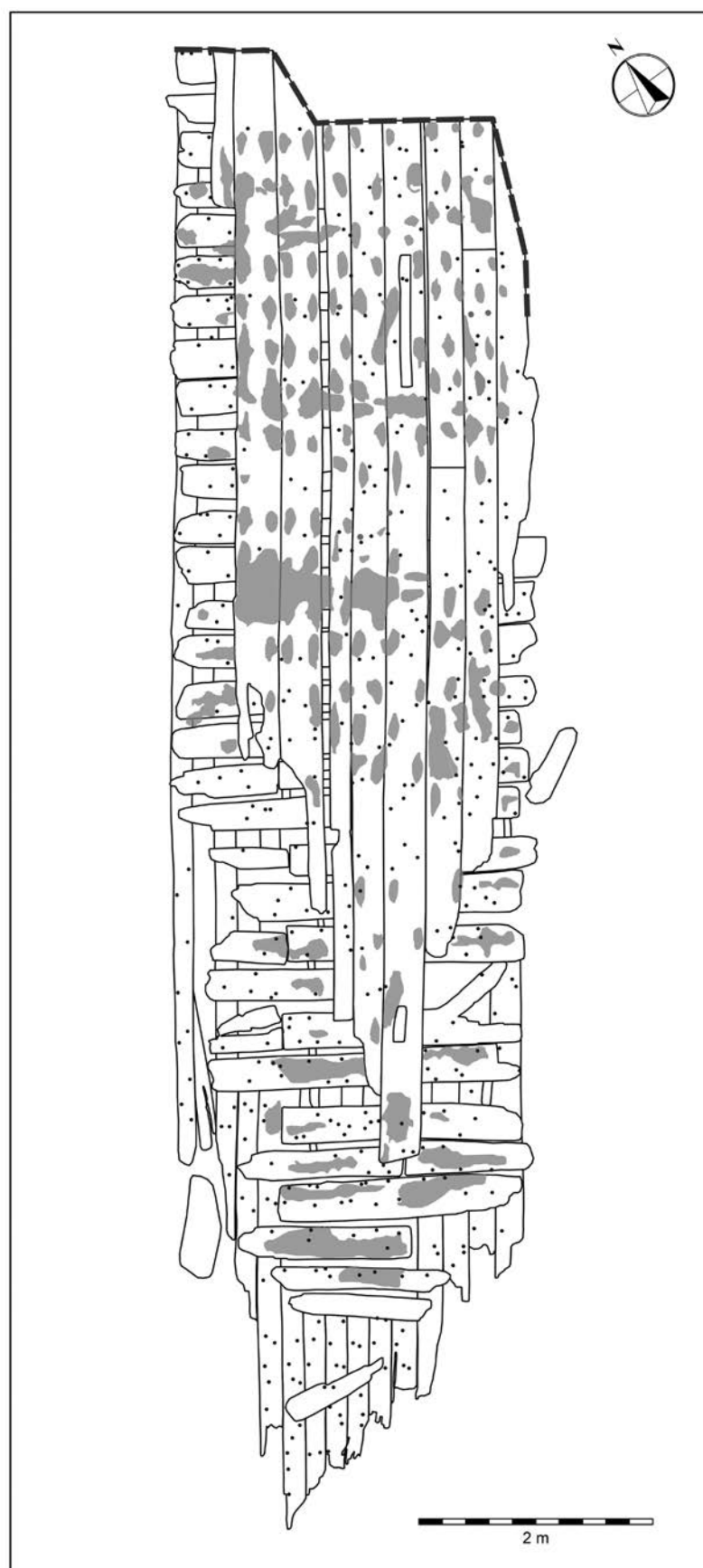


Figure 6. Plan of the BH-006 ship, partially damaged by the trailing suction dredge.

In addition to scientific publication, the dissemination strategy included several initiatives so far. Firstly, the creation of an underwater preserve for larger finds, such as cannons, often visited by sea-tour operators. Secondly, conducting informative sessions for the local community, including guided tours to the finds. Thirdly, setting up an exhibition («Histórias que vêm do Mar» [«Stories from the Sea»]), in association with the Observatório do Mar dos Açores (Observatory of the Azores Sea) and other regional institutions. Initially presented in the Island of Faial in 2011, at the Old Whaling Station of Porto Pim, it became an itinerant exhibition that was on display in the Islands of São Miguel, Terceira and Pico and is currently on display at the Museu de Marinha in Lisbon. Besides the display of informative panels and artefacts, the exhibition also created opportunities for several conferences to be held, as well as educational activities and other events related to the Sea of Azores.

Concluding remarks

The Horta project has been a very important lab for our team. From a technical standpoint, the analysis of results revealed specific aspects of the approach to port contexts located in the Azorean coast:

1. these contexts are usually easily accessible and occupy low depth areas, which leads to the impoverishment of the archaeological record due to cultural processes;
2. the intense human use of those areas means a continuous input of artefacts related to maritime activities or land occupations;
3. maritime works carried out over time changed the circulation of sediments and the conditions of archaeological deposits;
4. the shipwrecks that occurred in these spaces were generally violent, taking place during storms;
5. submerged areas feature a dynamic and irregular sedimentary coverage, affected by waves that cause the dispersion and erosion of lighter artefacts or the vertical displacement of the heaviest;
6. sediments –sand, gravel or blocks– feature good oxidation conditions, which jeopardize the preservation of organic materials and favor the activity of biological organisms.

These characteristics originated an archaeological record where scattered and overlapping wrecks predominate due to the vertical displacement of the remains, which tend to migrate until they reach the hard substrate or the vertical limits of the effects of undulation on the bottom (Murphy, 1990: 14-16). This also leads to the gradual impoverishment of archaeological deposits due to the disintegration of structures and the disappearance of the less resistant materials.

It is therefore obvious that the specific nature of shallow port areas requires the use of several extensive and intensive survey and assessment methods, not exclusive but complementary. For example, the side-scan sonar provided a global map of the area, but wasn't able to identify small or buried remains, the most common finds in such sites. Contamination caused by contemporary materials overrides the effectiveness of magnetometers to detect small artifacts, the most common target on salvage-scattered shipwreck sites. The visual survey can locate exposed remains, but its efficacy depends on the seabed type and its dynamics. In this framework, the trial excavation can be considered the best approach, but it is a time-consuming method. The archaeological monitoring of dredging works is also crucial, but its success depends on the type of dredger and requires previous knowledge of the type of contexts present in the area.

Nevertheless, it is considered that the approach adopted in Horta was appropriate in the current context of Portuguese archeology. Unprecedented resources in rescue underwater archeology projects were made available to the team. The intervention substantially increased our knowledge of the underwater cultural heritage of Horta Bay, opening up several perspectives for future analysis. For instance, BH-001 is the oldest known archaeological evidence of English ships calling at Horta, a key factor for the economic, social and urban development of Faial Island. The BH-006 ship may correspond to one of the many American whalers lost in Horta during refueling stops in the 19th century. The two sites are examples of Atlantic navigation in the 18th and 19th centuries.

The data gathered during the archaeological works and the recovered artifacts also have a very high museological potential. They could be the basis for an exhibition about maritime Atlantic history and encourage several dissemination initiatives.

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Visualization and monitoring of underwater sites using new generation multibeam echosounders

La visualización y monitorización de yacimientos subacuáticos utilizando ecosondas multihaz de nueva generación

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Abstract: The latest (fifth) generation of multibeam echosounders can be used as a tool to provide high detailed and accurate images of underwater sites. This technique is especially usable in waters with poor visibility, where divers may not get a clear overview of the site. The combination of improved transducers and the development of faster computers in the past years make it possible to provide centimetre resolution of wreck sites. Enhanced 3D software makes it possible to view sites interactively from different perspectives. Besides providing high detailed 3D models and images of sites, frequent recordings can be used to monitor the state of an underwater site in time. The analysis of the recorded data has played an important role for the decision to physically protect a number of wreck sites in the Netherlands.

Key words: Archaeology, geophysical, multibeam, visualization, monitoring.

Abstract: la última (quinta) generación de ecosondas multihaz se puede utilizar como una herramienta para proporcionar imágenes de mayor detalle y precisión de yacimientos subacuáticos.

Esta técnica es especialmente útil en aguas con poca visibilidad, donde los buceadores pueden no tener una clara visión de conjunto del sitio. En los últimos años, la combinación de mejores transductores y el desarrollo de ordenadores más rápidos hacen que sea posible proporcionar una resolución de centímetros de los sitios de los naufragios. Un software 3D mejorado hace que sea posible ver los sitios de forma interactiva desde diferentes perspectivas. Además de proporcionar modelos 3D de mayor detalle y las imágenes de sitios, frecuentes grabaciones se pueden utilizar para monitorizar el estado de un yacimiento subacuático en el tiempo. El análisis de los datos registrados ha jugado un papel importante a la hora de decidir proteger físicamente algunos naufragios en los Países Bajos.

Palabras clave: arqueología, geofísica, multihaz, visualización, monitorización.

Introduction

The Dutch waters are full of shipwrecks. Some of these wrecks have been discovered. At the moment approximately 60 000 locations are registered in the various databases of the Dutch government. However, many more wrecks are still lost and thus their exact locations are unknown. They may be immediately threatened by construction works being carried out. To prevent this, Dutch legislation states that before any projects starts, on land or in water, archaeological research has to be carried out. This has to go through various stages, from desktop research to fieldwork. Because of poor visibility and strong currents occurs, it is not always possible to investigate the seabed by divers. High resolution multibeam echo sounders have no problems with these circumstances. Also, large areas can be covered and exactly measured in a short period of time.

High resolution multibeam

A multibeam echosounder uses bundled acoustics resulting in a point cloud (comparable to LIDAR) which can be used to construct a 3D model of the seabed. High resolution multibeam is nowadays a very common research tool within maritime and offshore projects. With this technique, often in combination with the use of side scan sonar, large areas of the seabed can be mapped in high detail, and accurate, high resolution models can be obtained from (archaeological) objects.

The latest (fifth generation) multibeam systems provide centimetre resolution at a water depth of 20 meters and inhibit the possibility of online tilting of the transducer, thus making it possible to scan an object from various sides, resulting in an accurate true 3D model.

For archaeological research, multibeam echosounders can be applied for visualization of sites in high detail and monitoring the state of archaeological sites.

Visualization

High resolution multibeam images offer the archaeologist a first impression of an object on the seabed (Fig. 1). Not only an outline of the object can be visualized but also details can be obtained, providing a base for measurements or analysis of construction details. From the images, a georeferenced general site plan can already be drawn as a base for further (dive) research.

From the resulting 3D point clouds, 3D images can be constructed of the situation of the wreck on the seabed and viewed from different perspectives (see Fig. 2).

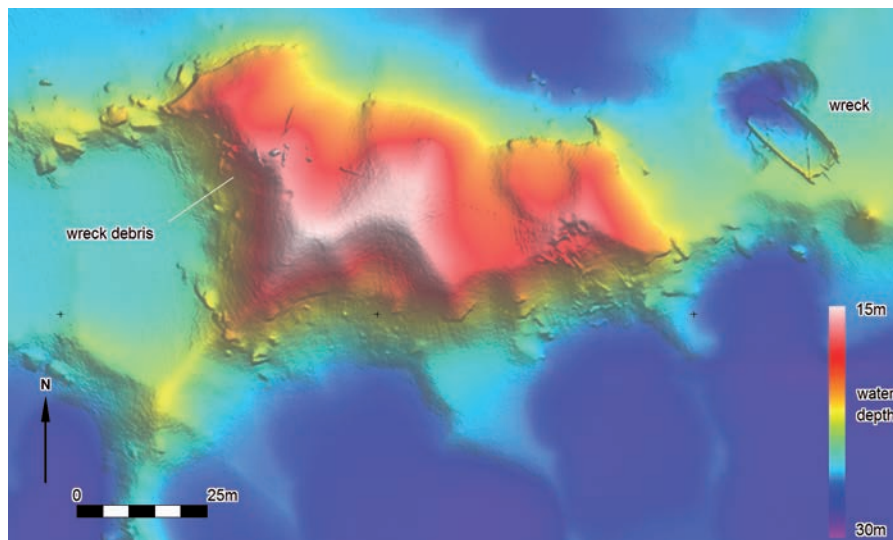


Figure 1. Multibeam image of a wreck site at a water depth of 15-30 meters (R2Sonic 2014 UHD system).

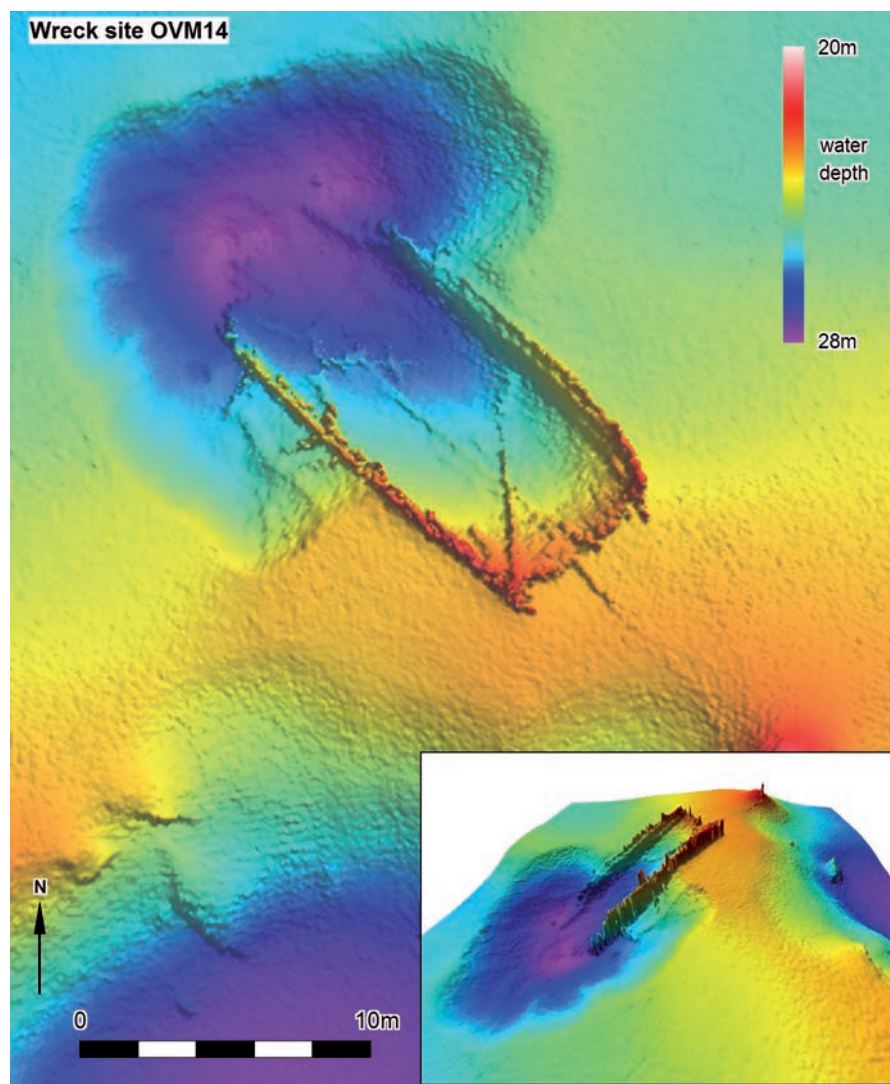


Figure 2. Detail of a wreck at a water depth of 24 meters (R2Sonic 2014 UHD system).

Monitoring

By comparing different multibeam recordings in time, site changes over a longer period of time can be analysed.

As a case study a monitoring project is presented which is performed in cooperation between the maritime archaeological company Periplus Archeomare and the Dutch Cultural Heritage Agency (RCE). The project exists of an annual survey at an area called Burgzand in the Dutch Wadden Sea. This area is known for being a former roadstead near the Island of Texel in the 17th and 18th century (Fig. 3).

This roadstead was a shelter for Dutch East Indiamen (and other ships) awaiting favourable weather conditions to sail out or being loaded or unloaded of their cargo. Despite the shelter conditions, many ships were lost during storms.

Since the 1970s dozens of shipwrecks and remains of wrecks are found in the area which is now stated as a national monument with high archaeological value. A number of the wrecks have been investigated and physical protected by scaffolding nets, sandbags and artificial sea grass. In order to monitor the state of the protection, the sites had to be visited by divers on a regular base.

A monitoring project with high resolution multibeam started in 2002 as part of the European MoSS project (Monitoring, Safeguarding and Visualizing North-European Shipwreck Sites).

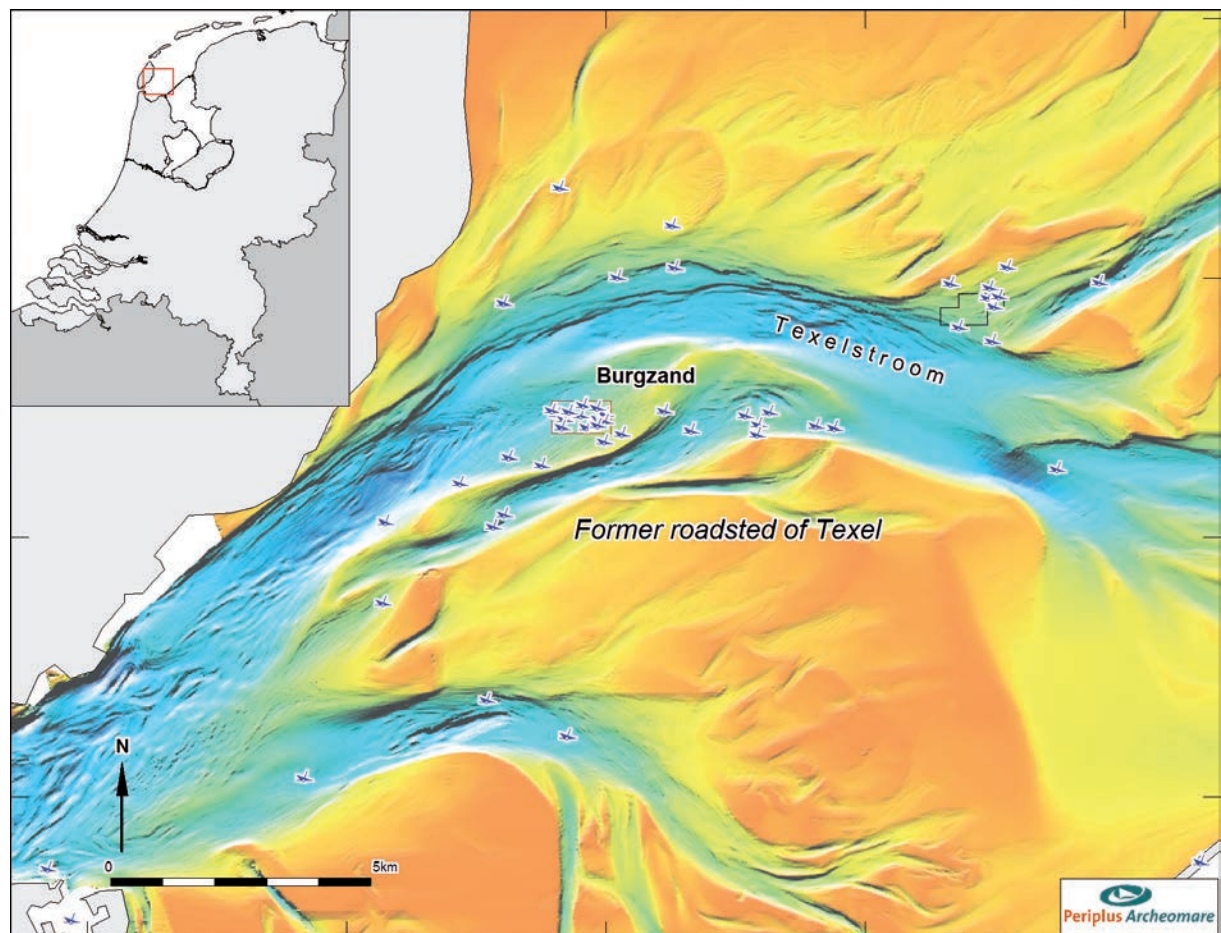


Figure 3. Location of the former Texel roadstead, Dutch Wadden Sea.

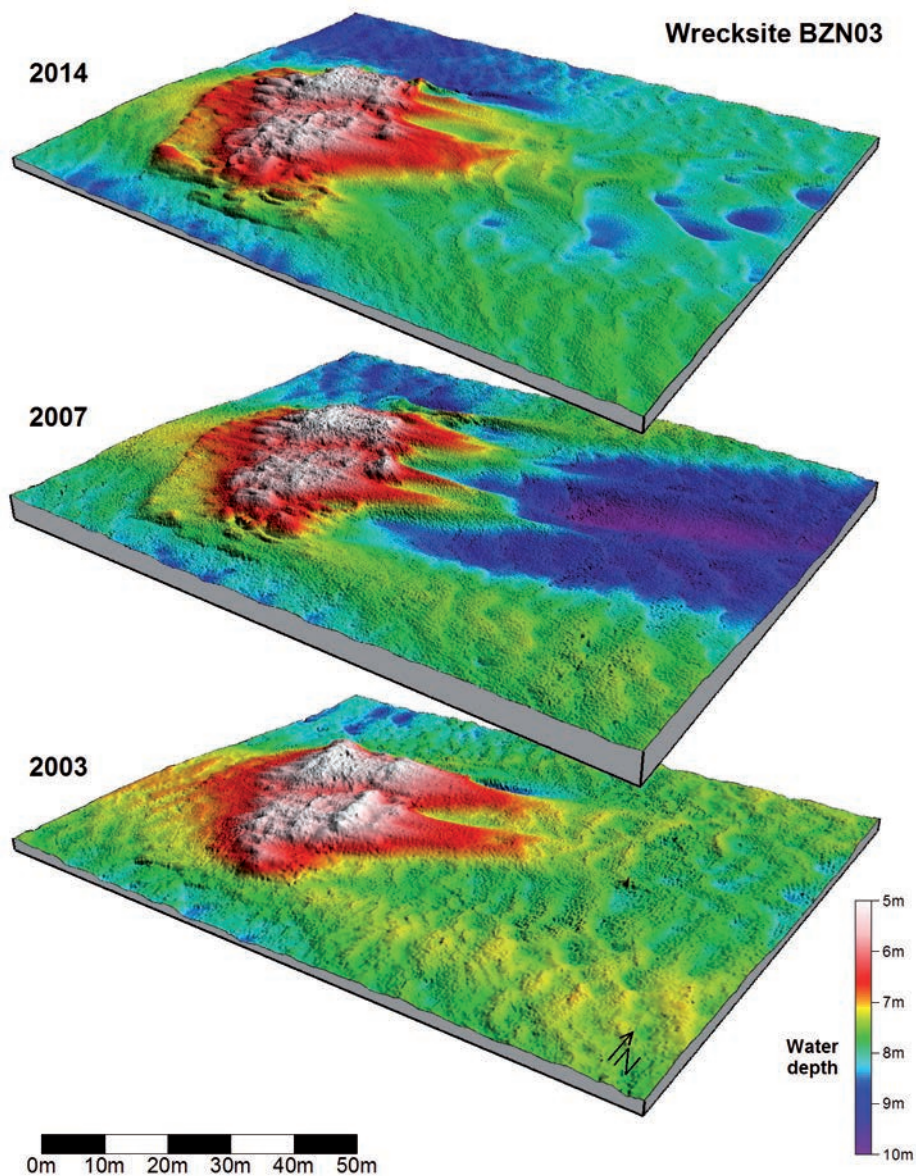


Figure 4. Comparison of annual multibeam recordings of wreck site BZN03 (Reson Seabat 8125).

From the first high resolution multibeam recording, researchers concluded that the data were very useful for detailed analyses. By combining the different recordings changes at wreck sites and morphology of the seabed became visible. Since 2002 multibeam recordings have been executed annually.

In this paper, the results of the annual monitoring of two different wreck sites are presented.

Site Burgzand Noord 03

The so called Burgzand Noord 03 wreck was discovered in 1985 by a local fisherman who was caught with his nets behind an obstacle. In 1986 the Dutch Cultural Heritage Agency carried out an archaeological investment. A large part of the construction was still intact and a number of artefacts were found including a canon marked with the date 1638. Based on the findings it is

believed that this wreck might be the Dutch East-Indiaman *Rob* which was lost in January 1640 east of Texel.

Because of the archaeological and historical significance and excellent condition, the wreck was declared in 1988 as a historical monument and physical protected. The site was largely covered in scaffolding sheet and 6000 sandbags. This resulted in a natural mound on the seafloor, preventing looting, erosion of the site and damage by shipworm. The method of protection has proven largely successful, however the dynamic conditions at the site call for frequent monitoring and further physical protection.

Since 2003 the site is annually monitored by means of multibeam. The comparison of the different recordings (Fig. 4) shows a general deepening (erosion) of the area surrounding the wreck site, but the wreck site itself remains stable. However, detailed damage to the scaffolding sheet is not visible. Therefore regular diving inspections are still necessary. As a

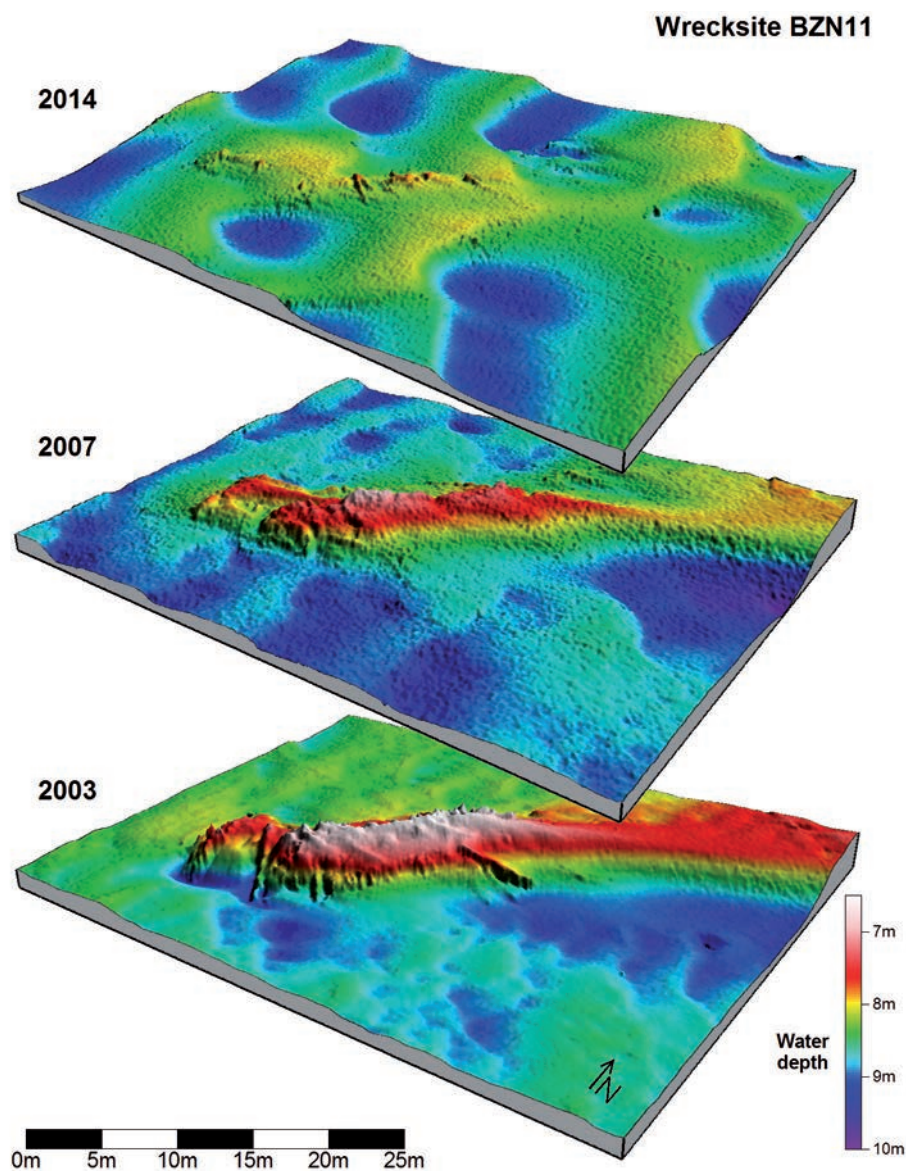


Figure 5. Comparison of annual multibeam recordings of wreck site BZN11 (Reson Seabat 8125).

result from this monitoring, the protection measures have been repaired and extended several times.

Site Burgzand Noord 11

The other wreck is the so called Burgzand Noord 11, or Big Empty. It was discovered in 1997 by sports divers, and an archaeological assessment was carried in 2000. The site contained the remains of a large seagoing vessel with a possible length of 35-40 metre scattered over a large area. Cargo or inventory was not found, except for a few artefacts near the stern. By dendrochronological research the dating was set on 1567 AD +/- 6.

During dive inspections between 2001 and 2005 it became clear that the wreck was deteriorating quickly.

An important decision was made to leave the remains unprotected on the surface and to monitor the deterioration by natural processes. Since 2003 the wreck site is annually recorded with multibeam. The results show, that within ten years all the remains on the seabed have disappeared due to currents and natural deepening of the area (Fig. 5).

Conclusion

High resolution multibeam recording proves to be a useful tool for maritime archaeologists. The data can be used as a base for detailed site maps, and the 3D models offer the opportunity to study the site from different perspectives. Furthermore, the use of high resolution multibeam can also be applied for monitoring. The environmental changes on and around wreck sites can be observed and even exactly measured. By putting the different images in a sequence together, animations can be constructed that show the tendency of what is happening on an archaeological site. These animations accidentally also appeal to a wider audience.

Due to the continuing improvement of both multibeam transducers and computer technology, the resolution becomes higher and higher. Already measurements are often more accurate than divers can record underwater.

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ARQUEOMONITOR: study of the influence of physical, chemical and biological conditions in the damage and protection of underwater historical heritage. Constructing the bases for *in situ* protection

ARQUEOMONITOR: estudio de las condiciones físicas, químicas y biológicas en la degradación y protección del patrimonio histórico subacuático. Construyendo las bases de la protección *in situ*

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Abstract: The deterioration of shipwrecks varies depending on location and time due to changes in environmental conditions, and the nature of the archaeological objects. In order to assess the influence of physical, chemical and biological conditions in the damage and protection of underwater historical heritage, these variables were monitored in two shipwrecks with similar chronology: *Fougueux* and *Bucentaure* site (Battle of Trafalgar, 1805), in the vicinity of the Bay of Cadiz. In addition, to studying the relationship between marine environmental conditions and the development and conservation status of archaeological site, the degradation rates of different materials subject to different environmental conditions (permanent burial, continuously exposed, and alternatively reburial/exposed) were evaluated after various exposition periods in the study sites. The preliminary results of ARQUEOMONITOR Project are presented. These results will be used to develop a decision making system, based on the knowledge of materials and analysis of risk factors imposed by the marine environment.

Key words: Shipwreck, environmental dynamic, *in situ* protection, management, site formation process.

Resumen: la degradación de los yacimientos arqueológicos subacuáticos varía según su localización y según diferentes escalas temporales debido a cambios en las condiciones ambientales y a la naturaleza de los objetos arqueológicos. Para evaluar la influencia de las condiciones físicas, químicas y biológicas en el estado de conservación del patrimonio cultural subacuático, estas variables fueron monitorizadas en dos yacimientos de cronología similar, *Fougueux* y *Bucentaure* (Batalla de Trafalgar, 1805), ambos localizados en las inmediaciones de la Bahía de Cádiz. Además, se midieron periódicamente las tasas de corrosión en muestras de materiales modernos colocados en ambos yacimientos, permitiendo establecer la relación entre las condiciones ambientales marinas y la degradación de los yacimientos. Este trabajo muestra los resultados preliminares del proyecto ARQUEOMONITOR. Estos resultados serán usados posteriormente para desarrollar un sistema de toma de decisiones basado en el conocimiento en sus tasas de deterioro y su relación con los factores ambientales del medio marino.

Palabras clave: pecio, factores ambientales, protección *in situ*, gestión, formación yacimiento arqueológico.

Introduction

In recent decades there has been a growing interest in the study and conservation of underwater archaeological heritage (UCH). Simultaneously, there had also been a transition from intrusive excavation and recovery methods towards the *in situ* protection and managing of UCH. Several problems in the process of extraction and subsequent conservation have promoted this change of strategy in the UCH management. Among them, the large number of underwater archaeological sites discovered which is associated to the recent improvements in prospection techniques. Secondly, the high costs of extraction, stabilization and storage, make infeasible the extraction and subsequent conservation process. Finally, the past experiences have revealed weaknesses difficulties in the stabilization techniques, still unresolved, which might endanger UCH. So, these reasons have led to include the *in situ* preservation as a main principle of Unesco Convention on the Protection of the Underwater Cultural Heritage in 2001, ratified by Spain in 2005. Nowadays, the *in situ* conservation has become the priority option for UCH conservation.

However, prior to carry out the *in situ* protection practice a good knowledge of relationship between the different degradation processes and the environmental conditions on marine environment should be acquired. It is well known that stability, degradation and corrosion rates of different materials depend on environmental marine conditions (Oxley, 1992: 105-110). Thus,

shipwreck site formation and degradation are influenced by physical phenomena (currents, waves, etc.), chemical conditions (in water and sediment) and biological factors (Wheeler, 2002: 1149-1159). In addition changes in marine environmental conditions at different time-scales may promote geomorphologic changes around the site, which can modify the stability or corrosion rates of UCH. Specifically, when a metallic object is immersed in sea water, a deterioration process starts. In the case of the casting used to manufacture artillery, after a prolonged exposure time, loss of iron ions in the surface layer is produced, resulting in a graphitic surface layer in which are present various corrosion products, such as carbides, iron chloride or iron hydroxide. Meanwhile, inside the remaining metal comprises ferrite and pearlite unchanged. On the outermost layer, a colonization occurs rapidly by benthic biological communities present in the area generating what is known as calcareous concretion, as a result of the accumulation of calcareous deposits of organisms that colonized the object. It's composed of algae, molluscs, bryozoos, cnidarians, polychaetes, sponges, etc. This layer may act as a barrier, reducing the exchange of corrosion products and sea water, and helping to stabilize the metallic material in the marine environment. All the processes outlined above are closely related with the marine environmental conditions and exposure conditions. Despite the in situ monitoring program carried out in last decades, the effect of environmental marine conditions on degradation process rates in different materials still today is not fully known.

In this context, the Arqueomonitor project arises with the aim to study the influence of physical, chemical and biological conditions in the damage and protection of underwater cultural heritage. In this project an intensive program for monitoring of environmental conditions along with the study of corrosion and degradation in modern metallic samples after different exposition times were conducted in two wrecks, the *Fougueux* and the *Bucentaure* (Trafalgar Battle 1805). Both study sites have the same chronology but different environmental conditions. In this work we present the preliminary results obtained during the monitoring and degradation evaluation. Results will be later used to develop a decision making system, based on predictive models of permanence through the knowledge of materials and analysis of risk factors imposed by the marine environment.

Materials and Methods

Study site

Located near to the Bay of Cadiz, in the southwest coast of the Iberian Peninsula, the two archaeological sites monitored in Arqueomonitor project are associated with *Fougueux* and *Bucentaure* ships (Fig. 1a). Both vessels, belonging to the Franco-Spanish fleet in the Battle of Trafalgar (1805), were sunken during the violent storm that struck the coast of Cadiz during the following days to the Trafalgar Battle.

The ship S.M.I. *Bucentaure*, represents a scattered shipwreck where a total of 22 iron guns, remains of an anchor and other metallic artifacts are preserved. The site is located in the outer Bay of Cadiz, on a mixed rocky-sandy bottom at 12 m depth (Fig. 1b). Meanwhile, at *Fougueux* site, an important portion of the hull structure is preserved, along with 35 cannons and an anchor (Fig. 1c). The *Fougueux* lays on a sandy bottom at 7 m depth next to a little rock shoal. Located in front of the Sancti Petri sandspit, it's exposed to west and southwest waves.

The two shipwreck sites were selected after a previous archaeometry study conducted on metallic artifacts. This study had found significant differences in the corrosion rates. Despite the same chronology and proximity of both archaeological sites (16.5 km).

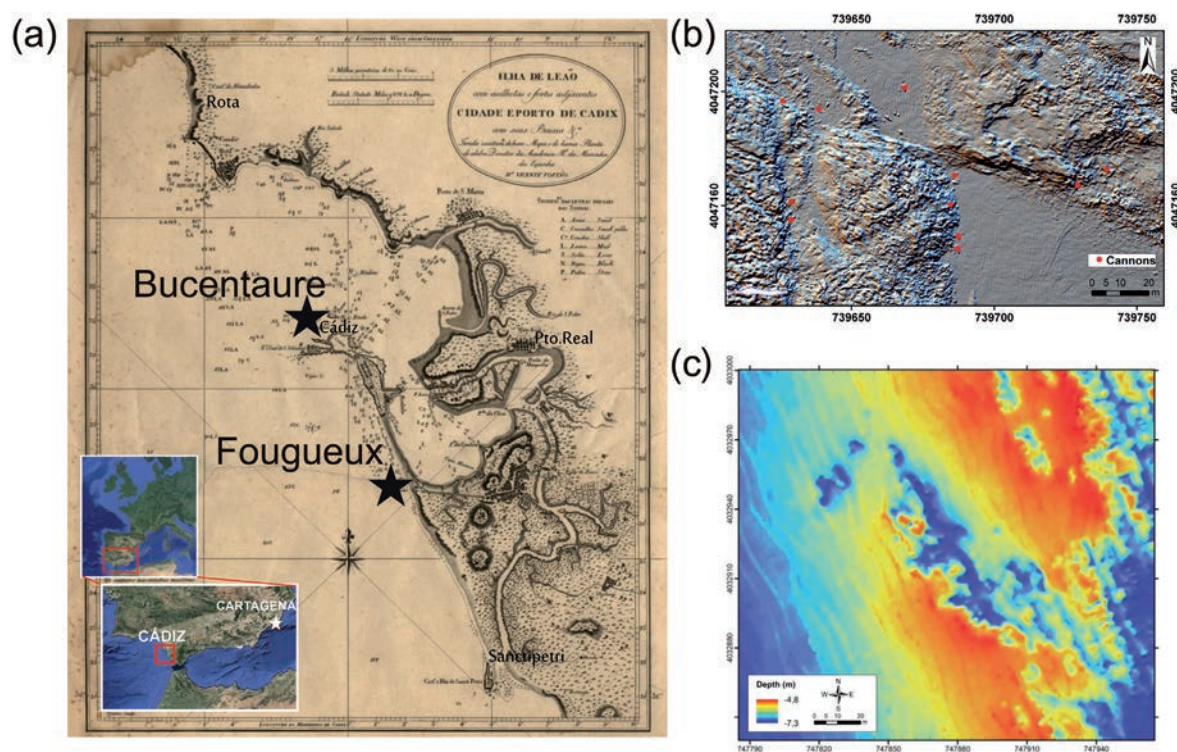


Figure 1. (a) Location of monitored sites (b) Bathymetry on the *Bucentaure* site derived from multibeam echo sounder. (c) Multibeam echo sounder bathymetry on the *Fougueux* site.

Environmental condition

The following section summarizes the methodology applied in order to monitor and study the marine environmental conditions at the *Fougueux* and *Bucentaure* sites.

Hydro chemical characterization

Two different sets of measurements were acquired at each studied site. On one hand, continuous measurement of temperature and turbidity was performed during different field experiments extended from 2011 to 2014. To this end, two moorings were installed. On the other hand, multiparametric probe profiles (Hidronaut 305 probe) were periodically acquired with monthly frequency in order to evaluate seasonal variation of seawater characteristics. Variables (S (‰), T (°C), pH, redox potential (mV) and dissolved oxygen (ppm) were measured each 10 cm depth interval.

Geochemical characterization

In order to characterize the chemical properties of the sediment surface layer, sediment cores were sampled at the *Fougueux* and *Bucentaure* sites. Three sediment cores with 60 cm length and 5.7 cm diameter were manually collected by a scuba diver. Subsequently pH, oxidation-reduction potential (ORP) and total organic carbon (TOC) were measured each 3 cm interval in order to characterize the above parameters variation. pH and ORP were measured using HANNA 1053B pH and HANNA HI3131B ORP instruments respectively, whereas TOC was measured using the titration method (El Rayis, 1985: 45-47).

Sediment characterization

In order to characterize the sediment grain size five sediment samples were manually collected by a scuba diver in each shipwreck site. Grain size analysis was performed through dry sieving method. Subsequently, statistics of particle size distributions were computed using the Folk and Ward method within the GRADISTAT software developed by Blott and Pye (2001). The sediment mobility and the geomorphological changes at the shipwreck sites were evaluated by time lapsed bathymetric surveys and the derived accretion-erosion model (Quinn/Boland, 2010: 2938-2946), as well as bed forms study on the sites.

Biological characterization

The biological community characterization at *Fougueux* and *Bucentaure* was carried out through two different studies. First, a quantitative analysis of benthic community in natural substrate was performed. Video transect sampling was carried out during cold and warm seasons. Second, a quantitative analysis of benthic community on artificial substrate was realized. Panels of 20 × 30 cm of copper, brass, cast, pine and oak were seated on sandy seabed, and on rocky seabed at two studied sites. Panels were periodically sampled by photography. In the two studied substrates, collection of organisms for identification was conducted, as well as abundance analysis applying image analysis techniques (fixed point quadrant with photograph and video) (Van Rein *et alii*, 2011: 676-689). Finally, the abundance of the different species was compared applying multivariate statistical analysis techniques (Anderson, 2001: 32-46).

Hydrodynamics and wave characterization

Local time series of waves and currents were acquired at the *Fougueux* and *Bucentaure* sites, during different field campaigns conducted from 2011 to 2014. An Acoustic Doppler Current Profiler (ADCP) was used to characterize current conditions in the whole column water. In addition an Electromagnetic Currentmeter (EM) allowed to measure current velocity and wave orbital velocity near the bottom. Afterward, acquired data were subject to statistical and harmonic analysis to facilitate the characterization of waves and hydrodynamic conditions.

Corrosion rates determination in modern samples

In order to evaluate metallic material degradation and assess correlation with marine environmental conditions, simultaneously to the environmental monitoring conditions, a field exposure test of metallic samples was conducted at both studied sites. The metallic materials selected for this purpose were the more usual in underwater archaeological sites: iron, iron cast, copper and brass. Metallic samples (7 cm × 3 cm) mounted in racks were emplaced on different environments: permanent burial under 30 cm sediment layer (H3); alternatively reburial and exposed conditions (H2) on seabed; continuously environmental exposed (H1) one meter above seabed. Samples were periodically collected after 6, 12 and 18 months exposure times. Afterwards electrochemical tests were performed on the samples whose result is not shown in this work. Finally weight loss tests, following the ASTM G1 procedure, were performed on samples in order to evaluate metal and alloys damage after the mentioned exposure times.

Results and Discussion

Environmental conditions

Hydro-chemical characterization

Measured hydro-chemical variables revealed analogous values at both studied sites, which can be explained by their proximity and similar water depths. Seasonal temperature variations oscillate between 13-14° C registered during February-March and 24° C registered on September. Both

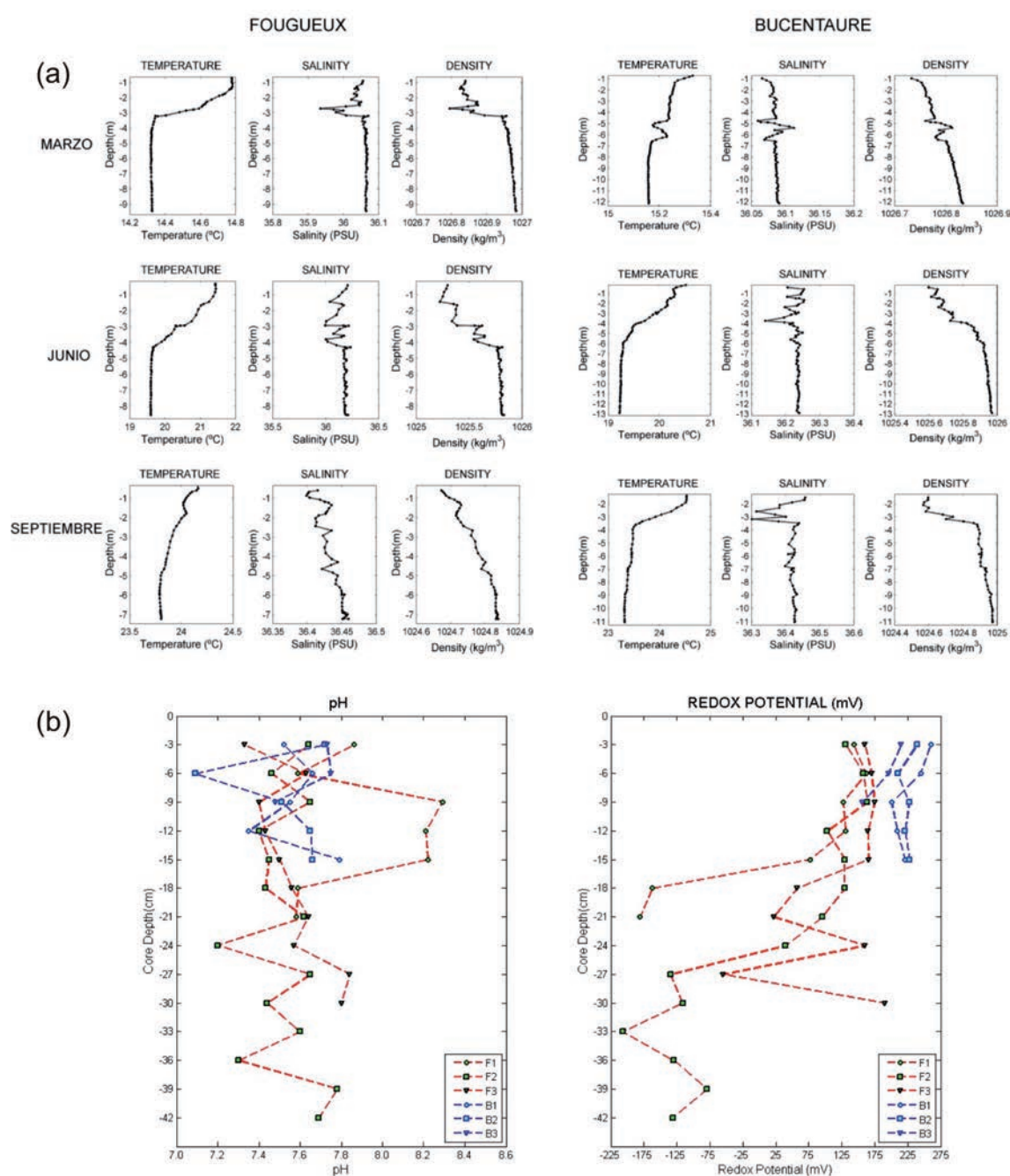


Figure 2. (a) Seasonal variation of temperature, salinity and derived density. (b) Profiles of pH and ORP in sediment surface layer in *Fougueux* and *Bucentaure* sites.

studied sites are subject to small variation in salinity, around 36-36.2 psu. These variations are even lower near the bottom. The density profiles show a well-mixed water column, although with a weak pycnocline associated with diurnal thermocline (Fig. 2a). Oxygen profiles showed well oxygenated water with levels around 8 mg/l. pH values are quite similar in both shipwreck sites, around 8.2, with a small seasonal and depth variation. Redox potential in water column fluctuates from 50 to 200 mV, showing similar values at both sampled sites.

Geo-chemical characterization

Regarding the geochemical characterization, dissimilarities were found in the *Fougueux* and the *Bucentaure* sediment surface layer (Fig. 2b). Despite the limited depth reached in the cores collected at *Bucentaure* station, differences were observed even in the first 15 cm of sediment layer. Thus, ORP reached 225 mV mean value at *Bucentaure* site, whereas at *Fougueux* 130 mV was measured. As ORP may be considered as a proxy of oxygen concentration, data revealed a lower oxygen concentration in sediment at *Fougueux*. Negative values of ORP were measured beyond 15 cm at *Fougueux*, which can be related with the existence of anoxic condition. The pH values are fairly similar at both sites and close to seawater value (8.2), although slightly more acid (7.6). The value of COT analysed in sediment shows a small concentration at both sites, though slightly higher at *Bucentaure*, which could be associated with the higher organic matter concentration due to the proximity of Guadalete river, and organic matter added in clay fraction transported from the inner Bay of Cadiz.

The lower content of oxygen at *Fougueux* site could inhibit the growing of shipworm *Teredo navalis*, allowing the conservation of wood material, which is consistent with the rests of the hull localized in *Fougueux* site, in opposition to *Bucentaure* site where only metallic artifacts remain.

Sediment characterization

Grain size analysis shows differences between sampled stations; while at *Bucentaure* sediments can be classified as moderately sorted coarse sand ($D_{50}=1.095$ mm), *Fougueux* site sediment is categorized as well sorted fine sand ($D_{50} = 0.177$ mm). The coarse grain size at *Bucentaure* entails more difficulty to transport in suspension mode, whereas at *Fougueux* the smaller grain size is likely transported in suspension mode. In addition well sorted sediments are present at the *Fougueux*, correlated with the high energy conditions in this area.

Fougueux seabed is mostly flat with little ripples identified during diving inspection, indicative of high energy conditions and transport in suspension mode. By contrast at *Bucentaure* site ripples 7-8 cm in height and 1.5 m in length remain always at sandy bottom, showing relative lower energy conditions, as well as predominance of bed load transport (Fig. 3b).

The time lapsed bathymetric surveys have shown that larger geomorphological changes occur at *Fougueux* site, where wave and hull remains interactions promote important scouring. Thus, during high energy conditions, the erosion around hull structure reaches a depth of 0.7 m at *Fougueux* site (Fig. 3a), whereas at *Bucentaure* only 0.3 m of erosion was measured. This process is promoted by the fact that sediment transport occurs in suspension and due to the higher energy imposed by waves. It should be noted that scouring may induce changes in geochemical conditions (oxic/anoxic) and promotes the scattering and loss of artifacts. In addition, sediment transport in suspension mode may have a negative impact due to the sediment abrasive effect on archaeological material.

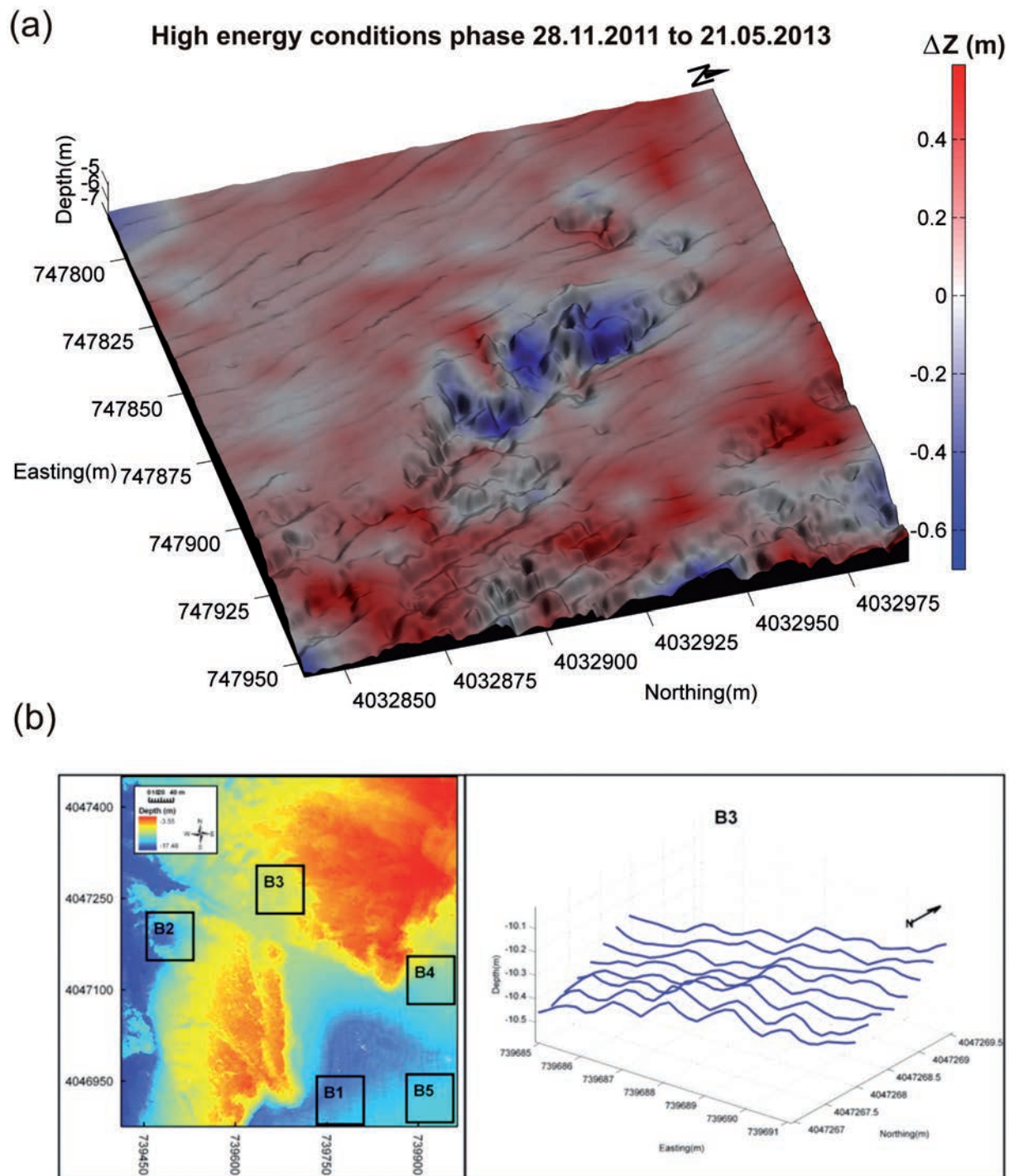


Figure 3. (a) Accretion-erosion plot of the *Fougueux* site derived from time-lapse bathymetric surveys and related to high energy condition period. (b) Bed forms at *Bucentaure* site.

Hydrodynamics and wave characterization

As the rose diagram shows (Fig. 4.a, Fig. 4.b), higher current velocity was registered in *Fougueux* site. Due to coast line orientation and predominant wind direction, the maximum value reaches up 0.5 m s^{-1} and has NNE direction, probably linked to an east wind event (Fig. 3a). However at the *Bucentaure* site the maximum velocity registered was 0.35 m s^{-1} (Fig. 3b). The current velocity

spectral analysis showed that tidal current velocity extracted was higher at *Bucentaure* site, being the main tidal component in the area M2 close to 0.2 m s^{-1} at *Bucentaure* and 0.10 m s^{-1} at *Fougueux*. Current direction is parallel to shore line, NNW-SSE at *Fougueux* (Fig. 3a) and WSW-E at *Bucentaure* site (Fig. 3b).

The lower panel shows the importance of wave factor, thus, for relative minor waves higher orbital velocity is measured at *Fougueux* site. In addition, for similar values of significant wave height (Fig. 3c) the orbital velocity is greater in *Fougueux* site (Fig. 3d) due to the depth linear dependence. Consequently, the bed shear stress induced by waves is markedly larger at *Fougueux* site, where it can promote higher rates of sediment transport and remobilization. Those results are in good agreement with the higher erosion rates measured and showed in the above section.

Biological characterization

Biological characterization at *Fougueux* and *Bucentaure* sites showed variations in the hard substrate benthic community, as well as in artificial substrate. In the case of natural substrate algae characterize the community at *Fougueux* site whereas sponges, molluscs, bryozoans, polychaete, characterize the community at *Bucentaure*. In addition it should be noted that benthonic community undergoes seasonal changes in the *Fougueux*, whereas remain relatively stable in *Bucentaure*. Regarding the artificial substrate, divergences arise between materials and substrate typology. Copper and brass panels did not experience colonization whereas in oak, pine, iron and iron cast panels there were greater rates of colonization. In addition, panels exposed on sandy seabed were periodically buried, leading to lower colonization rates. Moreover, concerning to artificial substrate, distinction between sites could be established. If well, after two months

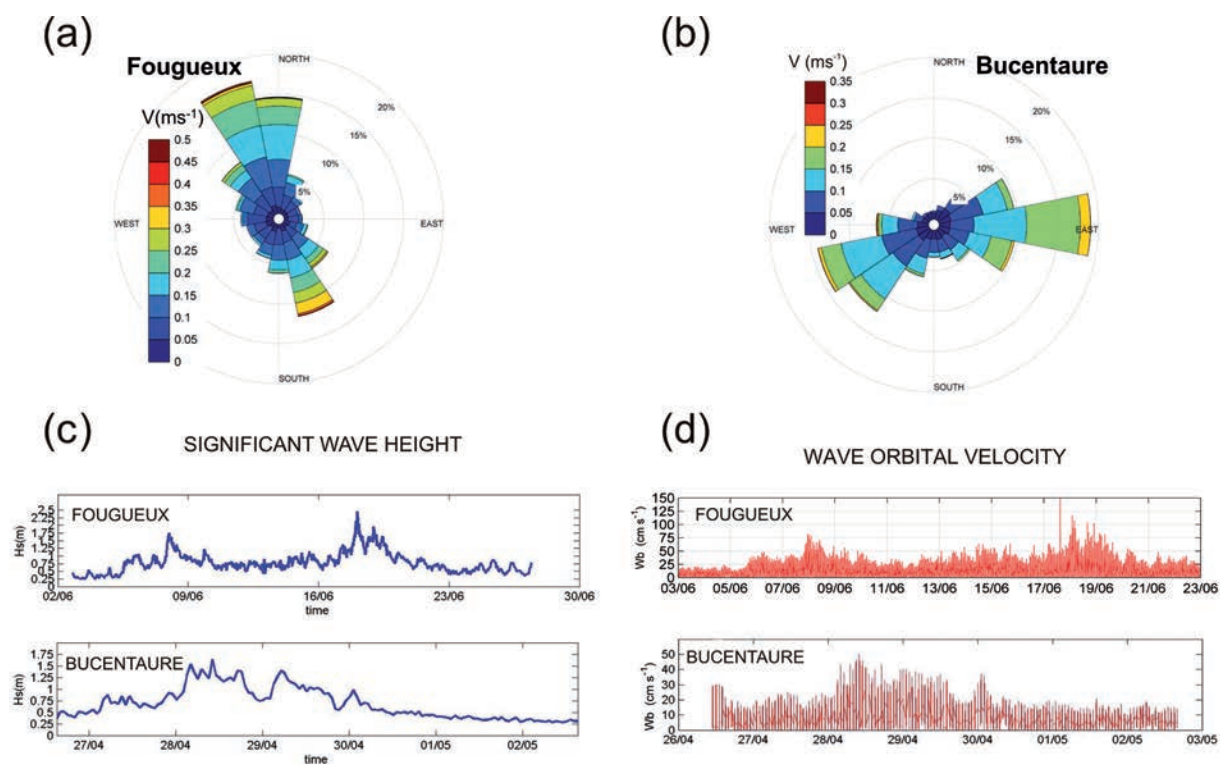


Figure 4. (a) Rose diagram of the mean depth current velocity in *Fougueux*. (b) Rose diagram of the mean depth current velocity in *Bucentaure*. (c) Time series of significant wave height at *Fougueux* and *Bucentaure* sites. (d) Time series of near bottom orbital velocity at *Fougueux* and *Bucentaure* sites.

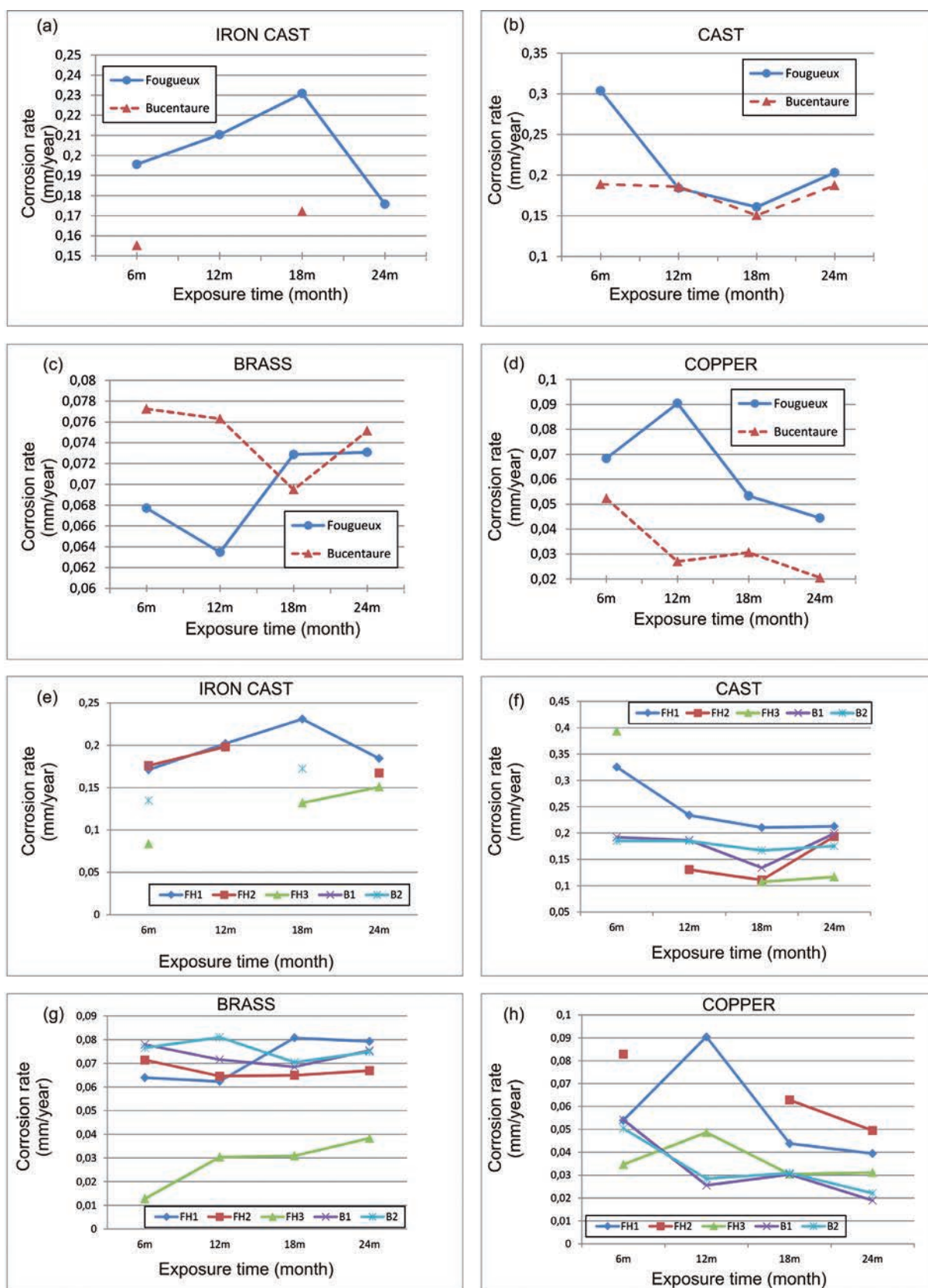


Figure 5. Weight loss test results. Evolution of corrosion rates of different materials analysed, result of average value from H1 and H2 (a) Iron cast. (b) Cast. (c) Brass. (d) Copper. Evolution of corrosion rates of different materials analysed taking into account the different location of samples. (e) Iron cast. (f) Cast. (g) Brass. (h) Copper.

of exposure the algae were the largest group which determine slight differences between sites, with the development of a biological community in the transition to mature status, after 15 month of exposure, the greater colonization of mollusks, bryozoans, annelids and barnacles at *Bucentaure* site also contributed to differentiate the community.

Corrosion rates determination in modern samples

Only the weight loss test results were present in this work. In order to undertake a comparative analysis between study sites an average value from H1 and H2 locations was calculated in each station. These results are depicted in Fig. 5a-5d which show the progress of corrosion rates derived from weight loss test. Highest rates of corrosion correspond to the *Fougueux* site with the exception of brass. Cast and iron cast show the higher corrosion rates with values 0.15-0.30 mm/year. Corrosion rates of brass and copper were markedly lower with values among 0.03-0.09 mm/year. Corrosion rate of iron cast, unlike other materials, continue to increase during all the tests performed.

Figures 5e-5h show the progress of corrosion rates derived from mass loss test performed after different exposure times, taking into account the different location of samples (H1 1 m above seabed; H2 on seabed; H3 buried under seabed, 0.30 cm approximately); code F is used for *Fougueux* location and B code is used for *Bucentaure* location.

In the case of *Fougueux*, where buried material is located, corrosion rates are markedly lower for H3 location, with values close to the half compared to the samples located above seabed. It can be observed that this behaviour was continued over the time. Although slighter than H3 and H2, differences also can be found between the H1 and H2 positions, with higher corrosion rates corresponding to H1 location with the exception of copper samples. The exception of copper samples could be explained by the elimination of patina during burial-exposure transition.

Conversely, corrosion rates measured at *Bucentaure* site showed smaller variations between samples located above seabed and those located one meter above the seabed.

The differences observed in the different heights could be attributed mainly to the sediment abrasive effect, thus whereas permanently buried samples keep on unaffected, samples located on the seabed are subject to alternate exposure and burial conditions, alternating periods of damage and protection. Samples located 1 m above seabed are continuously exposed to the sediment abrasive effect. The abrasive effect can act directly on material or removing the protective layer (as corrosion products or biological depositions).

A second factor could be the dissolved oxygen concentration in sediment layer, which decreases quickly at the *Fougueux* site as the geochemical characterization reveals, which reduces the corrosion rates in buried samples. However, salinity and temperature measurements don't show great differences between the first meter above the seabed.

Conclusions

Physical conditions have a crucial role in the degradation of the shipwrecks. The highest rates of corrosion were measured on metallic samples placed at *Fougueux*, which is subjected to higher energetic conditions due to wave action. Sediment remobilization and transport induced by waves at *Fougueux* site could cause the damage by direct mechanical effect on metallic material as well as by removing the layer of corrosion products developed on these along with the decrease of calcareous concretion thickness, having a direct negative impact on their conservation status.

Physical and hydro-chemical conditions, can contribute to develop different types of benthic community: dominated by algae or in turn with a greater presence of sponges, squirts and polychaetes, whose calcareous depositions seem to contribute positively to the UCH conservation.

Corrosion test results reveal that burial samples have markedly lower corrosion rates, showing that *in situ* conservation using burial methods could improve the conservation status of metal archaeological remains. Caution should be assumed and the characteristics of sediment and the nature of the objects must be analysed at each specific site, which may determine the minimum burial depth.

These results will be used to develop a decision making system, based on predictive models of permanence through the knowledge of materials and analysis of risk factors imposed by the marine environment.

Acknowledgments

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Propuesta de un sistema estructural modular prefabricado para proteger y conservar *in situ* el patrimonio arqueológico sumergido

Proposal of a modular prefabricated structural system in order to protect and preserve the underwater archaeological heritage *in situ*

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Resumen: esta comunicación analiza y desarrolla un sistema modular fijo destinado a preservar y conservar *in situ* elementos del patrimonio arqueológico sumergido. Esta iniciativa plantea la instalación de estructuras modulares prefabricadas que protejan este legado de posibles actos vandálicos, a la vez que faciliten la observación del yacimiento impidiendo el contacto directo del público con los restos protegidos. El sistema incluye puntos de anclaje que permiten el fondeo de embarcaciones para las diferentes intervenciones arqueológicas, así como del turismo subacuático controlado. Este sistema plantea la posibilidad de poder realizar excavaciones subacuáticas en seco, creando una atmósfera de aire alrededor del yacimiento que, si bien no evita a los arqueólogos estar sometidos a la presión existente en el exterior de la estructura y por tanto a la necesidad de realizar descompresiones, sí les permitiría poder trabajar en un ambiente aéreo sin necesidad de utilizar constantemente el limitativo equipo de buceo.

Palabras clave: Fundación Emilio Pérez Piñero, estructura modular, patrimonio arqueológico subacuático.

Abstract: This paper analyzes and develops a fixed modular system that preserves and conserves *in situ* the underwater archaeological heritage elements. This initiative proposes the installation of prefabricated modular structures that protect this heritage against possible vandalism, and also facilitate the observation while preventing the protected remains from direct contact with the general public. The system includes attachment points that allow anchoring boats for different archaeological interventions as well as monitored underwater tourism, in order to preserve and promote cultural heritage. This system presents the possibility to make dry underwater excavation, creating an atmosphere of air around the site; this doesn't prevent archaeologists to be subject to the pressure on the outside of the structure, and therefore to the need for decompression, but it would allow them to work in the open air without having to constantly use the limited diving equipment.

Key words: Emilio Pérez Piñero's Foundation, modular system, underwater archaeological heritage.

La creciente preocupación que a nivel nacional e internacional se está produciendo con respecto a la conservación y protección de los yacimientos arqueológicos subacuáticos ha hecho que en el equipo de la Fundación Emilio Pérez Piñero haya surgido la idea de intentar adaptar algunas de las tipologías de estructuras que componen nuestro objeto de estudio, para dar respuesta a esta situación. El avance técnico en la construcción de equipos de buceo, ya en la antigüedad, permitía la realización de trabajos subacuáticos. Con la modernidad, la tecnología consiguió emprender extracciones sistemáticas de pecios. Sin embargo, la llegada de los equipos autónomos de buceo y el acceso a los mismos por parte del gran público, a mediados del siglo pasado, vio incrementado en progresión geométrica el problema del vandalismo y el expolio de yacimientos. Otros factores a tener en cuenta en el deterioro de yacimientos son las amenazas biológicas como el *Teredo Naualis*, químicas como la corrosión de los metales, y ambientales como las tormentas. Si a esto se suma el hecho de excavar cuando los restos conservados sean interesantes a nivel científico para la humanidad, nos encontramos con la necesidad de proteger y conservar en su contexto original el patrimonio arqueológico sumergido.

La Convención sobre la Protección del Patrimonio Cultural Subacuático aprobada por la Conferencia General de la Unesco en noviembre de 2001, recomienda proteger el yacimiento en su contexto original y solo por motivos científicos extraer los objetos de la manera menos perjudicial, así como la posterior supervisión del mismo para evitar intrusismo. Con ello, se pretende que los yacimientos arqueológicos subacuáticos, casi siempre submarinos, sean más versátiles a la hora de trabajar en ellos, a la vez que más seguros ante las amenazas y más atractivos desde la óptica de la musealización *in situ*, sin necesidad de extraer los restos de su entorno físico y, por tanto, evitando algunos de los complejos y costosos métodos de conservación preventiva y restauración en un ambiente aéreo.

Ante esta necesidad de proteger y conservar *in situ* el patrimonio arqueológico subacuático se origina la propuesta que a continuación se desarrolla, sobre un sistema estructural modular prefabricado. La Fundación Emilio Pérez Piñero pretende contribuir con su investigación en el campo de las estructuras ligeras modulares y desplegadas, adaptando sus sistemas de estructuras a las necesidades propias de los yacimientos arqueológicos subacuáticos, con respecto de su entorno y, sobre todo, fomentando la creación de parques arqueológicos y museos subacuáticos. Esta iniciativa plantea la instalación de estructuras modulares prefabricadas que protejan este legado de posibles actos vandálicos, a la vez que faciliten la observación del yacimiento desde fuera, impidiendo al mismo tiempo el contacto directo del público en general con los restos protegidos.

Esta intervención parte de hechos y formas de trabajo reales e implantadas recientemente en España como el sarcófago metálico que protege el pecio fenicio de Mazarrón II (Fig. 1), pero también el sistema de jaulas metálicas desarrolladas sobre diversos yacimientos de Croacia (Fig. 2).



Figura 1. Armazón protector del pecio fenicio de Mazarrón II (España). © Archivo Museo Nacional de Arqueología Subacuática de Cartagena.

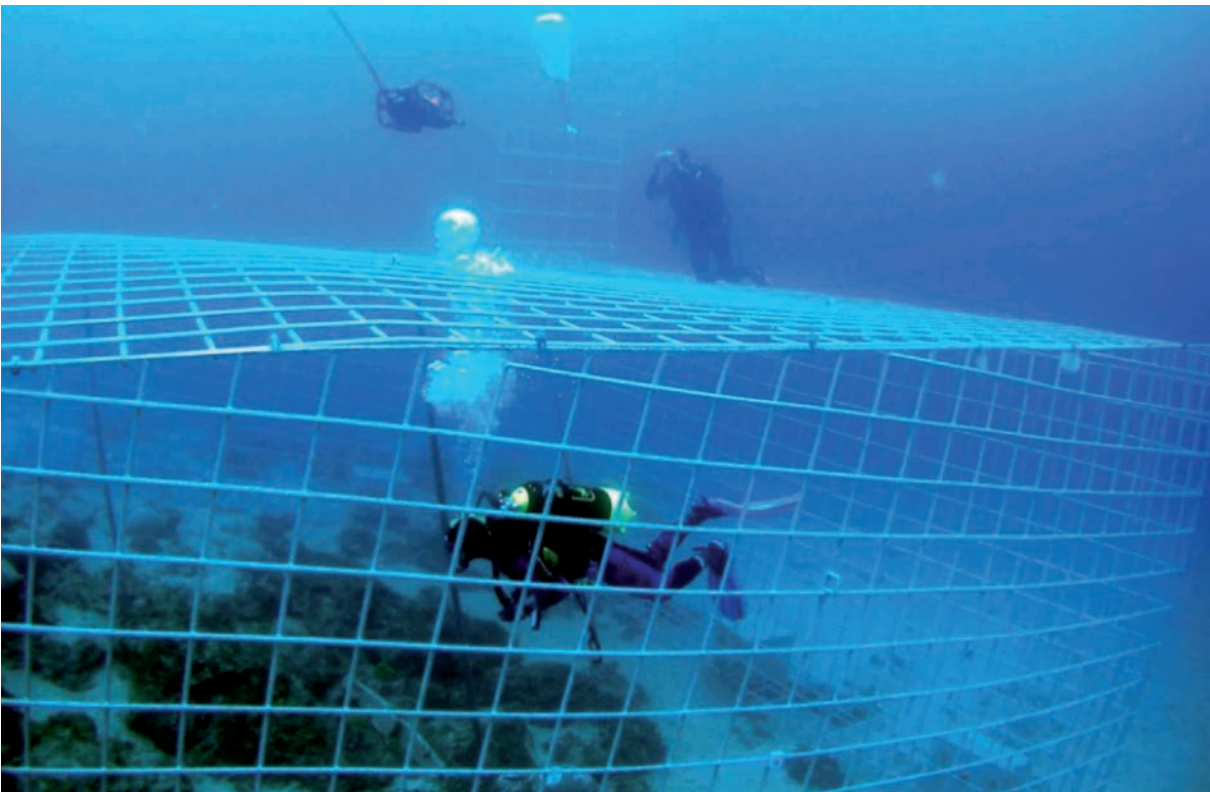


Figura 2. Pecio cerca de Pag (Croacia). © I. Radic-Rossi/Unesco.

Aunque algún aspecto de la propuesta se puede tildar de utopía, este campo de trabajo que hace tan solo unos pocos años era impensable, hoy día es una posibilidad real. Desde el punto de vista técnico hace tiempo que las soluciones tecnológicas requeridas en este estudio están más que resueltas. Lo mismo sucede con nuestra propuesta estructural que pretende, siempre y cuando las condiciones ambientales lo permitan, la valoración de los yacimientos sumergidos en su propio contexto, sin necesidad de tener que ser extraídos, posteriormente sometidos a complejos y costosos tratamientos de conservación o restauración y, finalmente, expuestos en una sala de museo.

No se trata de trasladar los museos de arqueología subacuática debajo del agua, sino de musealizar aquellos yacimientos que por su ubicación y condiciones ambientales sea posible. Una profundidad razonable sería en torno a los 20 m, aunque podría ser algo mayor siempre que se tuvieran en cuenta los tiempos necesarios de descompresión. Los museos seguirán teniendo su razón de ser al custodiar la memoria y conservar los objetos extraídos, sin embargo cuando haya estructuras arquitectónicas, embarcaciones y otros elementos de tamaño considerable, para evitar su descontextualización y la posterior conservación del pecio, se abogaría por la conservación *in situ*, cumpliendo con el artículo 2.5. de la mencionada Convención de la Unesco. De esta forma, los restos se expondrían en el propio pecio, en su contexto real, sin tener que recurrir a decorados y recreaciones artificiales, en ocasiones más teatrales que reales.

Nuestra propuesta consiste en un proyecto experimental de cúpula reticular desplegable realizada en acero inoxidable (Fig. 3). Se compone de nudos rígidos sobre los que se articulan tres barras que al girar sobre aquellos permiten plegar y desplegar la estructura, de forma prácticamente automática. Con ello se consigue la colocación de una de estas estructuras en cual-

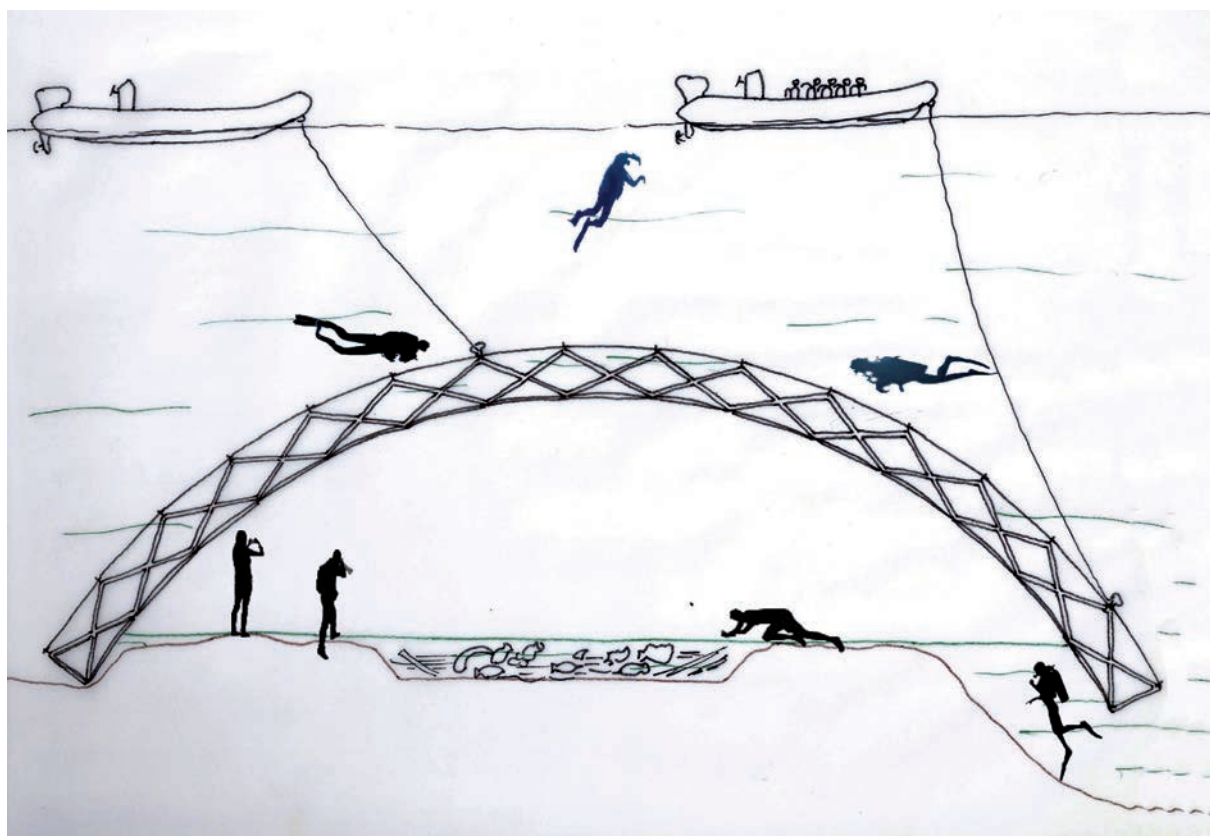


Figura 3. Esquema de sección de cubierta para proteger un pecio subacuático. © Fundación Emilio Pérez Piñero.

quier fondo, cubriendo y protegiendo el yacimiento en un espacio de tiempo muy reducido. Las dimensiones de esta cúpula irán en función del tipo de yacimiento que se pretenda proteger. Podría considerarse la posibilidad de maclar o unir mediante «pasillos» dos o más cúpulas cuando la complejidad y extensión del yacimiento lo requiera.

Esta estructura fue resuelta por el arquitecto Emilio Pérez Piñero en 1962 (Pérez Piñero, 1968: 1-18; 1970: 84-89). Está fabricada en aluminio y su transporte y posterior despliegue se ejecuta desde un helicóptero. Aprovechando los nudos inferiores, el despliegue se realiza espontáneamente y la rigidización es automática tras abrirse. Para recuperar la cúpula, solo es necesario suspender desde los nudos superiores, de esta forma la estructura se pliega automáticamente.

Las recientes investigaciones pretenden adaptar al ámbito subacuático este sistema, fabricándolo en acero inoxidable y añadiendo los elementos necesarios, como un sistema de anclaje de succión adecuado, que asegure en el fondo subacuático la estructura y permita subir la presión del aire de su interior para que los técnicos puedan trabajar en un ambiente aéreo. De esta manera no tendrían que utilizar el engorroso equipo de buceo durante el trabajo, tan solo sería necesario para realizar la inmersión de acceso al yacimiento. La cúpula albergaría en su interior espacio suficiente para los diferentes útiles de trabajo, así como una accesibilidad idónea para que pudieran trabajar los arqueólogos y el resto de técnicos restauradores, químicos o fotógrafos, entre otros.

Por tanto, nuestro planteamiento consiste en la adaptación de una cúpula desplegable en la que se crearía una «burbuja» de aire alrededor del yacimiento y simplificaría importantes labores de investigación, como zonificación del yacimiento, toma de datos, dibujos de campo o realización de fotografías. La cúpula desplegable vendría totalmente prefabricada al yacimiento. Una vez sumergida y colocada en el centro del área a cubrir se procedería a realizar el despliegue automático del conjunto. Este se conseguiría simplemente suspendiendo la estructura de seis nudos de la cara inferior de la misma. Posteriormente, se procedería al anclaje de la estructura al fondo marino. Con anterioridad, se localizarían los puntos clave sin restos donde anclar la estructura. De esta forma, ya se dispondría de una jaula protectora contra vandalismo y expolio que a su vez podría ser utilizada como elemento de fijación de cabos de fondeo de embarcaciones propias y de visitantes.

En el caso de querer crear el ambiente aéreo en torno al yacimiento, el paquete inicial de barras que forman la cúpula plegada ya llevaría incorporada la lámina plástica que separa el ambiente exterior del interior y permite la creación de la burbuja de aire en su interior. Los restos conservados siempre estarían sumergidos en el agua. Dependiendo del tipo de interés que ofrezca la excavación del pecio, la lámina plástica sería transparente o simplemente translúcida, debiéndose colocar en la capa interior de la estructura (Fig. 4).

Descripción y geometría de la cúpula propuesta para proteger un pecio subacuático	
Base útil	14,00 m Ø
Longitud de la circunferencia base	43,98 m
Altura libre en la clave	4,95 m
Canto de la estructura	1,00 m
Superficie útil	153,94 m ²
Superficie interior del casquete	230,78 m ²
Volumen interior del casquete	444,17 m ³

Figura 4. Descripción y geometría de la cúpula propuesta para proteger un pecio subacuático.

Quizás, el problema más importante por resolver sea la ya mencionada sujeción al fondo del conjunto, de forma que estos anclajes eviten que la «burbuja» creada tienda a separarse del fondo y flote como un enorme globo. Para resolver este problema se utilizarían pilotes de succión del mismo tipo que el empleado para el anclaje al fondo de las plataformas petrolíferas, boyas de descarga de petróleo o el fondeo de grandes barcos. Estos pilotes funcionan llegando a admitir cargas de tracción de varias decenas de toneladas y consisten en un tubo hueco de acero análogo a un pilote, pero de mayor diámetro. El pilote de succión se introduce en el lecho marino mediante una bomba ubicada en la parte superior del tubo que crea un diferencial de presión. Cuando la presión en el interior del tubo es menor que en el exterior, el tubo es succionado y penetra en el suelo. Tras la instalación, la bomba se extrae. Como sucede con el pilote convencional, la capacidad de agarre de un pilote de succión se genera por el rozamiento del terreno a lo largo del pilote y por la resistencia del suelo.

A modo de conclusión, desde la Fundación Emilio Pérez Piñero se pretende contribuir a la salvaguarda del patrimonio cultural subacuático con esta estructura. Se trata de una propuesta, a nuestro juicio innovadora, que se puede adaptar a cada yacimiento. Aunque no evita a los buzos estar sometidos a la presión existente, sí facilita la excavación al crear una atmósfera de aire alrededor del pecio, a la vez que delimita el entorno como si de una jaula se tratase, con el fin de que tanto el propio pecio como el proceso de excavación pueda ser observado desde fuera por el público en general.

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Proyecto Cabrera 2013. Prospecciones subacuáticas en la isla de Cabrera

Cabrera Project 2013. Underwater survey in the island of Cabrera

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Resumen: en el año 2013, promovido por la Asociación SIAS (Sociedad de Investigadores en Arqueología Subacuática) se inició el Proyecto Cabrera. Este proyecto consiste en la prospección subacuática, documentación y seguimiento arqueológico de una serie de pecios conocidos ya desde los años 1980-1990, concretamente los denominados como *Cabrera I, III y XII*. En este artículo presentaremos los resultados de la actuación llevada a cabo analizando la metodología utilizada y las dificultades encontradas a la hora de realizar dichos trabajos. La importancia de este proyecto radica no solo en la realización de un seguimiento arqueológico de una de las áreas de mayor importancia para el comercio en la Antigüedad, sino también en la aplicación de nuevas vías de financiación para su realización así como el uso de nuevas tecnologías como la fotogrametría digital subacuática para su documentación.

Palabras clave: *crowdfunding*, Cabrera, prospecciones subacuáticas, fotogrametría digital subacuática, pecio.

Abstract: The Cabrera Project began in 2013, being promoted by the SIAS Association (Society of Researchers in Underwater Archaeology). This project consists in underwater survey, documentation and archaeological monitoring of a number of shipwrecks known in the 80s and 90s and specifically called as Cabrera I, III and XII. This article presents the results of the actions carried out, by analyzing the methodology used and the difficulties encountered when performing such work. The importance of this project lies not only in conducting an archaeological monitoring of the areas of greatest importance for trade in the Antiquity, but also in implementing new funding for its accomplishment and the use of new technologies such as underwater digital photogrammetry for documentation.

Key words: Crowdfunding, Cabrera, underwater surveys, underwater digital photogrammetry, shipwreck.

Introducción

El Proyecto Cabrera es el primer proyecto realizado por la Asociación de Investigadores de Arqueología Subacuática (SIAS) tras su creación en el año 2013. El objetivo de esta asociación española sin ánimo de lucro es la creación de proyectos que valoren el patrimonio arqueológico subacuático así como servir de plataforma para la formación y promoción de jóvenes investigadores, tanto nacionales como internacionales. Asimismo, el objetivo del Proyecto Cabrera fue la realización de una serie de prospecciones subacuáticas sobre tres pecios localizados en las inmediaciones del puerto de la isla de Cabrera. En dos de los pecios prospectados (*Cabrera I* y *Cabrera III*) se realizaron una serie de sondeos por parte del PEAS (Patronato de Excavaciones Submarinas de Baleares) en la década de 1970 y posteriormente por Guerrero y Colls (Bost/Campo/Colls, 1992; Guerrero/Colls/Mayet, 1987; Guerrero/Colls, 1982). Por el contrario, del tercer pecio (*Cabrera XII*) se conocía poco más que su localización aproximada y parte de su cargamento, gracias a las intervenciones realizadas por el GAS (Grup d'Arqueologia Subaquàtica de Mallorca) entre 1997 y 2000 (Pons *et alii*, 2001). Por tanto, el proyecto se centró en la relocalización de los pecios con la finalidad de determinar su actual estado de conservación, concretar el tipo de cargamento que transportaban así como servir de elementos para la implantación de nuevas técnicas de documentación arqueológica, como puede ser la fotogrametría.

Este proyecto se caracteriza por la novedad de ser financiado a través de micromecenazgo o *crowdfunding*¹, siendo el primer proyecto de Arqueología Subacuática en España que utiliza este tipo de estrategia para su financiación. Esta herramienta ha demostrado ser de gran

¹ <http://www.verkami.com/projects/5670-proyecto-cabrera-2013-intervenciones-de-arqueologia-subacuatica>

efectividad a la hora de conseguir una implicación social en las propuestas presentadas. Por tanto, la campaña de *crowdfunding* ha permitido alcanzar uno de los principales objetivos de SIAS: la concienciación social sobre el patrimonio arqueológico subacuático de la isla de Cabrera, mediante la realización de visitas guiadas al archipiélago; visitas a museos y centros de interpretación; así como la realización de un documental sobre el Proyecto Cabrera.

Tras dos campañas quincenales en los meses de septiembre y octubre durante los años 2013 y 2014, el equipo de SIAS, formado por jóvenes investigadores, tanto de ámbito nacional como internacional, presenta a continuación los resultados preliminares de ambas campañas.

Contextualización geográfica e histórica

Antes de abordar los aspectos técnicos del Proyecto Cabrera, debemos contextualizar geográficamente e históricamente el área arqueológica en que se intervino, el archipiélago de Cabrera.

La isla de Cabrera es la mayor de las 18 islas que conforman el Parque Marítimo Terrestre de Cabrera, situado a unas 10 millas náuticas al sur de la isla de Mallorca. Tanto las islas Baleares, como el archipiélago de Cabrera, se encuentran a medio camino entre la península ibérica, y las islas de Córcega y Cerdeña, y en última instancia, del resto del Mediterráneo central y del oriental. Esta situación confiere a las islas un enorme valor estratégico para aquellas culturas que realizaban comercio de larga distancia por vía marítima durante la Antigüedad, desde púnicos y romanos hasta época moderna y contemporánea (Guerrero/Colls, 1982). Por tanto, nos encontramos ante unas islas que, dado su enclave estratégico, fueron de gran atractivo para los navegantes y comerciantes de la Antigüedad como bien atestigua la gran cantidad de pecios que se encuentran bajo sus aguas. No obstante, los primeros vestigios de actividad humana en el archipiélago de Cabrera se remontan a época talayótica (Camps, 1960), pero no será hasta la época clásica, con la llegada de las embarcaciones púnicas, y posteriormente romanas, que el archipiélago vivirá su época de mayor esplendor.

A pesar de que Cabrera cuenta con uno de los puertos naturales mejor protegidos al este del Mediterráneo, su escarpada orografía, junto con los ocasionales fuertes vientos de tramontana de componente norte, produjeron gran número de naufragios a lo largo de los siglos. Buena prueba de ello es la referencia que hace Plinio en su *Historia Natural* sobre el archipiélago (Blanes *et alii*, 1990):

«Cabrera, peligrosa a causa de los naufragios, dista de la isla mayor (Mallorca) 12000 pasos hacia altamar». Plinio, *Hist. Nat.*, III, 77

A pesar de ello, las posibilidades de resguardo así como de abastecimiento de agua y comida, hicieron que Cabrera se convirtiera en una parada obligatoria para aquellos navegantes que frecuentaban el archipiélago balear.

Desafortunadamente, y como ha podido atestigüarse en gran parte de la costa mediterránea, desde las décadas de 1960-1970 del siglo pasado, el rico patrimonio arqueológico subacuático del archipiélago ha sido sistemáticamente expoliado por gran número de submarinistas que, junto con la escasa actividad científica realizada sobre el mismo, ha provocado un gran desconocimiento del mismo.

Es en este punto donde SIAS decide reemprender la actividad científica en el archipiélago mediante la realización de una serie de prospecciones subacuáticas que procederemos a explicar a continuación.

Prospección arqueológica

La primera fase de trabajos efectuados en el año 2013 consistió en la realización de una serie de prospecciones subacuáticas sobre las áreas previamente delimitadas donde debían de localizarse los pecios *Cabrera I*, *Cabrera III* y *Cabrera XII*. Por tanto, el objetivo principal de esta actuación fue la identificación de las zonas con mayor concentración de materiales en superficie para determinar los lugares más adecuados para la realización de sondeos en futuras campañas. No hay que olvidar que, a pesar de que estos yacimientos ya fueron objeto de estudio con anterioridad, en alguno de los casos hacía décadas que no se realizaba ningún tipo de actuación sobre los mismos, y dado que los fondos estaban compuestos mayormente por arena y placas de *posidonia*, la localización de estas embarcaciones suponía un gran reto para los medios técnicos con los que se contaba. En este sentido, hay que señalar que los permisos otorgados por la Consejería de Patrimonio solo permitían la prospección visual de los yacimientos, impidiendo cualquier tipo de remoción de sedimentos.

Áreas de prospección

Dadas las grandes dimensiones del puerto de Cabrera, y gracias a las referencias encontradas en la bibliografía (Bost/Campo/Colls, 1992; Guerrero/Colls, 1982; Guerrero/Colls/Mayet, 1987; Pons/Riera/Riera, 2001), se delimitaron dos áreas de prospección: Área A y Área B.

En el Área A, también conocida como «Ensenada des Castell», las fuentes situaban la localización de los yacimientos *Cabrera I* y *Cabrera III*, apenas separados por unos 60 metros el uno del otro (Guerrero/Colls, 1982). Se trata de una pequeña cala situada en la entrada del puerto de Cabrera, cuyos fondos alcanzan los 90 metros de profundidad en la parte central del

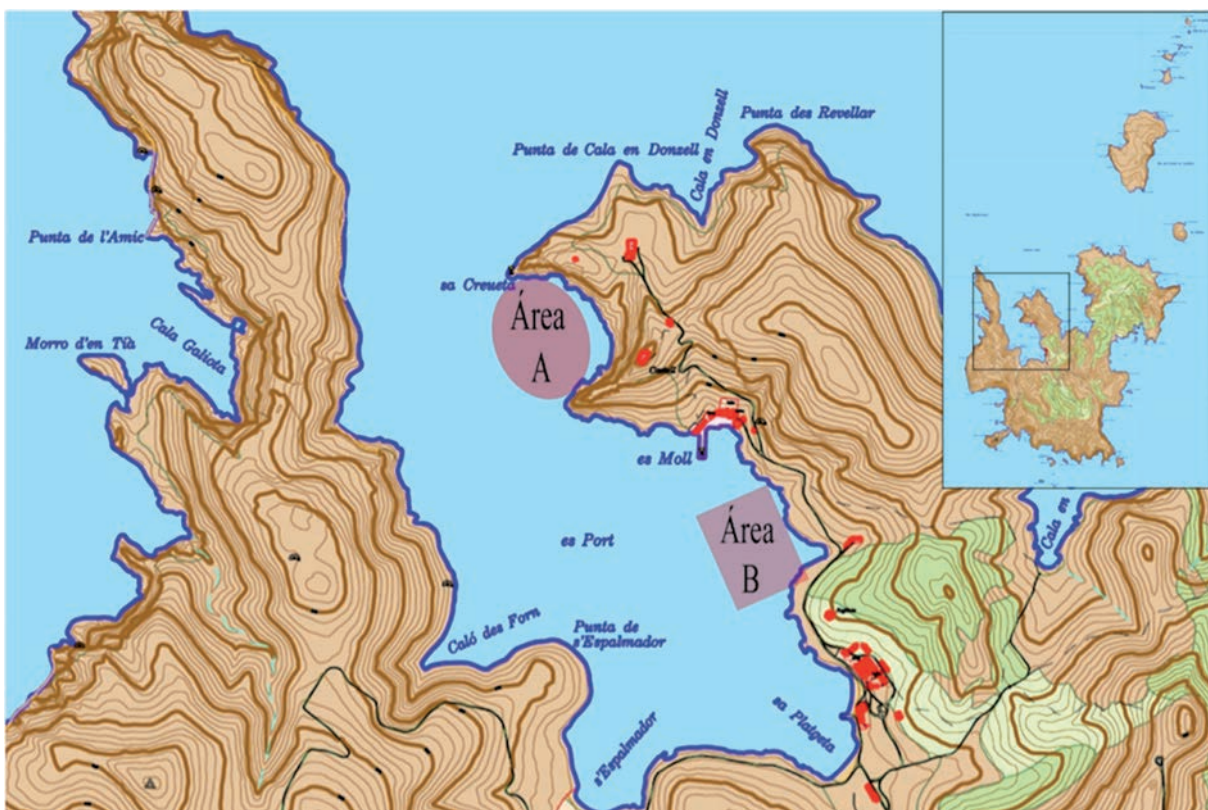


Figura 1. Localización de las áreas de prospección A y B del puerto de Cabrera.

canal del puerto. Según las mismas fuentes, durante las excavaciones realizadas en la década de 1970, se localizaron dos embarcaciones romanas a unos 22 metros de profundidad, datadas entre los años 244 y 258 d. C., gracias a la localización de 970 monedas de bronce encontradas en un ánfora Dressel 23. Asimismo se han atribuido cargamentos prácticamente iguales para ambas embarcaciones, formados por ánforas Dressel 20 así como ánforas del sur peninsular Almagro 50 y 51C, Beltrán 72 y 68. Igualmente, se localizaron ánforas norteafricanas de la Byzancenne de tipología Africana II-B y C, para el transporte de aceite y salazones de pescado, así como cerámica común y de cocina, de la misma procedencia. Por último, bajo el cargamento anfórico del *Cabrera III*, se encontraron restos de la arquitectura naval que hacen pensar que se trataba de un navío de unos 35 metros de eslora por 9 de manga.

Paralelamente, situado a unos 200 metros al sur del Área A, y a una profundidad de unos 15 metros, se localizó lo que se ha interpretado como un alijo de expolio formado por un conjunto de ánforas compuesto por: un ánfora Bizancena Africana IIC; una Dressel 14; y un pivote sin identificar. Dada su descontextualización y posible procedencia de varios pecios del archipiélago, se cree que estas ánforas fueron expoliadas y depositadas en una zona segura y de fácil acceso, a la espera del momento idóneo para su extracción.

Por otro lado, el pecio *Cabrera XII* se sitúa en el Área B, frente al «Caló de ses Gules», a unos 500 metros al sur del actual embarcadero de Cabrera. En este caso, se trata de una embarcación de finales del siglo XVII y mediados del siglo XVIII en el que fue localizado material cerámico a nivel superficial, formado por cerámicas decoradas destinadas a la importación así como cerámicas comunes de producción local y otros materiales de diversa índole como un conjunto de pipas de caolín y pastas negras, a una profundidad de entre 10 y 15 metros. No obstante, a pesar de su poca profundidad, la localización de esta embarcación fue la que conllevó mayor problemática, debido a la gran dispersión de los materiales en superficie.

Técnicas de prospección

Para la realización de las prospecciones se contó con tres equipos formados por cuatro arqueólogos subacuáticos y una pequeña embarcación de apoyo. Cada equipo contaba además con una cámara *GoPro Hero 3* para la cobertura en vídeo de las inmersiones.

Para la revisión del Área A se llevó a cabo una prospección con recorridos previos. De este modo, los arqueólogos inspeccionaron de manera sistemática una zona previamente delimitada. Para ello, se instaló un carril de prospección mediante la disposición de un cabo de nilón plomado de unos 600 metros de longitud. Dicho cabo fue marcado con etiquetas identificativas cada 10 metros para facilitar la ubicación de los posibles hallazgos arqueológicos. El cabo plomado fue lanzado desde la embarcación de apoyo, georeferenciado con GPS y balizado en superficie con boyas de señalización en ambos extremos. Una vez instalado el carril de prospección, se procedió a la cobertura visual del área delimitada, en algunos casos llegando a una cobertura de hasta 40 metros de anchura. Por tanto, la utilización de esta metodología garantizó una inspección exhaustiva y controlada de toda el área.

Una vez localizada el área correspondiente a los pecios *Cabrera I* y *Cabrera III* se balizó el lugar y se procedió a la documentación del yacimiento.

Por lo que respecta al Área B, dada la gran extensión y dispersión de materiales arqueológicos existentes en la zona, tuvieron que realizarse diversas técnicas de prospección. En este caso, se alternaron prospecciones circulares con ayuda de un eje guía y prospecciones por carriles. Finalmente, tras cubrir un área de más de 15 000 metros cuadrados, se localizó una zona

de unos 100 metros cuadrados con una gran concentración de materiales correspondientes al pecio *Cabrera XII*. No obstante, y a falta de realizar sondeos y una excavación en extensión, no se podrá identificar la localización exacta de la embarcación.

Documentación de los yacimientos

Una vez localizados los pecios *Cabrera I* y *Cabrera III* en el Área A se procedió a su documentación. Dado que ambas embarcaciones se encontraban en dos lenguas de arena rodeadas por placas de *posidonia oceanica*, se procedió a realizar un croquis acotado para cada uno de los pecios (Fig. 2). Los materiales en superficie se plasmaron sobre una planimetría utilizando ejes cartesianos X-Y, con el fin de identificar posibles patrones de dispersión que pudieran corresponderse con el cargamento ya identificado en 1970. No obstante, dada la gran fragmentación de los materiales no ha sido posible identificar un número suficiente de piezas para tal propósito.

La metodología utilizada para la realización de dicha planimetría requirió la participación de tres arqueólogos; dos encargados de tomar las coordenadas X e Y, mientras un tercero pasaba dichos puntos al papel milimetrado, junto con un esbozo de las piezas identificadas. Una vez finalizado el dibujo planimétrico se procedió al fotografiado de los diferentes conjuntos cerámicos, para su posterior identificación y, finalmente, se realizó un fotomosaico de cada pecio así como una fotogrametría en extensión, la cual será explicada con mayor detalle en el siguiente apartado.

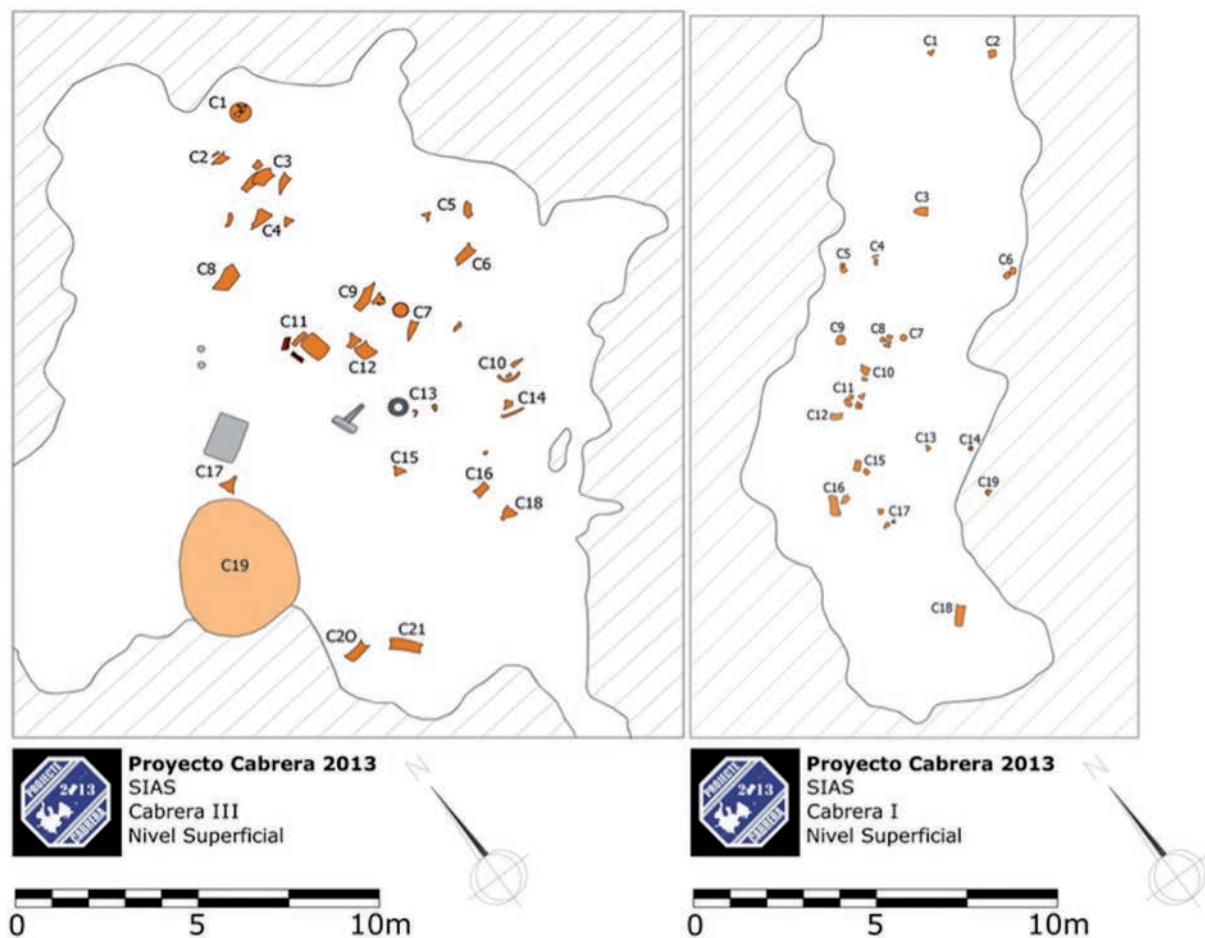


Figura 2. Planimetrías de los yacimientos *Cabrera III* y *Cabrera I*.

Por lo que respecta al Área B, en un primer momento, se descartó la realización de un croquis dada la gran extensión del área a cubrir. No obstante, tras la delimitación del área gracias a la localización en 2014 de la concentración de materiales, se procedió a la realización de un croquis utilizando la misma técnica aplicada en el Área A. De igual modo, se numeraron, ubicaron y fotografiaron las piezas para su posterior identificación.

Aplicación de nuevas tecnologías: fotogrametría digital subacuática

La fotogrametría digital nos permite obtener modelos tridimensionales a partir de un conjunto de fotografías o fotogramas que son procesados por un *software*, como por ejemplo *Agisoft Photoscan* o *PPT*. La fotogrametría digital subacuática se está aplicando actualmente por distintos equipos de investigación y está demostrando ser una técnica que proporciona muy buenos resultados tanto para la documentación de yacimientos subacuáticos como para la divulgación de los mismos.

En el Proyecto Cabrera utilizamos la fotogrametría digital subacuática en los yacimientos tanto del Área A como del Área B, explicadas anteriormente, puesto que ofrecían distintos escenarios en los que experimentar con varias estrategias de captura de imágenes y diferente equipo fotográfico, así como distintos *software* para generar modelos tridimensionales y ortofotografías, tanto de grandes áreas de fondo marino como de artefactos individuales. Estos planteamientos fueron posibles gracias a la gran visibilidad de las aguas de Cabrera y las buenas condiciones climatológicas que permitieron obtener unos buenos resultados.

En la campaña de 2013 los trabajos se centraron en el Área A, en la que se contó con una cámara *GoPro Hero3* y una cámara compacta para la toma fotográfica. El yacimiento *Cabrera III* proporcionaba una gran área bien delimitada por *posidonia* por lo que se decidió experimentar con la obtención de un modelo tridimensional a partir de vídeo con *GoPro*. La toma de vídeo se realizó siguiendo un recorrido en carriles de menos de 2 metros de separación, para que el solape entre las tomas fuese el mayor posible, a una velocidad y profundidad constante. Una vez finalizado el recorrido se seleccionaron los mejores fotogramas para su posterior procesamiento. Con esta técnica obtuvimos un modelo tridimensional del *Cabrera III* y una ortofotografía, muy útil para la organización de las intervenciones en esa área (Fig. 3). En este sentido, este proceso demostró cómo la obtención de imágenes mediante fotogramas es muy útil durante el principio de la

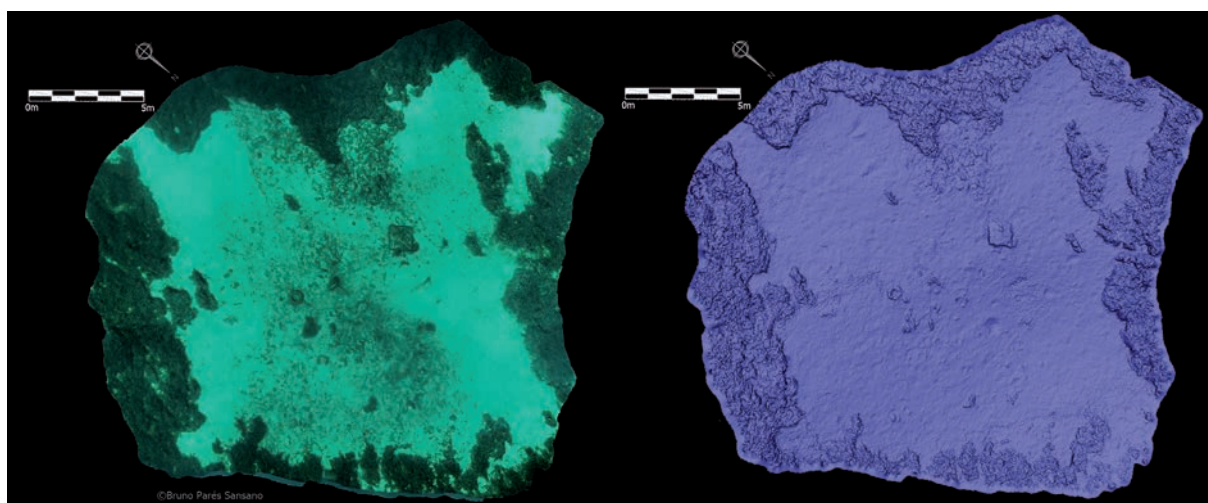


Figura 3. Ortofotografía y modelo tridimensional del pecio *Cabrera III*.

campana ya que con ella se puede generar, después de una sola inmersión, sin un entrenamiento específico y sin utilizar marcadores (utilizando elementos del entorno previamente medidos para escalar el modelo), una ortofotografía del área que se va a intervenir.

Sobre el conjunto de fragmentos anfóricos correspondiente al alijo de material arqueológico expoliado hallado, se combinó la captura de imágenes mediante fotografías con la cámara compacta y la toma de video con cámara *GoPro*. Para ello se dispusieron una serie de marcadores sobre el conjunto anfórico y se procedió a una estrategia de captura fotográfica y de vídeo en cúpula, es decir, sobrevolando el conjunto en círculos para formar una cúpula de fotografías alrededor del conjunto y obtener un gran solapado fotográfico. El resultado de este método fue un modelo tridimensional del conjunto arqueológico que poseía una mayor precisión y calidad que el modelo hecho con fotogramas a partir de vídeo, pudiendo visualizarse perfectamente y sin ninguna deformación tridimensional las formas de los materiales arqueológicos y el fondo marino. De las dos pruebas, el modelo 3D generado con las fotografías de la cámara compacta fue superior al generado con *GoPro* al tener un mayor control sobre el enfoque y la iluminación. No obstante, hay que indicar que, con esta técnica no se pueden hacer áreas demasiado grandes. Asimismo, los submarinistas han de tener un buen control de la flotabilidad, y la zona necesita una preparación previa de medición y posicionamiento de marcadores para la correcta toma fotográfica.

En lo que respecta a la campaña de 2014, se preparó un campo de pruebas subacuático de 30 metros cuadrados a 2 metros de profundidad para poner en práctica las técnicas y estrategias de captura de imágenes y posicionamiento de marcadores, antes de ser utilizadas en los yacimientos de las Áreas A y B. Asimismo, en esta segunda campaña se contó con un equipo fotográfico profesional con focos para la toma de fotografías y vídeo subacuático, una cámara réflex Canon 7D y un torno subacuático *Ostreatus 1.0*, para la obtención de modelos tridimensionales completos de artefactos arqueológicos.

En el Área A se realizó nuevamente el modelo tridimensional del área del yacimiento *Cabrera III*, pero esta vez con fotografías en alta calidad, con iluminación y carriles de un metro marcados con marcadores. Esta estrategia de captura fue la que ofreció unos resultados más precisos y permitió hacer la toma fotográfica en distintas inmersiones, siempre y cuando no haya una alteración del área a fotografiar, consiguiendo cientos de fotografías por carril. El modelo tridimensional obtenido con esta técnica ofrece una gran resolución y detalle. No obstante, se requiere un ordenador de gran potencia y se exige una buena coordinación entre los submarinistas para una correcta cobertura fotográfica.

En el Área B, una vez finalizada la documentación y referenciación geográfica de la extensa zona arqueológica del *Cabrera XII*, en el que hay mucho material disperso y en movimiento debido a las corrientes en la superficie del fondo marino, se eligieron una serie de artefactos con gran potencial para su virtualización completa mediante fotografías de alta calidad. En esta ocasión, la estrategia de captura de imágenes fue la cobertura en cúpula. La estrategia de captura de imágenes en esta ocasión fue la de cúpula pero utilizando un *Ostreatus 1.0*, es decir, un torno subacuático con trípode adaptable al fondo y con los grados de rotación marcados para que la fotografía sea mucho más precisa. Una vez realizada la toma fotográfica de las diferentes partes de la pieza, esta se volvía a colocar en la ubicación y posición original en la que se había encontrado en el lecho marino. La ventaja de este sistema de documentación radica en que, si está ensayado por los miembros del equipo de fotogrametría, se pueden obtener en 30 minutos todas las fotografías necesarias para generar un modelo tridimensional completo del artefacto sin tener que sacarlo del agua, siempre y cuando las dimensiones del mismo no superen las del torno que lo sustenta. Los modelos generados con este procedimiento cuentan con gran resolución como se puede ver en la imagen (Fig. 4).

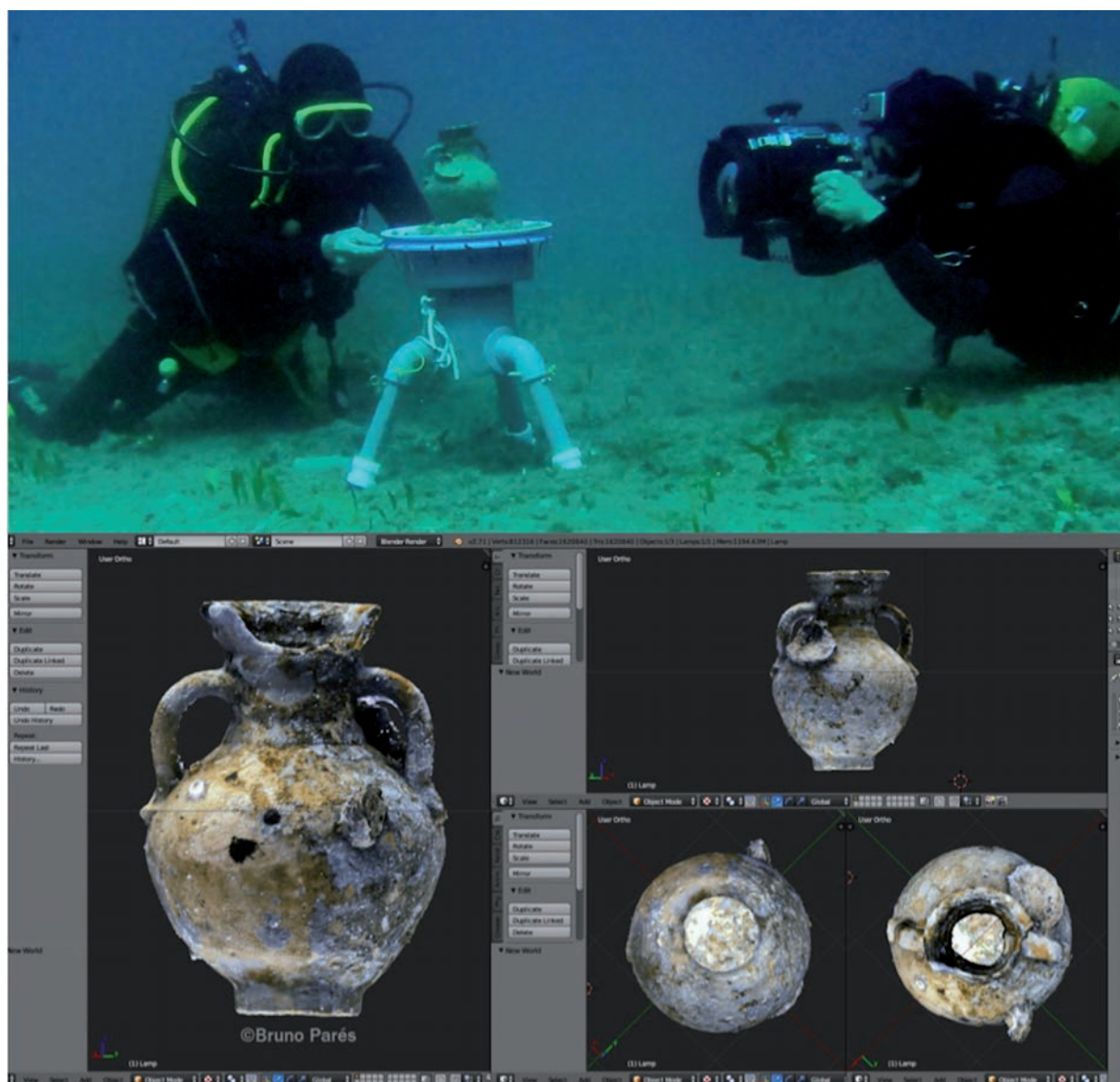


Figura 4. Cobertura fotográfica utilizando el *Ostreatus 1.0* y modelo tridimensional de una jarrita con doble asa del pecio *Cabrera XII*.

Asimismo, todos los modelos tridimensionales obtenidos mediante la fotogrametría digital subacuática en el Proyecto Cabrera pueden ser visualizados *online* y ser imprimidos con una impresora 3D, lo que supone una mejora tanto para la documentación e investigación de yacimientos arqueológicos como para su divulgación.

Materiales arqueológicos

Cabrera I y Cabrera III

Durante las inmersiones realizadas en las áreas arqueológicas correspondientes a *Cabrera I* y *III*, se ha podido verificar el estado actual de los pecios cuya situación no ha variado, salvando el tapado producido por la arena, las corrientes marinas y el avance de la *posidonia oceanica*, desde las intervenciones realizadas en la década de 1970. En el fondo marino todavía se obser-

van visiblemente las huellas de los sondeos realizados entonces, así como de la excavación de 1985 y 1986 en el *Cabrera III* (Bost/Campo/Colls, 1992; Guerrero/Colls, 1982; Guerrero/Colls/Mayet, 1987; Pons/Riera/Riera, 2001), con la presencia de grandes bloques de hormigón, varillas metálicas, y una dispersión, con grandes acumulaciones puntuales, de fragmentos anfóricos y cerámicos procedentes del material arqueológico desechado durante las intervenciones. Respecto a los materiales localizados, estos se encontraron muy fragmentados y dispersos en superficie, siendo pocos los individuos con formas reconocibles. No obstante, fueron identificados fragmentos de ánforas olearias Dressel 20, Almagro 51c y 50 de preparados de pescado provenientes de la Lusitania, así como Africanas II.

La gran dispersión de materiales presentes en el Área A no ha permitido diferenciar dónde empieza y dónde acaba cada pecio salvo por las lenguas de arena que los delimita. En este sentido queremos expresar nuestra incapacidad de abordar nueva información sobre la hipótesis de la existencia de un solo pecio en vez de dos, como propone Pons Valens (Pons, 1999), siendo necesaria la realización de excavaciones en extensión sobre la zona en cuestión (Fig. 5).

Cabrera XII

Durante las prospecciones realizadas en el 2014 se identificaron alrededor de un centenar de piezas cerámicas, la mayoría de ellas en buen estado de conservación, con dataciones comprendidas entre finales del siglo XVII y la primera mitad del siglo XVIII.

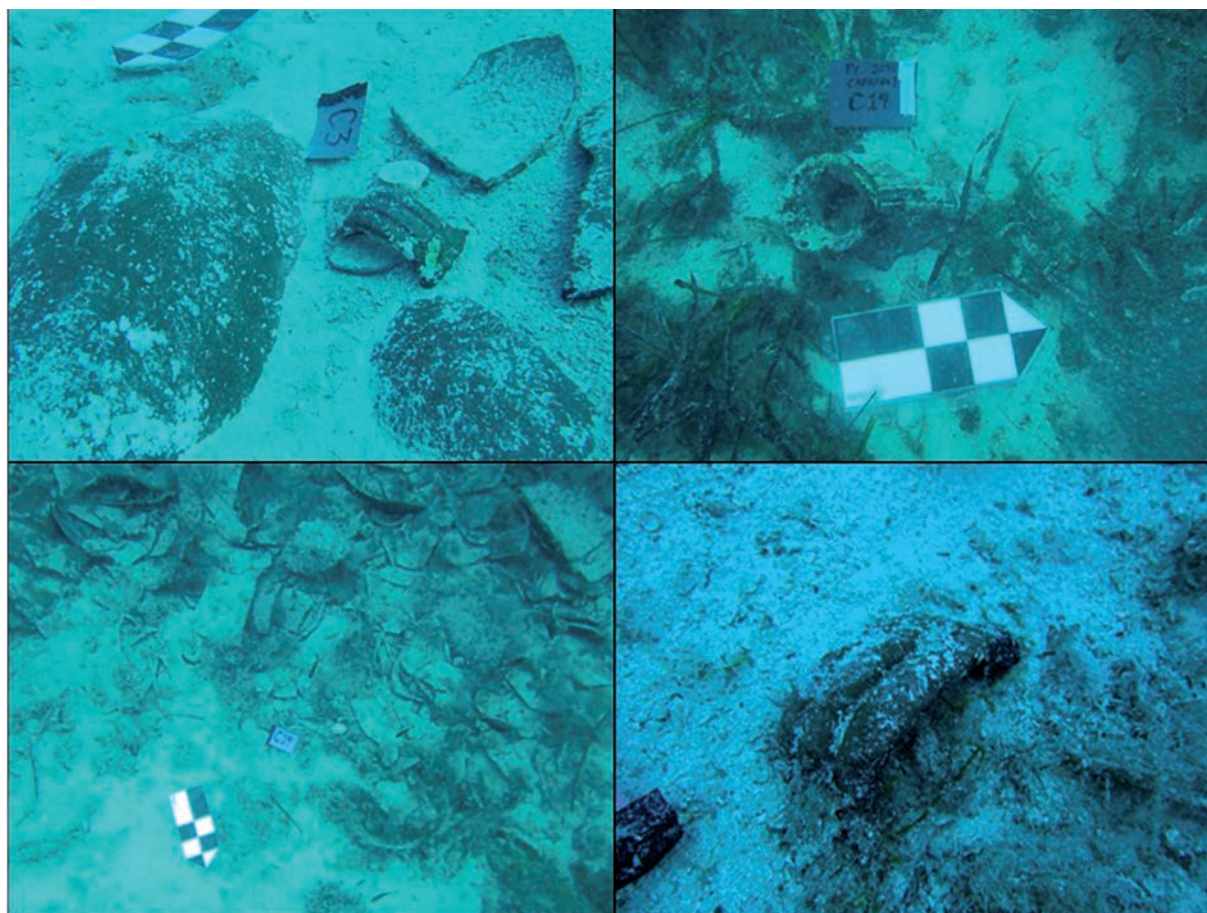


Figura 5. (Arriba) materiales del pecio *Cabrera I* (abajo) materiales del pecio *Cabrera III*.

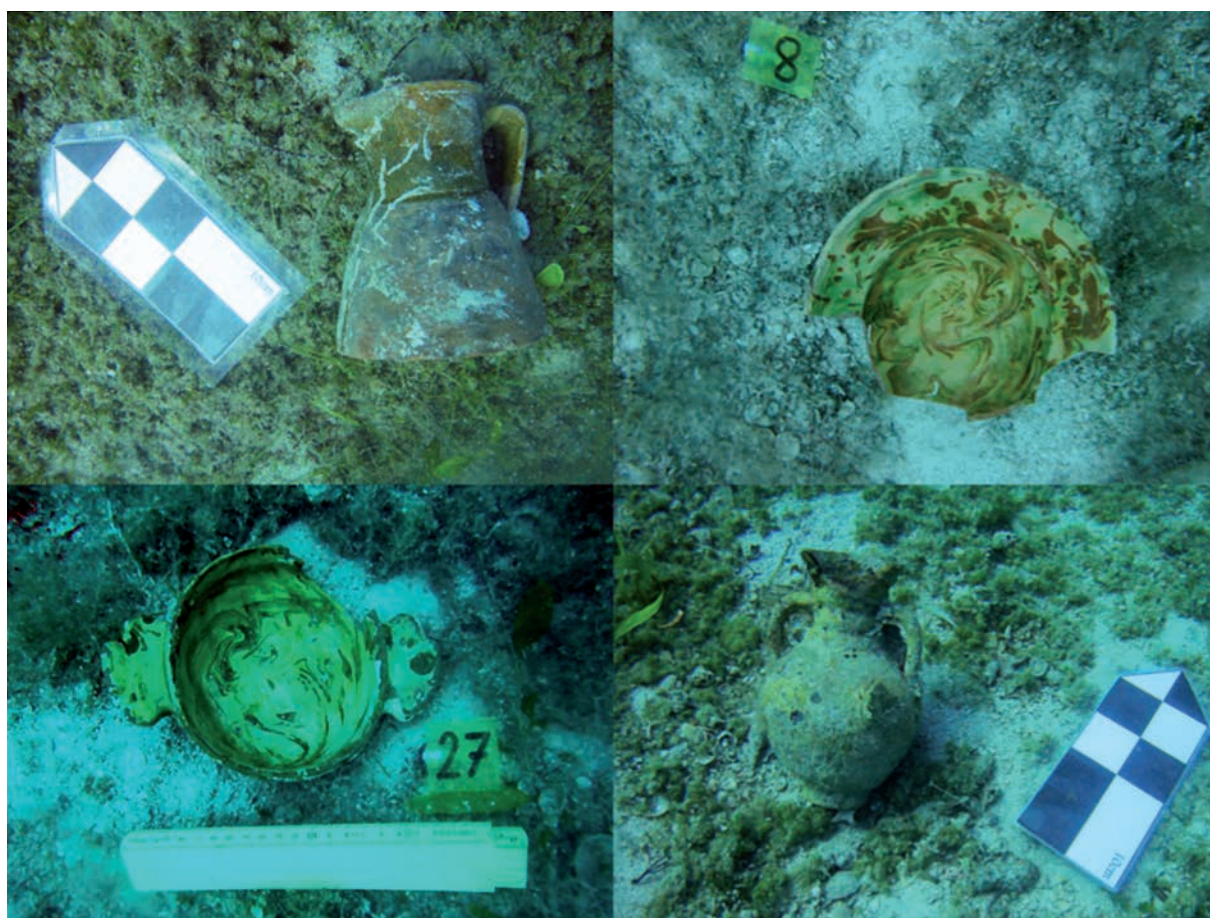


Figura 6. Materiales del pecio *Cabrera XII*.

A pesar de contar con un cargamento bastante homogéneo, es posible diferenciar tres grupos según su procedencia.

Cerámica decorada de importación italiana y francesa

Este grupo de piezas de importación está formado por escudillas, platos y jarras decoradas procedentes del norte de Italia y sur de Francia. De todas ellas, cabe destacar una escudilla vidriada con decoraciones en blanco, marrón y verdes, datada de la segunda mitad del siglo XVII, procedente probablemente de Aviñón (Fig. 6) (Carru *et alii*, 1995), así como un plato de ala larga de la Provenza, con decoración policroma en forma de pájaro. De igual modo, aparecieron un gran número de piezas pisanas y ligures, como platos comunes pisanos con técnicas de decoración *maculata* y *marmorizzata* (Rosselló/Coll, 1997), así como escudillas con técnica *sgraffita* y fragmentos de piezas mailoicas de Montelupo con decoraciones en verde, azul y amarillo (Rosselló/Coll, 1997).

Cerámica común de producción catalana

Este grupo lo componen un número inferior de piezas con tipologías recurrentes, formadas por platos con decoraciones simples a base de líneas sinuosas con decoración en amarillo (Rosselló/Coll, 1997) así como jarras y aceiteras vidriadas, posiblemente procedentes de talleres de Barcelona (Artigues *et alii*, 1998).

Cargamento de pipas

Por último, fueron identificados un total de 15 fragmentos de pipas, tanto de caolín como de cerámica marrón y negra. Por lo que se refiere a las piezas de cerámica, podrían ser de procedencia balcánica o griega (Gosse, 2007), ya que presentan unas pastas negras duras y muy bien depuradas. Asimismo, presentan la unión entre la cazuela y la embocadura en ángulo agudo y decoraciones a molde en forma de costillas verticales y estrellas (Beltrán/Miró/Soberón, 2012). Respecto a las piezas de caolín, no ha podido atribuirse una zona de producción dada la gran fragmentación de las piezas y el hecho de que dichos fragmentos se corresponden en su mayoría por cañas sin decoración.

Conclusiones

Para abordar las conclusiones del Proyecto Cabrera, creemos necesario hacer una doble valoración. Por un lado, hay que remarcar la importancia del *crowdfunding* como instrumento de financiación, siendo el Proyecto Cabrera pionero en la utilización de esta herramienta para proyectos de Arqueología Subacuática en España. A este respecto, hay que destacar que incluso contando con un presupuesto muy reducido (3000 €), han podido realizarse prospecciones durante dos campañas quincenales de manera rigurosa y exhaustiva, permitiendo avanzar en el estudio de los pecios del archipiélago de Cabrera. Igualmente, la campaña de micromecenazgo ha favorecido el contacto entre el equipo de investigación y el público interesado en la disciplina, generándose un *feedback* que ha dado visualización mediática al patrimonio arqueológico subacuático de Cabrera. Por tanto, creemos que el Proyecto Cabrera ha demostrado la posibilidad de realizar proyectos científicos de manera autónoma, sin la necesidad de grandes inversiones de capital y a la vez con una gran repercusión social. Por otro lado, las prospecciones realizadas han aportado nuevas informaciones sobre los estados de conservación de los pecios *Cabrera I* y *Cabrera III*. Si bien no ha sido posible abordar la discusión sobre la existencia de uno o más pecios en el Área A, creemos que el potencial arqueológico sigue siendo muy elevado, siendo necesarias nuevas campañas de excavación en extensión. Asimismo, hay que resaltar las inquietantes evidencias de actividades de expolio en el archipiélago de Cabrera que tan duramente han dañado el patrimonio arqueológico subacuático de la zona durante décadas, esta vez, atestiguado por el conjunto de ánforas a la espera de ser extraídas del fondo que fue localizado en la campaña de 2013.

En lo que respecta al estudio preliminar de los materiales pertenecientes al pecio *Cabrera XII*, podemos decir que nos encontramos ante un cargamento característico de mediados del siglo XVII, principios del XVIII, formado mayoritariamente por piezas de importación procedentes del norte de Italia y sur de Francia. Esta ruta fue muy frecuentada en esta época ya que, tras el auge de las importaciones catalanas y valencianas de los siglos XIV y XV, las importaciones ligures, toscanas y meridionales fueron haciéndose cada vez más frecuentes, hasta llegar a su momento de esplendor entre mediados de los siglos XVI y XVII (Artigues *et alii*, 1998). Asimismo, la filiación balcánica/griega de la mayoría de las pipas, sugiere que estas fueron redistribuidas desde Marsella, como ya apuntan autores como Julia Beltrán (Beltrán/Miró/Soberón, 2012), lugar del que podría provenir parte del cargamento cerámico.

Por tanto, y a falta de un análisis más exhaustivo de las piezas, podemos enmarcar el pecio *Cabrera XII* en un momento de intensificación de la actividad comercial mallorquina, basada en la exportación de aceite e importación cada vez más presente de productos italianos y franceses, en detrimento de las producciones valencianas y catalanas (Artigues *et alii*, 1998).

Para finalizar, queremos remarcar los excelentes resultados obtenidos mediante la fotogrametría a lo largo del proyecto. Creemos que tanto la fotogrametría como sus distintas aplica-

ciones están demostrando ser muy efectivas a la hora de documentar, analizar y divulgar materiales y áreas arqueológicas. Gracias al avance tecnológico y a la bajada de los precios en los equipos de fotografía digital así como a la presencia de *software* libre, la fotogrametría digital subacuática se está convirtiendo en una herramienta muy útil que, cada vez, es más accesible para los equipos de investigación subacuática.

Por último, cabe agradecer la colaboración desinteresada de empresas locales como «Excursiones a Cabrera», «Mar Balear» y «Ona i Mar», así como la del equipo de investigadores, sin las cuales, el Proyecto Cabrera no hubiera sido posible.

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The biography of ancient shipwrecks in Cyprus: a challenge to take on

Historia de pecios de la antigüedad en Chipre: un desafío a abordar

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Abstract: Shipwrecks constitute a complex type of archaeological sites as regards research and management: they are «closed systems» confining both, immovable and movable remains that were not meant to be deposited; through the course of their biography they are associated with diverse concepts (historical, natural and social). Humans and objects exist within a diachronic relationship of social interaction. Throughout this process objects are saturated with meanings, continually reformed and renegotiated. This is particularly applicable to ancient shipwreck sites. Their *Long Life Histories approach* could shed light to the complex issues related to their evaluation and interpretation. The aim of this research is to identify and examine the various networks of interaction which are developed through the life histories of two shipwrecks of different characteristics: the Mazotos Shipwreck (late classical period) and the Nissia Shipwreck (late Ottoman period), both located in Cyprus and researched by the University of Cyprus.

Key words: Shipwrecks, biographies, long life histories.

Resumen: los pecios constituyen un tipo de yacimiento arqueológico de especial complejidad en su investigación, dado que: son «sistemas cerrados» que incluyen restos fijos y móviles que no estaban destinados a ser depositados; y durante su existencia han sido asociados a diversos conceptos (históricos, ecológicos, sociales). Los seres humanos y los objetos mantienen una relación diacrónica de interacción social. A lo largo de este proceso, los objetos son imbuidos de significados que continuamente son modificados y determinan su ulterior importancia. El enfoque basado en «historias de larga duración» puede arrojar luz sobre las complejas cuestiones vinculadas a la interpretación de dichos objetos, siendo por tanto de particular relevancia para el estudio de pecios. El objeto de esta investigación es examinar los diferentes sistemas de interacción que son desarrollados durante la historia de dos pecios con diferentes características: Mazotos y Nissia, ambos situados en Chipre y siendo investigados por la Universidad de Chipre.

Palabras clave: pecios, naufragios, historias de larga duración.

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The biography of ancient shipwrecks in Cyprus a challenge to take on

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Maritime Archaeological Research Laboratory

IKY

Ancient shipwrecks form a complex group of archaeological sites as regards research and management:

- They are 'closed systems' confining both, immovable and movable remains, which were not meant to be deposited.
- Through the course of their biography they relate with a diversity of frameworks (historical, natural and social).

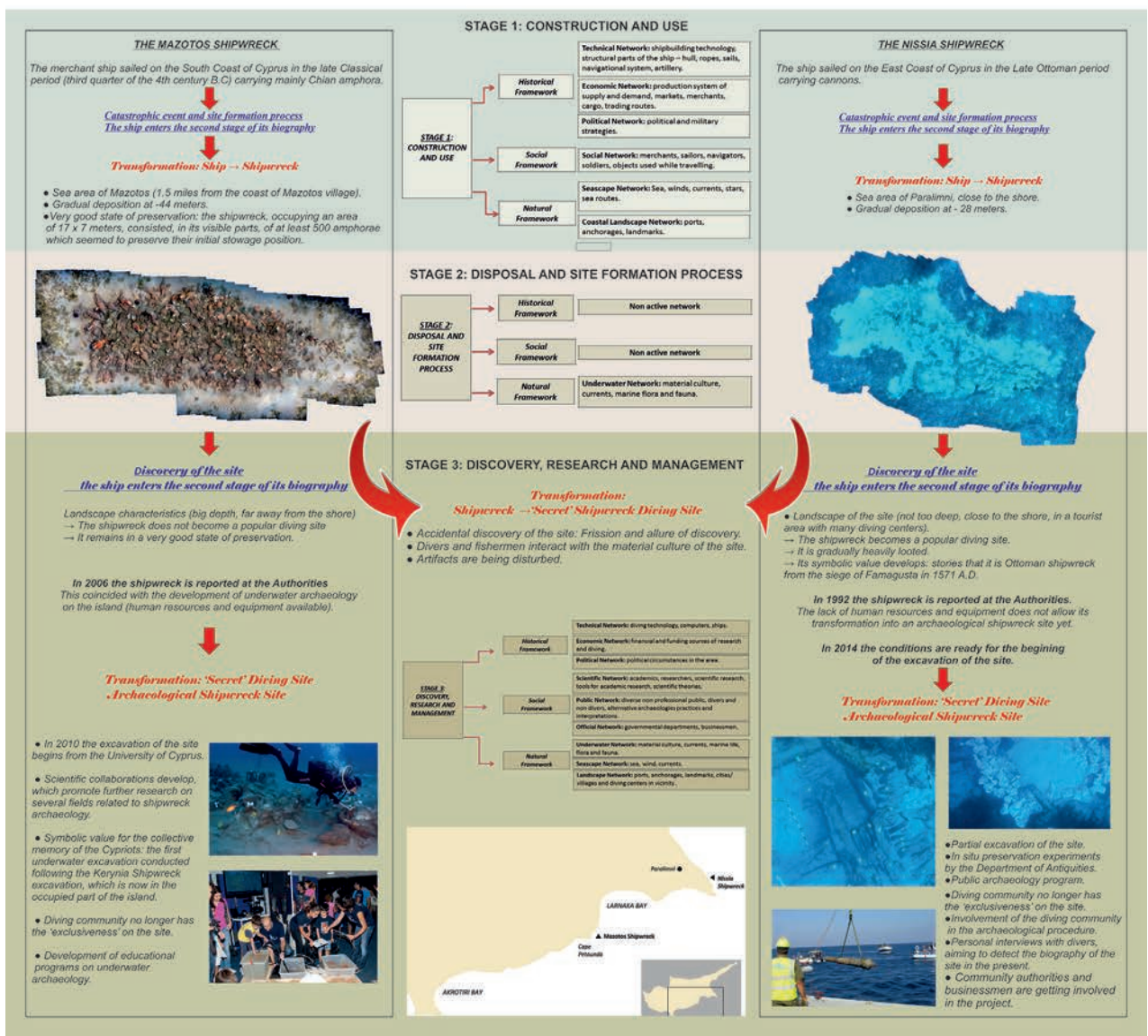


LONG LIFE HISTORIES OF SHIPWRECKS

Humans and objects exist within a diachronic relationship of social interaction and negotiation. Throughout this process objects are saturated with meaning continuously reformed and renegotiated, a fact that sets the basis for their significance attribution and interpretation. This is particularly applicable in ancient shipwreck sites as their Long Life Histories approach could shed light to the multiple and complex issues related to their evaluation and interpretation.

Ancient shipwreck sites are not only 'closed systems' of archaeological material, but also part of the history of present society. The challenge of their investigation and management relies on the identification of the networks developed through the course of their biography and their subsequent interpretation frameworks. From thereon derives the narratives and the management strategy which are not only scientifically grounded but also relate to the current society and our selves.

The aim of this research is to identify and examine the various networks of interaction which are developed through the life histories of shipwrecks. To that end, two shipwrecks of different characteristics are being studied. Both are located in Cyprus and are researched by the University of Cyprus.



Analysis of the underwater heritage management in the Mediterranean context: the case of Italy, France and Spain

Análisis de la gestión del patrimonio subacuático en el contexto Mediterráneo: los casos de Italia, Francia y España

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Abstract: The poster shows part of the outcomes of a PhD research based on the analysis of the management of the underwater heritage in the Mediterranean context, with a particular focus on France, Italy and Spain. The goal is to evaluate the conditions of the Underwater Cultural Heritage (UCH) management in a Mediterranean Perspective and the efficacy of the preservation policies. My research determines how UCH is perceived by society and how this perception has an impact on the UCH conservation policies. All the stakeholders involved in the management (which means experts and institutions and common citizen) of the UCH are taken into consideration in order to suggest best practices to solve shared problems in the preservation and enhancement of the Mediterranean UCH, creating a stronger connection between heritage and society. The idea is to identify problems and to propose best practices resulting from the comparison between the three countries systems.

Key words: Heritage management, Mediterranean context.

Resumen: el póster muestra parte de los resultados de la investigación doctoral basada en el análisis de la gestión del Patrimonio Cultural Subacuático (PCS) en el contexto Mediterráneo, especialmente en Francia, Italia y España. El objetivo es evaluar las condiciones de la gestión del PCS desde una perspectiva mediterránea y la eficacia de las políticas de conservación desarrolladas. Mi investigación determina de qué forma el PCS es realmente percibido por la sociedad y cómo esta percepción tiene un impacto en las políticas de conservación del PCS. Todas las partes interesadas e involucradas en la gestión del PCS (expertos, instituciones, ciudadanos corrientes), son tomadas en consideración con la intención de proponer las mejores prácticas para solucionar problemas comunes en la conservación y desarrollo del PCS mediterráneo, creando, de esta forma, una conexión mucho más sólida entre patrimonio y sociedad. El objetivo es identificar problemas y proponer las mejores actuaciones a partir de la comparación entre Francia, Italia y España.

Palabras clave: gestión del patrimonio, contexto mediterráneo.



Analysis of the Underwater Heritage Management in the Mediterranean Context: The case of Italy, France and Spain



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Introduction and research goal: This Poster presents the first results of a PhD research on the management of the Underwater Archaeological Heritage in Italy, France and Spain. The research is focused on the analysis, in a comparative perspective, of all the different aspects regarding the management of the heritage in the three Countries. The research has been realized through the analysis of specific case studies, but here only the general outcomes, especially regarding accessibility, will be presented. Beside the existing literature on the topic, the main instruments of data collecting have been direct observation, interviews with archaeologists and managers, surveys on the impressions of the public, in order also to evaluate the level of awareness of common citizens on the existence of the underwater heritage and their perception of it. From the first data, results that the level of awareness on underwater heritage existence is really low.

Underwater Heritage Accessibility:

Article 2 Paragraph 10 of 2001 UNESCO Convention:

"Responsible non-intrusive access to observe or document *in situ* underwater cultural heritage shall be encouraged to create public awareness, appreciation, and protection of the heritage except where such access is incompatible with its protection and management"

In different countries of the Mediterranean context this article led to the idea of different possibilities for visiting underwater archaeological ruins.

The main solutions adopted to make the underwater heritage accessible *in situ* are:

- Organization of guided tours on wrecks for few visitors during archaeological research campaigns (e.g. Cap de Vol, Spain);
- Creation of underwater trails with informative panels and possibilities of guided tours leaving the heritage *in situ* (Sicily, Italy);
- Institution of underwater archaeological parks as Marine Protected Areas with different possibilities of guided tours (e.g. Baia and Gaiola, Italy);
- Re-immersion of archaeological artifacts anchored on the seabed (e.g. Marseille Bay, France).

Obviously, the different solutions also depend on the territorial context and on different problems related to heritage management, but there are some common elements:

- 1) Italy, France and Spain all have a Civil Law system and the heritage is mainly administrated by Public Bodies;
- 2) For the implementation of the accessibility of the underwater heritage *in situ* there is, generally, an involvement of private bodies (associations, diving clubs, etc.) especially for the following actions:

- practical execution of the guided tours (especially diving centers);
- support in the positioning of the re-immersed artifacts or of the informative panels (diving clubs);
- monitoring of the state of maintenance of the underwater trails (diving clubs or associations);
- management of the visitor centers (when they exist);
- relations with local communities and different kinds of dissemination activities (generally with the involvement of NGOs or other kinds of associations).

SWOT analysis of the increasing of the accessibility of the underwater heritage *in situ* the given contexts

Strengths: - turning the "invisible" underwater heritage in something visible increase the interest of the public for underwater heritage;
- even with the involvement of private, heritage is always a public good;
- investments, especially in human resources, of diving centers and no-profit associations of personnel willing to contribute to underwater heritage management.

Opportunities: - job creation related to the underwater heritage management;
- possibilities of realizing more initiatives than those that could be carried out by Public Bodies by themselves.
- possibility to look at the experience of the marine environmental parks/ itineraries (which have a longer history) in order to plan accessibility to underwater sites;
- new possibility of accessing the invisible thanks to new technologies (underwater videos, augmented reality etc);
- possibility of networking at European (and possibly Mediterranean level).

General Italian Context: the management of the heritage in general is the responsibility of the Ministry for Cultural Heritage and Activities and Tourism. The Ministry has local branches, named Superintendences, devoted to the management and the preservation of the heritage on the territory. This means that there are some discrepancies from one Italian Region to another in the management of the cultural heritage in general, as well as underwater heritage in particular. Not all the Superintendences have trained personnel to carry out underwater archaeological initiatives. Significant number of private initiatives, which often try to be as independent as possible from public administration.

Only Sicily (which has autonomy from the central government for most of the aspects regarding cultural heritage management) has a Public Body completely devoted to the management of the underwater heritage: the Superintendence of the Sea.

General French Context: high level of centralization of the system of management of the Underwater Heritage, with the creation of a specific Public institution, the DRASSM, active at national level and involved in the field not only of the preservation and of the management of the heritage, but especially in the field of research. Significant number of private initiatives. Nevertheless, if in the past also amateurs could carry out small underwater archaeological campaigns, at present this possibility has been almost completely limited. At the same time, for all the aspects regarding dissemination activities, there are private initiatives which are compliant with the DRASSM. Generally, the State gives much more supports to no profit organizations than, for example in Spain and Italy, even though, regarding the marine heritage there are much less initiatives regarding underwater cultural heritage than regarding the marine environment protection.

General Spanish Context: each region (Comunidad Autonoma) has its independent bodies for the management of the heritage in general. Regarding underwater heritage management, there is a high level of discrepancy between the different regions. This means that some Comundida Autonoma have an organized system for the management of the underwater heritage, with a main public institution taking care of all the different aspects (like the CASC in Cataluña), whereas some others suffer for the lack of an organized system. Significant number of private initiatives than, especially for dissemination activities on heritage existence, in some case, are quite independent from public administration; however, also in this case there is a regional discrepancy.

Final Considerations: People still, generally, do not know and care for underwater heritage (which means they can act against its preservation, e.g. fishermen communities), simply because they don't care for what they cannot see. This means that still a lot needs to be done to disseminate on this heritage existence. Making underwater sites accessible can be a fascinating way for presenting it to the public, but naturally there are some risks. The involvement of private, as diving clubs and no-profit associations, can be an interesting solutions to keep public the management of the heritage and benefit of more creative and interdisciplinary work environment. Finally, especially for underwater park creation, we should look more at the experience of the marine environmental campaigns, in order to find out new tools for making the invisible visible for the general public.

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Weaknesses: - private initiatives need to be carried out in compliance with the public administration, which may cause long bureaucratic time of operation.
- lack of public bodies devoted to underwater heritage management to support either private or public initiatives of dissemination of the underwater heritage existence and value;
- cut to public administration (and in particular to cultural heritage sector) due to the economic crisis.

Threats: - risk of damages to the heritage in case of lack of controls;
- possibility that, delegating activities to private, public bodies get detached from the heritage they are supposed to care of;
- in case of underwater parks creation, risk of top-down approaches which impose the existence of the park (and its rules) to local communities.

Sociedad civil y administración pública: una gestión compartida. Arqueología subacuática en Lanzarote. Un referente en el archipiélago

Society and public administration: a shared management. Underwater archeology in Lanzarote: a reference in the Archipelago

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Resumen: la isla de Lanzarote (Islas Canarias, España) destaca por su rico patrimonio subacuático, con restos que van desde el mundo romano hasta el siglo XIX. Este patrimonio «oculto» necesita de unos enormes cuidados en lo que a su gestión y salvaguarda se refiere; máxime cuando está incorporado a la industria turística insular actual. Por ello, el Cabildo Insular de Lanzarote, a través de su Servicio de Patrimonio Histórico, ha articulado medidas de protección donde se incluye a la sociedad civil. Así, se han incorporado a la gestión de este patrimonio a los clubes de buceo como agentes activos en su protección a partir de la creación de protocolos de colaboración.

Palabras clave: patrimonio subacuático, sociedad civil, participación ciudadana, turismo, club de buceo.

Abstract: The island of Lanzarote (Canary Islands, Spain) is remarkable for its rich underwater heritage, where archaeological remains, dated from the Roman world until the 19th century, have been found. The management and safeguarding of this hidden heritage needs enormous efforts. For that reason, the Cabildo of Lanzarote has taken protection measures, where the civil society has been included. These agreements of collaboration have been signed with the diving clubs, including them as active agents in the management and protection of this hidden heritage.

Key words: Underwater heritage, civil society, tourism, public participation, diving club.

Sociedad civil y Administración Pública: Una Gestión Compartida

ARQUEOLOGÍA SUBACUÁTICA EN LANZAROTE. UN REFERENTE EN EL ARCHIPIÉLAGO

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Trabajos con voluntarios en la Bahía de Arrecife



Guía de Inmersiones de Lanzarote

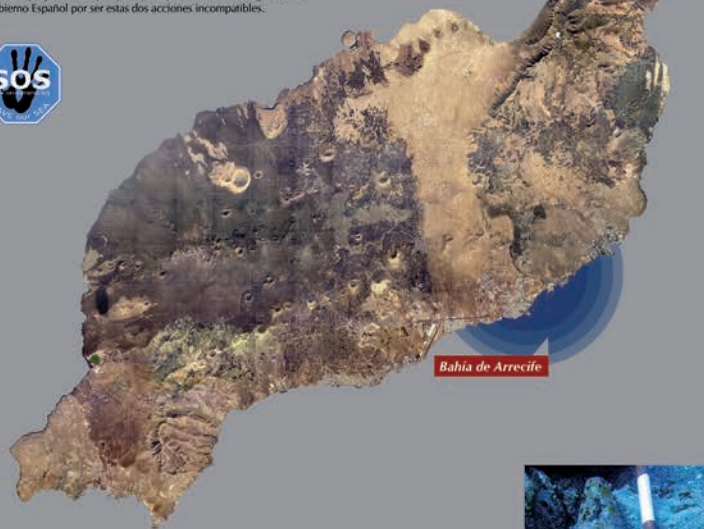
En Canarias, Lanzarote ha sido pionera en la incorporación de la arqueología subacuática a la investigación. Los estudios realizados han ido en paralelo al desarrollo de actividades subacuáticas en la isla, muy vinculadas al sector turístico, con más de 100.000 usuarios anuales. Este interés ha favorecido la publicación de una guía insular de inmersiones con 30 posibles destinos, que incluyen zonas con restos arqueológicos, a los que se puede acceder a través de los más de 25 clubes de buceo que existen en la isla.

Resulta imposible para la administración pública la gestión de un patrimonio arqueológico oculto bajo las aguas, puesto que no dispone de recursos suficientes para prevenir destrucciones y expolio. Por este motivo, propuso la participación de los propios usuarios como parte activa en su cuidado y protección.

Así, el Cabildo de Lanzarote, valorando la estrecha colaboración existente entre los clubes de buceo y la propia administración pública, ha suscrito un convenio de colaboración con los diferentes clubes de buceo con el fin de alcanzar los siguientes objetivos:

- Fomentar la colaboración activa, transformando a los clubes en "agentes informadores", colaborando en las tareas de vigilancia, protección y divulgación del patrimonio arqueológico sumergido
- Proporcionar formación patrimonial a los diferentes clubes de buceo
- Compatibilizar la actividad comercial recreativa en las zonas arqueológicas protegidas

El mantenimiento y conservación de un elemento no renovable como es el fondo marino, hace obligatoria la toma de decisiones estratégicas en lo que se refiere al uso de éste. Por ello, creemos firmemente en el desarrollo sostenible de la economía isleña, y por tanto rechazamos las propuestas de prospecciones petrolíferas en las aguas Canarias por parte del Gobierno Español por ser estas dos acciones incompatibles.



Recorte de prensa con motivo de la recuperación de material arqueológico por buceadores deportivos, integrantes de los primeros clubes de buceo de Lanzarote

Dado el alto valor de los fondos marinos de la isla, el Servicio de Patrimonio Histórico del Cabildo de Lanzarote propuso en el año 2003 la incoación del expediente de declaración de Bien de Interés Cultural, con la categoría de Zona Arqueológica, a favor de la zona de mar de El Río, La Graciosa y la Bahía de Arrecife.



Ilustración del perfil de las Arrecife en El Río

El Río y La Graciosa

El Río es una lengua de mar que separa la isla de La Graciosa de Lanzarote, constituyendo la mayor reserva marina de España. Existen referencias históricas de navegación habitual ya desde el siglo XVI, utilizándose este espacio para la limpieza de los carnados de las embarcaciones, a pesar del escaso fondo del lugar. La Graciosa ha aportado diverso material arqueológico, especialmente cerámico, destacando el registro de la mayor variedad y cantidad de vestigios arqueológicos susceptibles de ser vinculados a la presencia o conocimiento de la cultura romana en el Archipiélago.



Alfilería romana (siglo I-III) recuperada entre 1973 y 1980 en El Río



Alfilería del siglo XVI de procedencia portuguesa (Lanzarote). Autor: José Fariña



Ilustración del perfil de la Bahía de Arrecife

Bahía de Arrecife

La Bahía de Arrecife es un puerto natural que se ha utilizado históricamente como zona de desembarque de naves comerciales, pesqueras o militares.

La primera referencia del puerto aparece en Le Canarien, documento que recoge la conquista y colonización de Fuerteventura y Lanzarote a manos de nobles normandos al servicio de Castilla, citándolo como "muy buen puerto para invernar cualquier navío".

Este ir y venir de barcos ha generado gran cantidad de material arqueológico, que ha sido documentado en las últimas décadas a través de trabajos puntuales (labores de dragado o seguimientos arqueológicos en la ampliación de muelles o diques), de hallazgos casuales y prácticas de buceo.



Módulo de zoster con fondo marino. Durante la época Moderna la región de Arrecife propició grandes cantidades de resistencia para las invasiones canarias



Fondos de la Bahía de Arrecife con olive (siglo XIX). Autor: Rafael Méndez



Fragmento de plato decorado, Alcantarilla, siglo XIX. Cabildo de Lanzarote, La Graciosa



Cuerpo metálico, siglo XVIII-XIX, se encontraba en el agua. Dique de Arrecife, La Graciosa



Pico de cerdo decorado y con bollos, siglo XIX. Autor: Rafael Méndez



Underwater Cultural Heritage («SeArch»): Technological Innovation, a Legal Framework and Public Access

Patrimonio Cultural Subacuático («SEArch»): innovación tecnológica, marco legal y acceso público

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Abstract: Large parts of the Belgian territorial sea and the continental shelf are affected by commercial activities such as aggregate extraction, wind farms, dredging, cable/pipeline projects, intensive fishing, etc. All these activities constitute a serious threat for the underwater cultural heritage. The «SeArch» (2013-2016, www.sea-arch.be) project will offer solutions to these challenges through the realization of three objectives: to develop a reliable survey methodology based on geophysical and remote sensing techniques that allows accurate and cost-effective evaluation of the archaeological potential of marine areas under development; work out comprehensive proposals for a transparent and sustainable management policy regarding the marine historic environment and for the further development and implementation of a legal framework based on the international commitments (Unesco 2001 convention); and offer guidance to stakeholders (marine industry, government agencies, fisheries, ...) on how to implement the new methodology and management approach and increase the general awareness with regards to underwater cultural heritage.

Key words: Belgian territorial sea and continental shelf, commercial activities, underwater cultural heritage, management policy, research project.

Resumen: actividades comerciales tales como extracción de arena y grava, construcción de parques eólicos, dragados, tendido de cables submarinos, pesca, etc. afectan intensivamente al fondo del mar territorial y a la plataforma continental de Bélgica y amenazan al patrimonio cultural subacuático. El proyecto «SeArch» (2013-2016, www.sea-arch.be) busca soluciones a través de tres objetivos: confeccionar un método de prospección basado en técnicas geofísicas y de teledetección que permitan evaluar de manera correcta y barata el potencial arqueológico de áreas marítimas en desarrollo; elaborar propuestas integrales para realizar una política de gestión sostenible y transparente relacionada con el entorno histórico y para desarrollar un marco legal basado en los compromisos internacionales (Convención Unesco 2001); y ayudar a los interesados (industria marítima, administraciones públicas, pesquerías, etc.) con el desarrollo de la nueva metodología y de la política de gestión y, a través de esta actividad, movilizar e incrementar la conciencia ciudadana y política con respecto al patrimonio cultural subacuático.

Palabras clave: plataforma continental y mar territorial belga, actividades comerciales, patrimonio cultural subacuático, política de gestión, proyecto de investigación científica.



Underwater Cultural Heritage ('SeArch') - Technological Innovation, a Legal Framework and Public Access

Introduction

Large parts of the Belgian continental shelf are affected by commercial activities such as aggregate extraction, wind farms, dredging, cable/pipeline projects, intensive fishing, infrastructural works for harbour extension, etc. All these activities constitute a serious threat for the underwater cultural heritage. The 'SeArch' project (2013-2016) wants to provide different solutions for this urgent problem.



Marine Spatial Planning in the Belgian part of the North Sea. (© Mike van De Velde, Marjolijn Rabaut, Charlotte Herman en Steven Vandenborre, Et bezwaagt wat op zee... Een Maritiem nummer/à plan voor onze Noordzee, PGO Volksgezondheid, Veiligheid van de Woonsfeer en Leefmilieu, maart 2014)

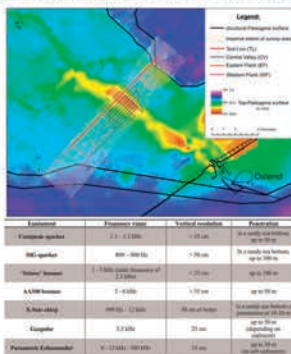
Technological Innovation

To develop a reliable survey methodology based on geophysical and remote sensing techniques that allows accurate and cost-effective evaluation of the archaeological potential of marine areas under development (offshore, nearshore, intertidal areas).

After thorough assessment of the present-day geophysical & remote sensing technology and the available archaeological & geological data of the Belgian part of the North Sea, different testsites (offshore, nearshore + intertidal) were selected to be surveyed.

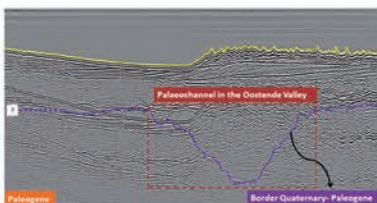
Oostende valley survey

In October 2013 and May 2014 a wide range of marine acoustic sources and receivers were tested over a buried Pleistocene river valley, the Oostende Valley, nowadays covered by a large sand bank.



Characteristics of the equipment used during the Oostende Valley survey
(© Ghent University, Research Centre of Marine Geology)

- A wide range of acoustic sources and receivers were used
- where possible simultaneously ('one-sweep survey')
- Emphasis on advanced ('smart') processing



First data interpretation of the Oostende Valley survey
(© Ghent University, Research Centre of Marine Geology)

Legal Framework

Work out comprehensive proposals for a transparent and sustainable management policy regarding the marine historic environment and for the further development and implementation of a legal framework based on the international commitments (UNESCO 2001 convention).



In 2013-2014 Belgium has ratified and implemented the UNESCO 2001 Convention on the Protection of the Underwater Cultural Heritage. The new Federal law "Wet betreffende de bescherming van cultureel erfgoed onderwater" came into force allowing Belgium to protect and preserve the Underwater Cultural Heritage.

This new law also states that finds, made within the Belgian part of the North Sea, have to be reported to the "Receiver of Cultural Heritage Underwater".



Dredgers reported the discovery of an airplane propeller, indicating the crash site of a WWII airplane. (DPMR)

The SeArch project will develop protocols to report and deal with archaeological discoveries at sea. Furthermore it will provide guidance, advice and procedures for every stage of marine development from assessment of new license areas, to mitigation and monitoring of sensitive sites.

Public Acces / Outreach / Communication

Offer guidance to stakeholders (marine industry, government agencies, fisheries, harbor authorities,...) on how to implement the new methodology and management approach and increase the general awareness with regards to underwater cultural heritage.



More Information

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Patrimonio subacuático de la ría de Ortigueira (Galicia)

Underwater heritage of the ría de Ortigueira (Galicia)

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Resumen: la ría de Ortigueira está situada en el extremo más septentrional de la provincia de A Coruña, en Galicia. En ella confluyen las desembocaduras de varios ríos de poco caudal – Mera, Ladrado, Casón, Pequeño, Maior–. Está flanqueada por dos sierras –Capelada, Faladora– y dos accidentes geográficos –cabo Ortegal y Estaca de Bares, considerado punto límite entre el Atlántico y el Cantábrico–. Es un enclave de fácil vigilancia, clima suave y numerosos recursos naturales que han convertido el entorno en un lugar apto para el asentamiento humano y las comunicaciones marítimas desde épocas muy tempranas. Presentamos un pequeño trabajo de recopilación, catalogación y estudio de las piezas que se han ido recuperando de contextos subacuáticos –tanto los de la propia ría como los de los ríos del entorno–. Estos servirán como ejemplo de intensos contactos y relaciones comerciales de los diversos asentamientos costeros del entorno, desde época protohistórica hasta nuestros días.

Palabras clave: Ortegal, Estaca de Bares, patrimonio subacuático, piezas arqueológicas, arqueología subacuática.

Abstract: Ortigueira Estuary, is located at the most northern end of the province of A Coruña, in Galicia. The mouths of several rivers of little flow –Mera, Ladrado, Cason, Pequeno, Maior– converge in it. It's flanked by two mountain ranges –Capelada, Faladora– and two landforms –Cape Ortegal and Estaca de Bares, considered point between the Atlantic and Cantabric Sea–. It is an enclave of easy surveillance, mild climate and full natural resources that have turned the environment into a fit place for human settlement and maritime communications since very early times. We try to present a small work of collecting, cataloguing and study of the parts who have been recovering from underwater contexts –both those of the own ria as of the rivers of the environment–. These will serve as example of intense contacts and trade relations of the various coastal settlements of the environment, from protohistoric times until our days.

Key words: Ortegal, Estaca de Bares, underwater heritage, archaeological artifacts, underwater archaeology.

Patrimonio Subacuático de la Ría de Ortigueira (A Coruña), Galicia.

Vanessa Trevin Pita - David Fernández Abella

Acteo, A.P. / Universidade da Coruña - Argos S.A.S., S.L. / Universidade de Santiago de Compostela



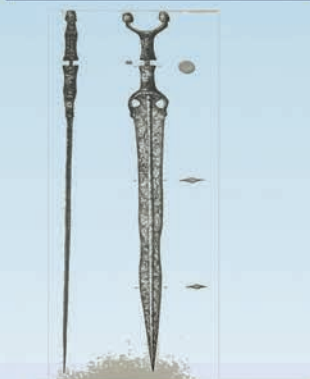
Fragmento de Dressel I (s. II a.C. - I d. C.). Encontrado en el interior de la Ría de Ortigueira. Museo-Fundación Ortegalia.

La ría de Ortigueira se sitúa en el extremo más septentrional de la provincia de A Coruña, en Galicia. En ella confluyen las desembocaduras de varios ríos de poco caudal *«Mera, Ladrado, Casón, Pequeño, Maior etc.»*. Posee una ubicación y configuración privilegiada como lugar de abrigo y protección, tanto a nivel marítimo como terrestre. Esto lo evidencia, el hecho de que se encuentra flanqueada por el cabo Ortegal y la Punta de Estaca de Bares -límite entre el Atlántico y el Cantábrico- y protegida por las sierras de *A Capelada* en su parte Occidental y *A Faladoura* en su parte Oriental.

Se trata de un enclave de fácil vigilancia, clima suave y numerosos recursos naturales, convirtiéndolo en un lugar apto para el asentamiento humano, y las comunicaciones marítimas desde épocas muy tempranas.



Botijuela, Siglos XVIII-XIX. Encontrada en Cariño. Museo-Fundación Ortegalia.



Puñal de Antenas. Adscripción cultural castreña. Localizado en Praia da Basteira (Cariño, 1965). Catálogo de la Dirección Xeral de Patrimonio Cultural (Santiago de Compostela). Desaparecido.



Machado Votivo. Localizado en Praia da Basteira (Cariño, 1961). Adscripción cultural castreña. Museo Arqueológico de San Antón (A Coruña). Fotografías: Fundación Ortegalia.

Medidas: 17 cm. Long. por 6,5 cm. de anchura.

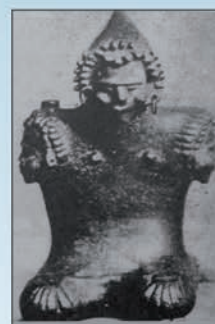


Figura orientalizante. Desembocadura del río Dola (Espasante, Ortigueira, 1899). En el contorno de una factoría de salazon romana. Desaparecida. Maciñeira (1947). Medidas: 18 cm.

En la zona se encuentran documentados más de 50 accidentes marítimos, debidos sobre todo a temporales y episodios de los cuales, unos 22 han dejado algún tipo de resto en el interior de las aguas de la ría. A esto hay que añadir la presencia de algunos interesantes objetos difíciles de datar que han ido apareciendo en zonas de playa y desembocaduras de los ríos que van a dar al estuario, algunos de ellos, actualmente, en paradero desconocido. Tenemos constancia también de una rueda pequeña con pie de latón con una inscripción que reza: "*A. Higginson-THE STEAM QUARTER MASTER-24 & 26 Liverpool*". También una caja de Bitácora de madera barnizada cuya inscripción dice: "*Sir William Thompson-Patent-Nº 706-Y. White, Glasgow*" (Puentes, 2003, 130).

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Praia da Basteira
Espasante
Interior de la Ría

Agradecimientos a la Fundación Ortegalia (Ortigueira, A Coruña), por las atenciones prestadas y la cesión de fotografías.



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Waterfront and Underwater Archaeology of the coastal zone around the Failaka Island, Kuwait – Arabian Gulf

Línea de costa y la arqueología subacuática de la zona costera alrededor de la isla de Failaka, Kuwait – Golfo Árabe

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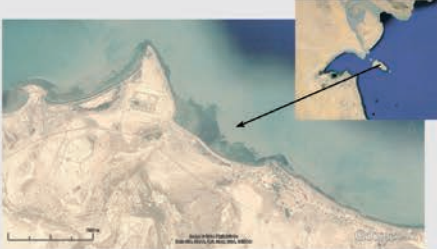
Abstract: The project was initiated in 2013. The Kuwaiti-Polish Archaeological Mission operates under an agreement between the Centre of Mediterranean Archaeology University of Warsaw and the Kuwait National Council for Culture, Arts and Letters. The «Waterfront Archaeology Team» is a part of Kuwaiti-Polish Failaka Archaeological Mission. The aim of this project is to detect and describe remaining archaeological sites at the seashore, as well as to provide documentary evidence and finally organise the proper preservation. The program of «waterfront archaeology» research for 2013 assumed the inventory of stone structures in Kharaiib el-Desht Bay. The aim of it was to recognize and document groups of stone objects, which were interpreted as an installation for fishing farm, so-called «fish traps». During the Kharaiib el-Desht Bay survey 12 stone constructions were registered. They can be divided into three groups: big linear stone constructions, small circle constructions and linear stone construction – relics of harbour construction (breakwater).

Key words: Fish trap, breakwater, Failaka Island, Arabian Gulf, fisheries.

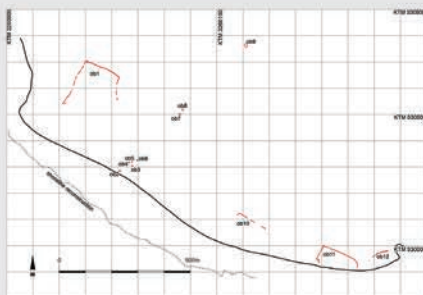
Resumen: el proyecto se inició en 2013. La Misión Arqueológica Kuwaití-Polaca opera bajo un acuerdo entre el Centro de Arqueología Mediterránea (Universidad de Varsovia) y el Consejo Nacional de Kuwait para la Cultura, Artes y Letras. El «Equipo de Arqueología Costera» forma parte de la Misión Arqueológica Kuwaití-Polaca de Failaka. El objetivo de este proyecto es localizar y describir los yacimientos arqueológicos en la orilla del mar, así como proporcionar pruebas documentales y organizar una adecuada preservación. El programa de investigación «Arqueología Costera» del año 2013 realizó el inventario de las estructuras de piedra en Kharaiib el-Desht Bay. El objetivo era reconocer y documentar grupos de objetos de piedra interpretados como una instalación pesquera, de las conocidas como «trampas para peces». Durante la prospección en Kharaiib el-Desht Bay se registraron doce construcciones de piedra. Se pueden dividir en tres grupos: grandes construcciones lineales, pequeñas construcciones circulares y otras construcciones lineales, testimonio de elementos/construcciones portuarias (rompeolas).

Palabras clave: trampa para peces, rompeolas, isla Failaka, Golfo Árabe, pesquerías.

Waterfront and Underwater Archeology of the coastal zone around the Failaka Island Kuwaiti – Arabian Gulf



Location of the Kharab el-Desht Bay



Plan of the site (by J. Kaniszewski, Sz. Lenarczyk)

Big linear stone constructions



Linear structures, object 1 (by M. Nowakowska)

Three big linear stone constructions (nr: 1, 10, 11) were localized in the Kharab el-Desht Bay. Two of them (nr 1 and 11) were qualified as well preserved, nr 10 as destroyed, probably to a large extent. The building stones of the objects are arranged in the form of walls, reaching up to a height of about 60-70 cm. The longest wall is composed of several sections, about 200 meters long, in the north-east direction. They were composed of several sections arranged more or less thoroughly. In some places gaps between them exceed 2 meters. Constructions line over a length of up to 200 meters goes smoothly for about 90 degrees in the other arm construction beginning on a small stone arch. The arch is forming a cove coming out to the north, beyond the main line of the structure. The length of this branch is up to 150m. The wall in a section with corner and the cove is constructed very carefully with collected stones. The north part of this objects is serving as a breakwater in a natural way, separating the area of the "pool" from the sea. Third part of this constructions – third branch – is going smoothly for about 90 degrees to the south-west, its length is about 30 meters, it is ended similarly

Small circle constructions



Circular stone constructions, objects 3 and 9 (by M. Nowakowska)

One of the most interesting findings are two groups of circle stone objects. The first of them include five objects: numbers 2, 3, 4, 5, 6. It was registered in at the relatively small area, close to the shoreline, about 100 m into the sea. Object 2 is situated partly on the beach and covered by sand. Only a part of the structure is visible. Next group – two objects (number 7 and 8), with similar constructions, were registered more than 200m to the north-east from the group of five. Last one is the object nr 9, discovered far from the others, about 800m to the north from the shoreline. Objects 3, 6, 7, 8 and 9 are located exactly on one north-east axis. Other structures are only a few meters away from them. All this objects were built with stones of different sizes, arranged next to each other, forming a regular circle construction. There are two gaps in the circumference in every single construction or the small part of the ring is significantly lower there. These gaps (or lower parts) act as the "entrance", enabling the free flow of the water. Entrances of the majority of structures are situated in the north-east and south-west orientation. The diameter of circle constructions ranges from 4.5 to 7.5 meters. These type of stone object were probably made by cutting whole in the bedrock and surrounding it by stones.

The Team



Magdalena Nowakowska



Jakub Kaniszewski

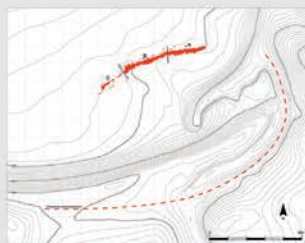


Szymon Lenarczyk

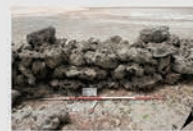
The project was initiated in the spring of 2013. Kuwaiti-Polish Archaeological Mission operates under an agreement between the Centre of Mediterranean Archaeology of Warsaw University and the Kuwait National Council for Culture, Arts and Letters. "Waterfront Archaeology Team" is a part of Kuwaiti-Polish Failaka Archaeological Mission. The aim of this project is to detect and describe remaining archaeological sites at the seashore, as well as to provide documentary evidence and finally organise the proper preservation, so that the discoveries could serve further educational opportunities. The program of "waterfront archaeology" research for 2013 assumed the inventory of stone structures in Kharab el-Desht Bay. The aim of it was to recognize and document groups of stone objects, which were interpreted as an installation for fishing farm, so-called "fish traps". Tidal process is essential for waterfront archaeological research in the Gulf. The amplitude in Kuwait Bay is about 2 meters, but tides can vary from 3.5 up to nearly 4 meters, depending predominately on the lunar phase. For survey and documentation of the littoral structures low water level and the daily light is required. During our activities in Kharab el-Desht we were completely dependent on the tidal cycle. Performing measurement and photographic documentation of stone structures was possible only for few hours a day, high water often made any kind of scientific activity impossible.

During the Kharab el-Desht Bay survey 12 stone constructions were registered. They can be divided into three groups:

Linear stone construction - object 12



Contour plan of the object 12 (by J. Kaniszewski, Sz. Lenarczyk)



Object 12 - part B (by M. Nowakowska)



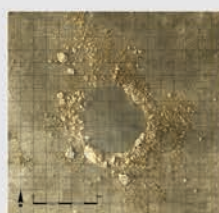
Object 12 - part A (by M. Nowakowska)



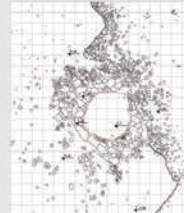
Photogrammetry of the object 12 (by J. Kaniszewski, Sz. Lenarczyk)

Object number 12 is located in eastern part of the bay. It consists of three sections, forming a solid stone structure. The first part (part C) is heavily damaged, preserved only in the outline. It is made of small stones arranged in a line, with the width of about 2m. The central part is built of stone blocks forming a regular wall with a height of about 1 m and a width of more than 2 meters. In this part, the construction is very solid. The construction required the adequate preparation of the blocks of stone. The third part is destroyed from the eastern side, but not as strongly as the first – from the western side. The face of the wall was partly formed by vertical stone slabs, and stones collected between them. Total width of the foundation, and the fact that the stone blocks were specially prepared, indicates that it was a strong and durable construction. Along the entire length of the wall, between the stones and surrounding structures, numerous fragments of pottery were recorded. Pieces of clay pots can be derived from the neighboring settlement of Al-Qurayniyah and could get there in the process of erosion of the site. The second possibility is that the fragments of pottery were used deliberately as a bedding layer to strengthen structure basis. The total length of the construction is about 60m, the first part is about 14,5m, central section about 23,5m length and the third one 21m length. The whole structure forms a smooth curve. The architectonic construction of object 12 is very interesting. It was possibly used as a harbour, pier and breakwater. Now we haven't got the evidence for establishing the chronology of the stone construction.

Methods of documentation



Photogrammetric plan (by J. Kaniszewski, Sz. Lenarczyk)



CAD plan (by J. Kaniszewski, Sz. Lenarczyk)



Documentation at the site (by M. Nowakowska)

Vertical pictures and geodetic measurements were a basis for the preparation of CAD documentation and photogrammetry of selected objects. It is a basis for the three dimensional photo scanning. The series of photos of several groups of stone object were made from a height of about 5 meters. For one small circle object about 60 vertical images were needed to obtain a photomosaic picture and finally: a photogrammetric plan. The photogrammetric documentation was made only for small circle stone constructions and for the linear object nr 12. Based on vertical photos 3D models of selected objects were made. Full 3D model consists of triangular mesh and raster texture. Documentation involved geometrical and photogrammetrical information. 3D models can be used for several forms of presentation: perspective and axonometric views; photogrammetrical projections; animations presentation; sections; contour plans. 3D models of shoreline constructions also give possibilities of sea-level simulations. Full documentation bases on geodetic measurements were made by Total Station. The attempts of evaluating the thickness of the objects indicates the depth of circa 1,5 meter.



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Beneficios del rigor en la investigación para una completa y correcta valoración de un resto arqueológico

Benefits of a precise research for a complete and accurate valuation of an archaeological rest

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Resumen: esta investigación pone de manifiesto las dificultades de una correcta datación y los riesgos de una restauración ineficiente. En 1806 el capitán Archibald Selman del bergantín *America* de Massachusetts, muere ahogado al volcar su bote en la ría de Bilbao. Su cuerpo se enterró en el cementerio británico existente en sus orillas y que posteriores inundaciones destruyeron. Estudiando su tumba, vemos los daños de la restauración llevada a cabo en 1862, que erróneamente le cataloga como súbdito británico y modifica la fecha de su muerte. A su vez, del estudio de documentación iconográfica y de hemeroteca realizado en EE. UU., sacamos a la luz un cuadro del bergantín *America* y el registro en la prensa local de la muerte de su capitán en el río Balboa, nombre luso que aleja de contexto su real emplazamiento complicando cualquier intento de localización posterior. Ahora estos restos arqueológicos han podido ser ya datados y documentados correctamente 200 años después.

Palabras clave: datación, restauración, tumba, Massachusetts, Bilbao.

Abstract: This research reveals the difficulties of proper dating and risks of inefficient restorations. In 1806, Captain Archibald Selman of the brig *America* from Massachusetts was drowned by the capsizing of a boat in the estuary of Bilbao. His body was buried in the British cemetery existing on its banks. Over time, river floods destroyed the cemetery. Studying his gravestone, we observed the damage of an inefficient restoration carried out in 1862. He was erroneously categorized as a British subject and the date of his death was modified. Furthermore, our study of iconographic documents and periodicals carried out in U.S., exposed a picture of the brig *America* and a record in the local press about the death of Archibald Selman on Balboa River, a name of Portuguese origin away from the context of its actual site and complicating any attempt to posterior location. These archaeological remains can now be dated and documented correctly 200 years later.

Key words: Dating, restoration, gravestone, Massachusetts, Bilbao.

BENEFITS OF A PRECISE RESEARCH FOR A COMPLETE AND ACCURATE VALUATION OF AN ARCHAEOLOGICAL REST



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One of the challenges facing underwater archeology when preserving cultural heritage is the correct identification of the findings and subsequent dating. We note in this regard the results of the following research:

In August 1806, Captain Archibald Selman brig America bearing the trade route between Massachusetts and the northern coast of Spain, drowned by the capsizing of a passage boat that took him to his ship in the estuary of Bilbao.

His body could be buried in the British cemetery existing on its banks due to the Spanish-British international agreements that allowed such religious and cultural coexistence. Over time, river floods destroyed the cemetery. The rescue and relocation of his remains highlight the arising problems and consequences in dating of underwater heritage to be protected.

Studying his gravestone, which is the oldest preserved there, we observed the damage of an inefficient restoration carried out in 1862. Even he was erroneously categorized as a British subject and the date of his death was modified.

Furthermore, our study of iconographic documents and periodicals carried out in U.S., exposed a picture of the brig America and a record in the local press about the death of Archibald Selman on Balboa river, a name of Portuguese origin away from the context of its actual site and complicating any attempt to posterior location.

The study and analysis of these two lines of research, reveal the difficulties of proper dating and risks of inefficient restorations, and lead us to conclude that both lines converge on a single element whose archaeological remains can now be dated and documented correctly 200 years later.

Show America of Marblehead Archibald Selman Master on Mond. 2 January 1803 M Corne, Peabody Essex Museum.



A. Anglican chapel in the British Cemetery in Loui, Biscay. B. British Cemetery map. Arrow indicating the location of the grave.



A. Archibald Selman's gravestone before the study.



B. The author of the study next to the gravestone.



A. Issue of the Newspaper Salem Register Oct. 20, 1806. Washington and Lee University, Farrar Collection.

"...Capt. Archibald Selman of Marblehead commander of the Brigantine "America." Drowned in Balboa River the 19th of August last by the upsetting of a passage boat..."

B. "To the memory of Captain Archibald Selman of Marble Head who was drowned in this river on Tuesday august 10 1806 aged 33 years. Farewell thou faithful and tried friend a long farewell thy sufferings and tried virtues are at an end. Restored by the trustees of the cemetery 1862"



ACCESO PÚBLICO Y SENSIBILIZACIÓN

PUBLIC OUTREACH AND AWARENESS

Marine Stewardship and Maritime Archaeology in Scotland: Preliminary observations from Project SAMPHIRE

Administración Marina y Arqueología Marítima en Escocia: observaciones preliminares del Proyecto SAMPHIRE

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Abstract: The Scottish Atlantic Maritime Past: Heritage, Investigation, Research and Education Project (SAMPHIRE), was established with the complementary aims of assessing the potential contribution of community engagement as a mean of accurately identifying and recording previously unknown maritime heritage, and fostering engagement between professional maritime archaeologists and local coastal communities in western Scotland. In the first two years of the project the SAMPHIRE team has undertaken a programme of community engagement, interviewing local community members including divers, fishermen, historians and others who had knowledge of the seafloor in their area. This engagement programme has identified a significant number of new archaeological sites, and the accuracy of reported data has been investigated through selected field survey. This publication represents an interim report and discussion around lessons learnt, and presents a specific case study which highlights both the constraints and achievements of our methodology.

Key words: Community archaeology, maritime archaeology, archaeological prospection, underwater cultural heritage, Scotland.

Resumen: el Proyecto SAMPHIRE se estableció con los objetivos complementarios de evaluar la contribución potencial de la participación de la comunidad como un medio para identificar y

recopilar con precisión el patrimonio marítimo hasta ahora desconocido, y fomentar el compromiso entre los arqueólogos marítimos y las comunidades costeras locales del oeste de Escocia. En los dos primeros años del proyecto, el equipo ha llevado a cabo un programa de participación de la comunidad local, entrevistando a buzos, pescadores, historiadores y otras personas que tenían conocimiento del fondo marino en su área. Este programa de participación ha identificado un número significativo de nuevos yacimientos arqueológicos y se ha investigado la exactitud de los datos notificados a través de un estudio de campo. Esta publicación presenta un informe provisional y el debate en torno a las lecciones aprendidas, un ejemplo de estudio específico que pone de relieve las limitaciones y los logros de nuestra metodología.

Palabras clave: arqueología comunitaria, arqueología marítima, prospección arqueológica, patrimonio cultural subacuático, Escocia.

Introduction

Scottish maritime archaeology

Amongst the most pressing issues in maritime archaeology is establishing a baseline level of knowledge on the presence of underwater sites. Simply put, we know the location of only a tiny fraction of the total number of vessels recorded as «lost» since records began. In addition to vessels known from historical records to have been lost, there are undoubtedly a vast number of wrecks lost both during and prior to the advent of formalised recording, and in particular there are few or no physical remains of many types of seafaring vessels that must have played such an important role in Scottish and British maritime activity from the prehistoric to post-medieval periods (cf. Cunliffe, 2013). This presents a huge challenge to the management of the finite and non-renewable resource that is maritime archaeology. This is an urgent task in an increasing world of pressure on the marine environment (Unesco, 2001), which is at risk from both human and environmental impacts, and which requires the implementation of effective policies to preserve underwater archaeology, and to promote public knowledge and enjoyment of underwater heritage (Dunkley, 2008). Enhancing our baseline knowledge of archaeological remains on the seabed is particularly crucial within the national research context as our knowledge for many types of maritime archaeological site types is far less complete than that for terrestrial archaeological sites of the same period or culture. Although Scotland has a strong tradition of underwater archaeology and research into the maritime past (eg. Martin, 1998), this major gap in knowledge has been increasingly recognised in recent years by cultural resource managers such as Historic Scotland and the Built Environmental Forum of Scotland (2009) and in the Scottish Archaeological Research Framework (Atkinson/Hale, 2012).

Within Scotland there are 4660 identified historic shipwrecks sites (RCAHMS, 2013: 2). While this may initially seem like a large number, there are 24 842 recorded losses (ie. reports of lost vessels and aircraft, but which have not been geographically confirmed) in Scottish waters. Therefore around 92% of recorded vessel and aircraft losses in Scotland remain unaccounted for (RCAHMS, 2013: 2). Furthermore, as records only started to become comprehensive in the mid-nineteenth century, it is likely that the number of wrecks from the nineteenth and twentieth centuries within Scottish waters is even larger. For earlier periods we have found only a handful of wrecks (Lancaster/McCarthy/Benjamin, in press; Fig. 1).

Within the past few decades our ability to locate and identify underwater heritage has been aided by the development of new technologies including marine sonar techniques and Remotely Operated Vehicles (Bowens, 2011). In the UK however only a small fraction of the seabed has been subject to such investigation. The Civil Hydrography Programme (CHP) run by the Maritime & Coastguard Agency (MCA) has been underway since 2004 and has now covered

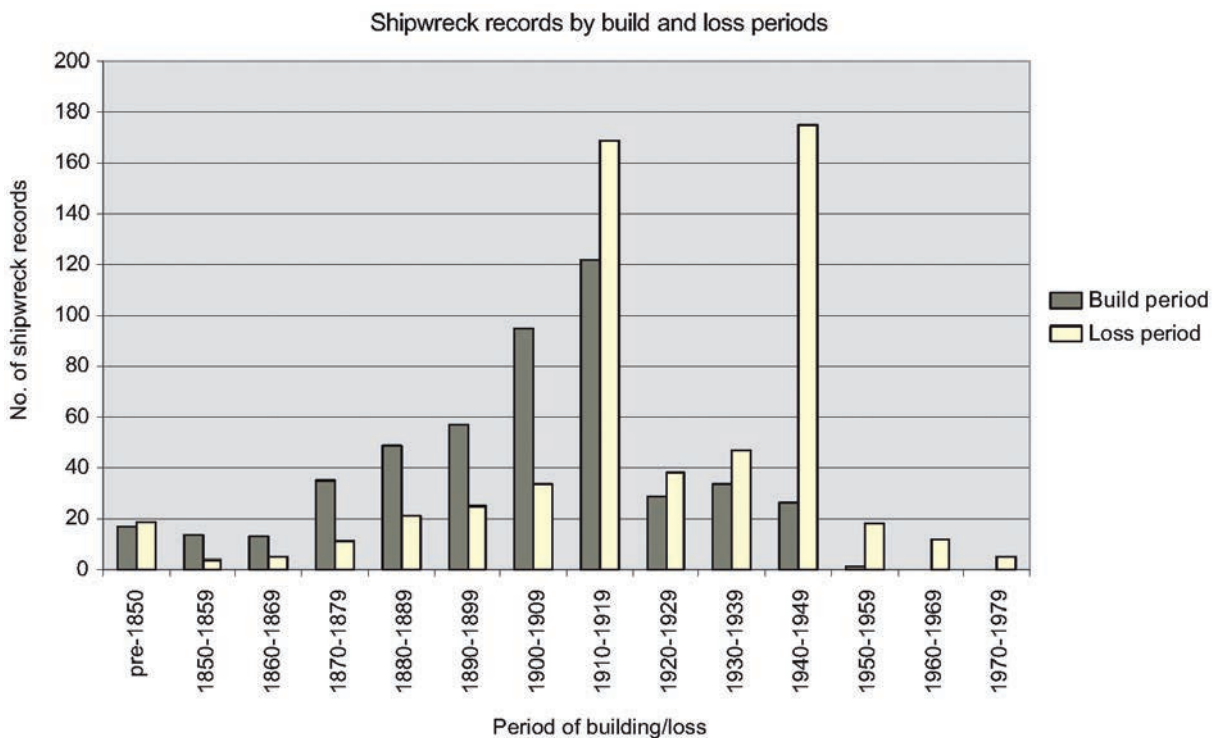


Figure 1. Shipwrecks with known locations in Scotland (after Lancaster, et al. 2015 Copyright Historic Scotland 2015).

around 12% of UK waters, mostly well away from the shore¹. The vast majority of recorded marine heritage sites in the UK have been found through geophysical survey, and as a result the local and national heritage databases are heavily skewed towards large modern metal ships in both England (English Heritage, 2012) and Scotland (McCarthy, 2011) and away from older, often more ephemeral vessels made mainly of wood remain. These modern, mostly 20th Century vessels are often the least significant from an archaeological research perspective and often are well recorded in the historical record and archives. As an illustration of this point, for all the known wrecks sites mentioned above, there have been no discoveries of Viking ships (except for a handful known from funerary contexts) and no Highland Galley wreck sites known in Scotland. This is the case, despite the fact that galleys are known to have been one of the most prevalent sea-going vessel types in the country throughout most of the medieval period (Rixson, 1998). If we continue to focus on sonar as a prospecting technique this is likely to remain the case as such wrecks are not likely to be discovered through large-scale, low frequency geophysical survey.

One way to address this imbalance is to explore other methods of discovering wrecks and other underwater heritage sites. A recent report on the state of Scottish maritime archaeology stated that «there is a need to further refine understanding of the most significant gaps in knowledge including geographic areas, types and periods of assets which are under-represented at present, in order to identify appropriate methodologies, prioritise and implement avenues of research for addressing the most significant gaps» (Historic Scotland and the Built Environment Forum, 2009: 11). A wide-ranging audit of possible sources of data for enhancement of marine heritage data was subsequently commissioned by Historic Scotland and highlighted the potential value of community sources, including the diving community (McCarthy,

¹ <https://www.gov.uk/share-hydrographic-data-with-maritime-and-coastguard-agency-mca> [Accessed 11/03/2015]

2011: 35-37). In the maritime context, large-scale survey and recording of sites is difficult due to the extra costs associated with conducting survey of the seabed. Therefore alternative sources of information must be considered. Local community knowledge may offer at least a partial solution to this dilemma, and justifies a positive effort to establish the nature and utility of this knowledge base.

Community Archaeology

The concept of community archaeology is one which has grown considerably in recent years; this is demonstrated by the establishment of a new technical periodical, *The Journal of Community Archaeology* printed by Maney Publishing, and which began in 2014. The term «Community Archaeology» is diverse, covering distinct and different types of projects ranging from developer-funded programmes (often managed by commercial archaeology companies), to research projects, which aim to include community groups in the process of a specific archaeological site or geographically constrained project. The term «community» can refer either to the public in general or to a more narrowly-defined special interest group. In the case of heritage there is often a risk that community projects reach only those with a pre-existing interest in archaeology, and can be lacking in diversity (Simpson, 2009). The justification for community projects is similarly diverse, centring on providing educational and social value, and the need to engage with public who fund research in the case of research council funded projects.

In the maritime context, avocational divers have become an increasingly prolific source of knowledge on the existence of archaeological sites with the growth in recreational diving and archaeological collaboration with sport diving communities since at least the 1950s (Goggin, 1960; Frost, 1963; Bass, 1966). It is increasingly recognised that recreational divers have become an important component in maritime archaeology, particularly with regard to prospecting for new discoveries. Recreational divers are often the first to find a new site, since professional underwater archaeologists are few in number and inevitably spend most of their time focussed on the investigation or publication of known sites (Roberts/Trow 2002).

There have been numerous initiatives over the last six decades to encourage responsible participation in archaeology by divers, most notably in the UK by the Nautical Archaeology Society which offers opportunities for archaeological training to divers (e.g. Bowens, 2011). Other examples include a guidance document for recreational divers by the Joint Nautical Archaeology Policy Committee (JNAPC, 1997), similar guidance by Historic Scotland (2012) and in America, a heritage awareness project by the Florida Public Archaeology network and Florida Bureau of Archaeological Research, which targets diving instructors, course directors, and instructor trainers, with the aim of raising awareness of the importance of submerged heritage, and fostering the same sense of community stewardship that exists for the natural marine environment (Scott-Ireton, 2008). In Australia, there have been several projects which focus on community, public education and awareness with recreational divers through responsible stewardship and cultural tourism, such as through the establishment of «heritage trails» (eg. Souter, 2006). Archaeological consultants have also increasingly become aware of the benefits of working with local communities to encourage reporting of heritage discoveries and developing educational resources to illustrate the wide benefits of heritage; the Fisheries Protocol (Wessex Archaeology, 2013) a programme designed to educate fishermen in England about the marine historic environment and to encourage them to report their discoveries and the related BMAPA Protocol (British Marine Aggregate Producers Association and English Heritage, 2005) which undertakes similar activity for offshore aggregate producers. These programmes can make a real difference to the perception of marine archaeology within maritime communities and can encourage responsible

and sustainable approaches as well as enhancing our knowledge of underwater cultural heritage (Scott-Ireton, 2007).

It has also been recognised that community engagement and public interpretation can be an important part of the management and protection of sites in remote locations. By fostering a sense of public stewardship amongst communities, these groups can play an important role in the long term preservation of sites (Jameson/Scott-Ireton, 2007). Engagement projects can range from avocational training, exhibits and educational resources. Programmes that focus on training are often better suited to small areas or to individual historic shipwreck sites. They require a relatively high level of community input over an extended period and one of the greatest challenges can be to find individuals who are able to make that level of commitment or time and money (e.g. Wessex Archaeology, 2013: 16-18).

Project SAMPHIRE

SAMPHIRE was established to enhance the maritime archaeological baseline off the west coast of Scotland through community engagement. Specifically, the project aimed to establish a two-way flow of communication utilising community participation to gather broad data on the location and type of submerged sites. It is important that projects undertaking community involvement are a two-way process. An area of concern for heritage professionals is how to effectively and respectfully access this local knowledge, how to preserve and disseminate it for the benefit of the local community, how to enhance the value of this information through further work, heritage managers and the wider field of researchers, students and practitioners of maritime archaeology. Building on previous experiences the goal for the SAMPHIRE project is for professional maritime archaeologists to share our technical expertise with local community members who in turn are encouraged to share their *existing* knowledge of their local marine historic environment, traditions and stories and their intangible sense of place related to local maritime heritage. The study area extends from Cape Wrath to the English border, though SAMPHIRE does not include the Outer Hebrides (which were assessed in an earlier study; Benjamin 2014). Rather than seek to encourage recreational divers and other locals with knowledge of the seabed to make a commitment to become avocational or semi-professional archaeologists, the SAMPHIRE team instead seeks to recognise and assess the community's *existing* knowledge. Because some of the villages, particularly those in the northwest, are very small and far often several hours drive from urban centres, the project relies heavily on face-to-face interaction.

The aims of this project therefore are firstly to conduct an assessment of the breadth and accuracy of local community knowledge with regards to the location and identification of underwater heritage. Secondly we aim to assess the archaeological value of such knowledge in terms of generating new reliable information on underwater heritage. Thirdly, we seek to help to develop a sense of stewardship by encouraging community involvement, and recording and presenting community-derived information in a way that is mutually beneficial for archaeologists and local communities. We have found that often community members are surprised to know that people are interested in their local maritime heritage, which in itself represents a small, but positive result.

The project aims are achieved through a four step methodology, currently in progress, and repeated on an annual basis in different sub-study areas. For the sake of practicality and the three year project, the west coast of Scotland has been divided into three areas from North to South. Within each area maritime communities are identified on the basis of their proximity to the coastline (most being located < 0.5 km from the water) and being actively or historically

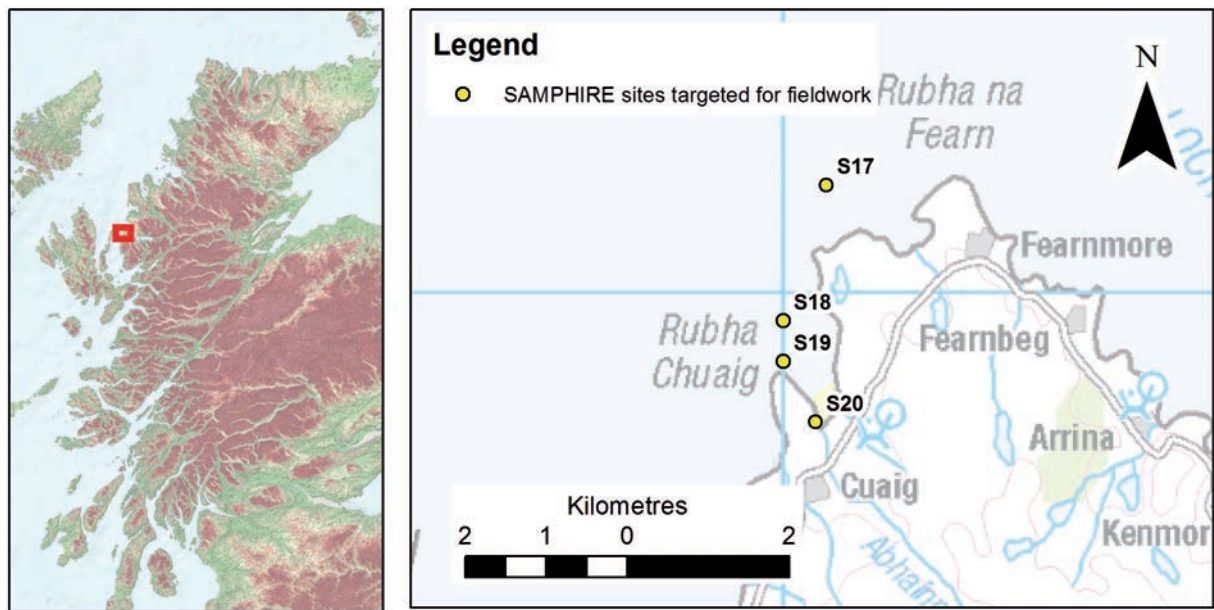


Figure 2. Location map of Murchadh Breac.

involved in maritime industries such as fishing and scallop diving. Within each of these communities, local establishments such as museums, community halls, dive clubs and harbour offices were contacted to introduce the project and promote our interest and goals through the distribution of printed flyers and posters. A website and online reporting form was also setup². As part of this process of contact, we asked for volunteers to participate in face-to-face focus groups.

During these group meetings, which took place over a period of two weeks each year, volunteers were asked to share their knowledge on the location and type of submerged heritage they had encountered. This process involved both qualitative information and in some cases, specific geographic coordinates from participants with access to GPS technology for example on smart phones, digital cameras or vessel tracking systems.

In the second phase, a basic level of research is undertaken into the reported sites, to confirm whether or not the sites were in fact previously «unknown» (i.e. whether there was an official record of the site) and to add any further information such as possible wreck identifications, based on known reported losses in the area. Following phases 1 and 2, a subset of identified sites are selected for further investigation by the SAMPHIRE team in phase 3. This selection targets the most credible reports with the highest resolution of geographic accuracy, and is designed to assess the accuracy of information provided through community interviews.

The data gathered is entered into a *proforma* Access database provided by the Royal Commission of Ancient and Historical Monuments of Scotland (RCAHMS) and following completion of the project will be added directly to the publically-accessible RCAHMS National Database. In this way the project data is widely available to the public with the minimum of delay.

² www.wessexarch.co.uk/samphire.

Case study: «Living Knowledge» and local history at Shieldaig (Wester Ross, NW Highlands)

The project team has recorded a significant amount of oral history from local community sources which might otherwise have been lost. In particular these have come from the generation born in the first half of the 20th Century; some of whom had accounts of maritime archaeological sites passed down from grandparents or even further. The following case study discusses our work with Mr. Robert Gordon, a retired seaman and local historian based in Shieldaig, and one of the most active and informative participants. Gordon pointed out that the traditional oral histories of the Highlands were being lost and that the recording of his story would help to ensure its preservation.

Mr. Gordon first came into contact with the SAMPHIRE project during a community engagement visit by the team to the remote village of Shieldaig. His status as a local expert on the maritime history of the area was mentioned by several people the team spoke to and ultimately Gordon provided information that led to the discovery of several new maritime archaeological sites. One of the sites that Gordon was particularly helpful with was a previously uncharted site at Murchadh Breac, a small drying rock near the mouth of a large west coast sea-loch, Loch Torriden (Fig. 2).

The site was (Fig. 2, S17) originally reported by locals to be the remains of the vessel *Sheila*, a steel steamship lost in 1927, but research conducted by Gordon proved otherwise. Thanks to Gordon's efforts and his knowledge of local resources, he was able to identify that the *Sheila* lay at another location in nearby Chuaig Bay and that the wreck at Murchadh Breac was either the *Fair Geraldine* a wooden cutter lost in 1902 or the SS *Viscount*, an iron steamship lost in 1924.

Gordon's efforts led the team to investigate the new location of the *Sheila* near Chuaig Bay (Fig. 2, S18). This decision was made as the *Sheila* was one of the earliest ferries in the area and was a key part of life in the maritime communities of this part of Scotland. During the fieldwork for the SAMPHIRE project, Gordon was able to uncover numerous accounts from the more elderly residents and former residents of Chuaig Bay of material having been recovered from the wreck and being used in the houses around Chuaig Bay. He also reported that some artefacts from the *Sheila* are preserved in the Applecross Heritage Museum, including ceramics and spoons. Gordon subsequently visited the museum in September 2013 and provided images of the collection to the SAMPHIRE Project. Although the SAMPHIRE dive team was unable to locate the wreck, local dive clubs subsequently came forward with images and sketches of the wreck remains (Fig. 3) and also provided photos of the wreck thought to be the *Fair Geraldine*/SS *Viscount*.

Though a single example is rather anecdotal, it is nevertheless important to this particular community and illustrates the project's methodology and outcomes. Gordon's interests and local knowledge of history, as well as people and resources proved to be invaluable to identifying and understanding the history of potential wreck sites. This type of interaction is typical of the recorded by Project SAMPHIRE to date and is exactly what the team hoped to accomplish. It would have never taken place without direct community engagement. There are numerous similar sites currently being investigated by the project team, with results scheduled for full publication following the completion of SAMPHIRE in 2016. A discussion of the project's current progress is found below.

Discussion

Introductions, dialogue with community groups have led to the fostering of mutual understanding, trust and relationships; so far this has resulted in the recording of over 100 new maritime archaeological sites in the first two years (2013-2014), which includes numerous wooden ship-

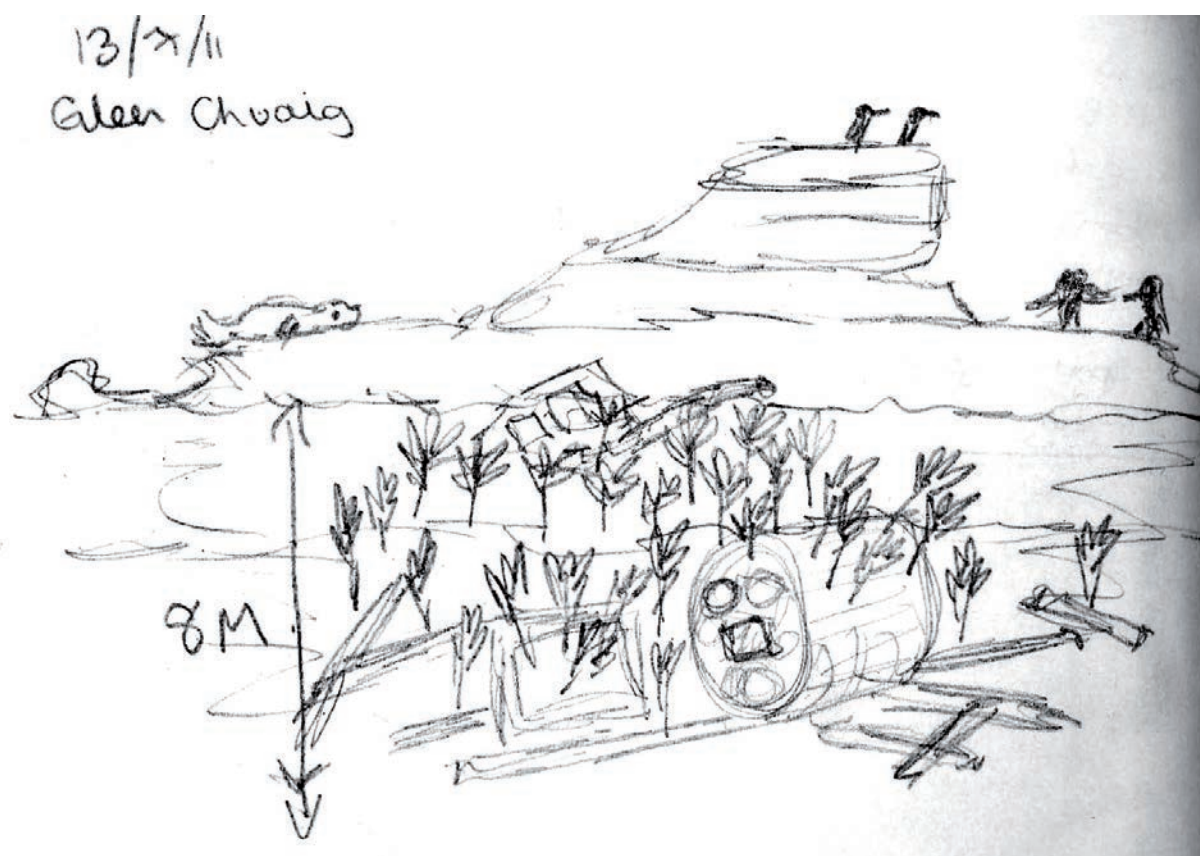


Figure 3. A club diver's sketch of the wreck at Chuaig Bay, offered to the project team (courtesy of Jo Beaton, Dalriada Dive Club). The wreck was previously unrecorded in the national database.

wrecks, WWII aircraft, stone anchors and even prehistoric coastal and intertidal sites (details of which can be found on the project website). In addition to recording previously unrecorded material, community involvement has also enhanced understanding of known sites.

The project has maintained a constant dialogue with community participants, providing professional interpretations of the sites and artefacts reported as soon realistically possible (and usually within a few days or weeks). This takes place directly through phone calls, emails and face-to-face meetings as well as indirectly, through contributing to online blogs, social media. The success of these tools as a means of disseminating information is beyond the scope of this paper (though available through the project blog). Final results will be assessed as part of the project synthesis upon completion.

Despite the fact that the project avoids formal programmes of training and education there is a major opportunity for raising the level of awareness of maritime archaeology in Scotland and part of this is allowing and encouraging community participation in the limited amount of fieldwork that is undertaken. The BEFS (2009, 14) strategy document also stated that «as a result of the low level of awareness and knowledge of the resource, the inaccessibility of it, the wide range of environmental and man-made drivers of change, and the logistical difficulties of operating off-shore, stewardship of the marine historic environment is less well developed than on land».

One of the key aims of Project SAMPHIRE is therefore to help to develop this sense of stewardship, by encouraging communities involved in the project to participate in the process of

documenting and investigating reported sites. In many cases, the individuals who have discovered archaeological sites feel a strong connection with them and can feel justifiably aggrieved if professional archaeologists seem to be «taking over». To avoid this, the SAMPHIRE team has sought to follow an inclusive model where professional archaeologists offer their expertise as a service to local communities and aim to ensure that any new knowledge arising from research and survey is passed back directly to those communities as both stakeholders and project participants.

The most challenging aspect of this project will be evaluating the effectiveness in terms of achieving its stated goals, particularly the third aim, of providing real value to local communities. A major study by Simpson (2009) recognises that community archaeology as a whole suffers from a lack of such evaluation criteria, and that such projects often fail to achieve the desired outcomes for all stakeholder groups. Indeed, even the «community» itself with which we hope to engage consists of a diverse group of people with potentially different, and maybe even competing interests. Despite these problems, community archaeology does have the potential to have an impact on how society understands and values maritime archaeological heritage.

Simpson concludes that the main problem often lies with the competing interests of different stakeholder groups. In the case of this project this means the communities with which we hope to engage and ourselves as heritage professionals. Further groups include the funders, and the professional bodies who are potential end users of the data that will be obtained. Simpson suggests a «double helix» approach, where the different values are interwoven, rather than seen as separate and competing. In this project, the two main values are firstly establishing whether community engagement can provide usable data that contribute to the heritage agenda, and secondly in making sure that this process of engagement provides something of value to these communities. This theoretical framework directly informs the SAMPHIRE methodology and expected outcomes.

Conclusions and Future Directions

In achieving its first aim, the project has so far proved to be a modest, but definite success. The community discussions have resulted in over 100 new maritime archaeological sites being recorded, many of a type that could not be found through hydrographic survey. This has been achieved without the need for training and in depth diver survey or excavation of wreck sites, in favour of gathering location/site type data already held outside professional archaeological circles within local communities. Though SAMPHIRE is ongoing, the case study presented here on «living knowledge», has already clearly identified the type of local knowledge retained with modern maritime communities. It is necessary to engage, not only from a research perspective, but also as an ethical obligation to the local communities within the environments that archaeologists work. It is important to recognise the different values attached to the project by ourselves as heritage professionals, and the communities as «providers» of knowledge. The case study presented in this chapter also raises new and important questions about the urgent need to record oral histories in the Highlands and other remote regions. It is hoped that the project team can build on the links that have been built between SAMPHIRE and these communities to provide an enduring legacy of cooperation and trust that will enable us to undertake effective future research in this area.

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England's Protected Wreck Diver Trails and the Economic Value of a Protected Wreck

Itinerarios de buceo en pecios protegidos ingleses y el valor económico de un pecio protegido

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Abstract: The paper looks at several diver trails in England, including on the Norman's Bay Wreck and on HMS *m/A1* submarine and highlights the role that guided access can play in education provision, public experience and interaction with underwater heritage. The paper argues that whilst the Protection of Wrecks Act (1973) remains the principle legislation used to protect and manage historic material on England's seabed, licensed public access must remain a cornerstone of any associated heritage management strategy, a strategy that must receive long-term commitment from both the trail organisers and the heritage agencies. In 2012 to 2013 the Nautical Archaeology Society undertook a study into the economic impact of the *Coronation* diver trail. The study aimed to determine the number of visitors to the site, and how much and on what each visitor had spent money while in the Plymouth area. The aim was to determine the value of the protected wreck to the local economy.

Key words: Protected wreck, diver trail, public access, economic benefit, English heritage

Resumen: este artículo analiza varios itinerarios de buceo en Inglaterra, incluyendo el pecio de Norman Bay y el submarino HMS *m/A1*. Además evidencia el papel que el acceso guiado puede jugar en la educación, la experiencia pública y la interacción con el patrimonio subacuático. Se argumenta que, si bien la ley «Protection of Wrecks» (1973) sigue siendo la principal legislación utilizada para proteger y gestionar este patrimonio histórico, el acceso público autorizado debe seguir siendo la piedra angular de cualquier estrategia de gestión del patrimonio asociado, recibiendo el compromiso a largo plazo de los organizadores de itinerarios y de las agencias de patrimonio. En 2012-2013 la Nautical Archaeology Society realizó un estudio sobre el impacto económico del itinerario subacuático *Coronation*. Su objetivo era determinar el número de visitantes al yacimiento, y cuánto y en qué se había gastado el dinero cada visitante mientras estaba en Plymouth. El objetivo fue determinar la incidencia del pecio protegido en la economía local.

Palabras clave: pecio protegido, itinerario de buceo, acceso público, beneficio económico, patrimonio inglés.

Summary

In April 2014 there were 49 wreck sites designated under the Protection of Wrecks Act (1973) in England. These wrecks are protected for being the most important historical and archaeological wrecks in UK territorial waters with a known location. Many of these wreck sites are buried, and therefore rather uninspiring to the public perception of the shipwreck and underwater archaeology. Some of them are fragmented and therefore difficult to understand, whilst others are fragile and like any delicate archaeological assemblage cannot withstand large numbers of visitors on a regular basis. However some designated wrecks lend themselves to licenced public access.

The Protection of Wrecks Act 1973

The designation of significant historic wreck sites in England occurs under Section 1 of the Protection of Wrecks Act 1973. The Act enables the Government to control investigations of wreck sites and on the seabed surrounding them. Designated sites under Section 1 of the Act are identified as being those likely to contain the remains of a vessel, or its contents, which are of historical, artistic or archaeological importance.

It must be stressed that the Protection of Wrecks Act 1973 does not prohibit access to designated wrecks; but instead, it controls activities so that designated wrecks are not put at risk from undisciplined investigations or actions (English Heritage, 2010).

English Heritage's responsibilities to underwater wreck sites derive from the National Heritage Act 2002, which modified functions to include firstly securing the preservation of ancient monuments in, on or under the seabed; and secondly promoting the public's enjoyment of (and their knowledge of) monuments in, on or under the seabed. The National Heritage Act 2002 Act also enabled the Secretary of State for Culture, Media and Sport to transfer administrative functions relating to the Protection of Wrecks Act 1973 to English Heritage.

Access to England's protected wreck sites is facilitated through a licensing scheme administered by English Heritage on behalf of the Department of Culture Media and Sport (DCMS). In England, licences enabling access are subject to the authorisation of the Secretary of State for Culture, Media and Sport.

Individuals or groups wishing to visit or undertake archaeological activities on a protected wreck may only do so with an appropriate licence, but anyone may apply to access a protected wreck. There are four types of licence: Visit, Survey, Surface Recovery and Excavation and one licence can cover multiple activities without the need for additional licences. All licences issued include conditions such as the full names of individual divers, duration of the licence and the requirement for reporting to English Heritage. They may also have specific conditions attached to them, so that each licence can be tailored to the particular site, the skills and experience of the applicant as well as the proposed activity.

Applications requesting access to protected wreck sites are each evaluated on their merit and applicants are invited to contact English Heritage to discuss proposed projects before submitting a formal application. The English Heritage website hosts application forms to access a protected wreck site that can be downloaded or completed online.

In the UK there has been a strong tradition of avocational groups working alongside professional archaeologists to actively investigate protected wrecks. Proactive groups like the South West Maritime Archaeology Group clearly show that the advantages of involvement far outweigh any disadvantages, so long as assistance is provided in the form of guidance, support, conservation and training (Parham/Williams, 2012).

Encouraging Access to England's Designated Wrecks

Back in 2002 English Heritage's Initial Policy for The Management of Maritime Archaeology in England, Taking to the Water identified the need «to engage with the recreational diving community and the non-diving public to instil an enthusiasm for the maritime environment and its conservation» (Roberts/Trow, 2002). Building on this initial policy the philosophy of English Heritage in 2014 is to encourage the participation of avocational volunteers in the management and understanding of their heritage and to encourage them to care for it, through a heritage cycle of understanding, valuing, caring and enjoying the historic environment (James, 2012).

Development of diver visitor trails

The concept of managed visitor access via an underwater trail is not a recent phenomenon. The Hampshire and Wight Trust for Maritime Archaeology (HTWMA), now the Maritime Archaeology Trust (MAT) installed a diver underwater navigation line on the Needles protected wreck in the late 1990's. The concept was developed further in West Sussex and resulted in the creation of an underwater dive trail on the protected wreck of the warship *Hazardous* in collaboration with the *Hazardous* project team and with the support of English Heritage. The trail experience included a presentation, a guided tour around the wreck trail as well as a visit to an artefact collection and display (HWTMA, 2005: 5).

In 2009 English Heritage supported the installation of a dive trail on the protected wreck of HMS *Colossus*, in the Scilly Isles, Cornwall (Camidge, 2009; 2012). At the time, one of the motivations for supporting the visitor trail on HMS *Colossus* was the opportunity to generate local social and economic benefits. The HMS *Colossus* trail was developed by volunteers from the Cornwall and Isles of Scilly Maritime Archaeology Society (CISMAS) and funded by English Heritage. The underwater trail used numbered observation diver stations at particular places on the seabed around the site and a waterproof information booklet to guide visiting divers around the wreck and to explain the exposed remains visible on the seabed. The dive trail on HMS *Colossus* has been a huge success; since it opened in 2009, with over 1000 divers having visited the protected wreck (see Table 1).

The Norman's Bay Designated Wreck Diver Trail

The creation of the Norman's Bay Designated Wreck Diver Trail was commissioned by English Heritage in the summer of 2010 (Project Number 5946). The aim of the project undertaken by the NAS was to develop, install and test a diver visitor trail around the Norman's Bay Wreck (designated under the Protection of Wrecks Act (1973) on 14th June 2006). The dive trail was designed and installed by the NAS in 2010 and launched in the spring of 2011.

Since it launched, the Norman's Bay Wreck trail has been promoted and managed by the NAS as a mechanism to provide divers with an opportunity to both visit and help survey

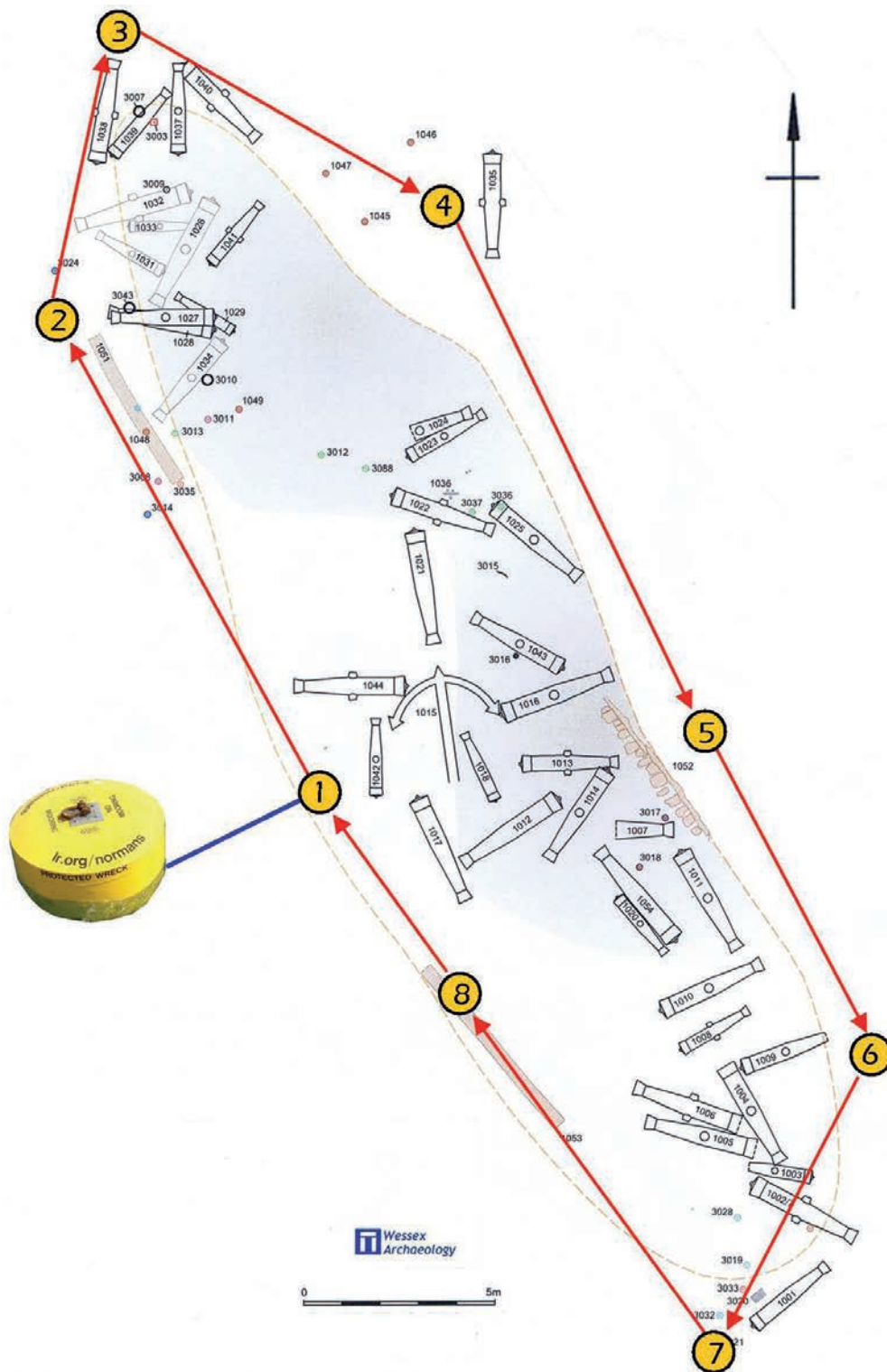


Figure 1. The location of eight diver stations surrounding the outer perimeter of the Norman's Bay Wreck. © NAS and Wessex Archaeology.

a protected wreck. As with HMS *Colossus*, an underwater information booklet guides divers around the site and eight diver stations were established around the wreck to aid diver navigation (Fig. 1).

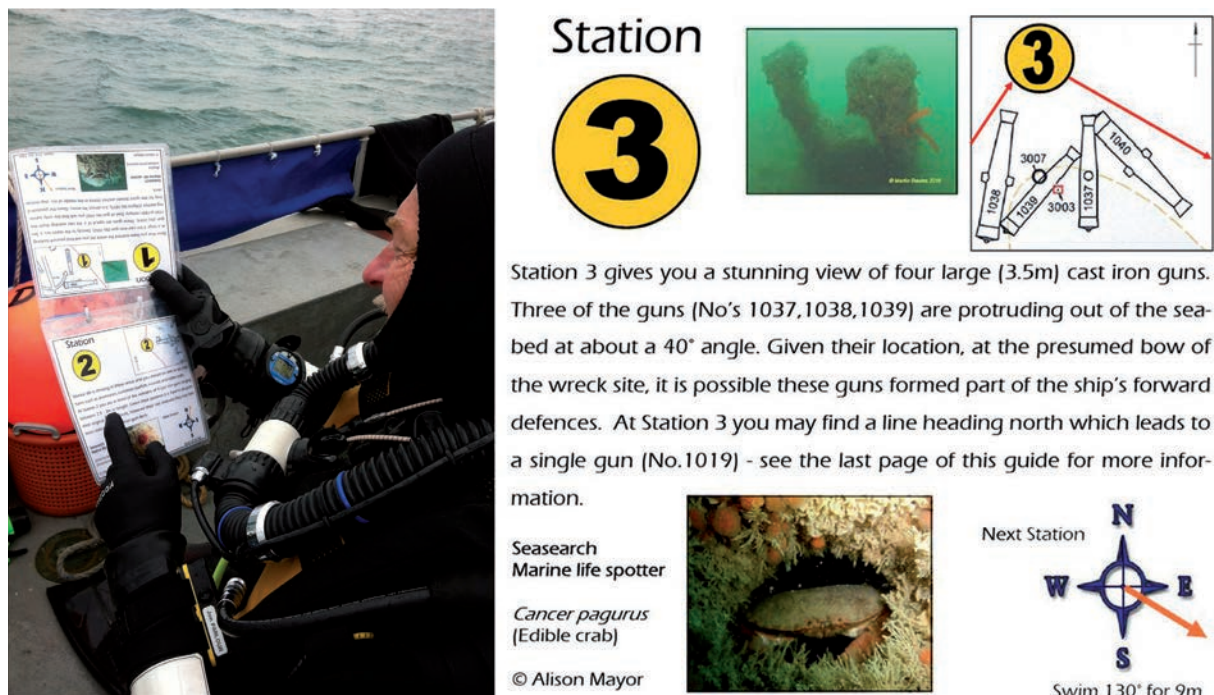


Figure 2. The waterproof booklet for divers visiting the Norman's Bay Wreck with the NAS. © NAS.

Additional information in the waterproof booklet is also included to assist visitors in navigating around the site and to help divers recognise features on the wreck site which often suffers from poor visibility of less than one meter. The waterproof booklet also explains the background of the exposed remains and the problems and issues in identifying the wreck (Fig. 2).

The waterproof booklet made from 250 micron laminating plastic is strong enough to be taken on a dive by the visitor. It consists of five double sided laminated pages of information. These pages are bound together using cable ties which also serve as a lanyard attachment point for the diver, to prevent losing the guides during their dive.

The underwater guides can be either downloaded (and then printed and laminated) from the project webpage or can be loaned from the NAS for a £5.00 refundable deposit. The information provided on the underwater booklet includes:

- Overall site map or plan.
- A photographic scale.
- Sponsors and supporters logos.
- Background information on the wreck.
- How to find the site including GPS coordinates.
- What to see at the eight diver stations.
- Additional areas of interest to visit.
- Where to send photos and video clips.
- How to help record the wreck.

Each of the eight diver stations that are on the seabed around the perimeter of the wreck are numbered with a small ball float. As visitors reach each diver station they are encouraged to read the text on the appropriate page of the underwater booklet. For example at Station N.º 3

visitors can see a «stunning view of four large cast iron guns....which formed part of the ship's forward defences» (Fig. 2). Divers are also given information to guide them to the next station and provided with a photograph and name of a marine species to look out for on the wreck.

The NAS created supporting project web-pages with an online Google calendar. The calendar is not designed to show the best dates to visit the wreck, but simply shows dates that have already been booked by a visiting group. The webpage also contains a Frequently Answered Questions section which aims to pick up on the questions that potential visitors may have prior to their visit.

After their visit the divers are asked to complete a feedback form about their experience, including whether they would recommend the visit to their friends, and if they would consider visiting another diver trail. The feedback form also encourages visitors to supply copies of their photographs and video to the NAS to add to the wreck archive, currently held at the NAS office in Portsmouth.

The HMS *m/A1* Submarine Designated Wreck Diver Trail

In February 2013 the NAS were commissioned by English Heritage (Project Number 6750) to develop a visitor diver trail on the designated wreck of the HMS *m/A1* submarine (designated under the Protection of Wrecks Act (1973) in 1998 (Statutory Instrument number 1998/2708), with an amendment in 2004 (Statutory Instrument number 2004/2395). The dive trail would be developed and managed by the Nautical Archaeology Society (NAS) in partnership with the Southsea branch of the British Sub-Aqua Club (SSAC) and the wreck licensee, Martin Davies.

An underwater information guide for divers visiting the site was designed that aids navigation and assists visitors in recognising features on the wreck. This guide also provides some additional factual information on the wreck and asked visitors to help in recording and managing the wreck. An online interactive visualisation was created by 3deep Media Ltd and supporting webpages and a Flickr photograph album are hosted by the NAS so that photographs from visiting divers can be posted.

For English Heritage, as the commissioning body, one of the key objectives of the project was to highlight the important historic value of the site to the general public, to the SCUBA diving community and the fishing community to reduce criminal impact on the site such as trawling, fishing and illegal diving. The NAS is a member of the Alliance to Reduce Crime against Heritage (ARCH) and believes that educational and awareness initiatives like this project can help reduce crime against monuments including wrecks (NAS, 2014a).

The creation of the diver trail on the HMS *m/A1* submarine worked on the premise that as a complete (single context) submarine wreck, every visiting diver would be able to navigate and orientate themselves easily, even in poor underwater visibility. Compared to other protected wreck diver trails, such as on the *Coronation* and the Norman's Bay Wreck, the features are not dispersed over a large area of seabed. The most appropriate method for the creation of the diver trail on the HMS *m/A1* submarine was felt to be through the use of multibeam sonar survey combined with an accurate artist's visualisation of the site which would be available online (Figs. 3 and 4).

No deposits of navigation aids/signage on the seabed were needed to establish the trail on the HMS *m/A1* submarine. Visiting divers would only need a waterproof underwater

HMS/m A1 Submarine Protected Wreck Visitor Trail

Finding the site:
Do not drop your shot directly on the wreck as this risks damaging the historic wreck.

Bow (WGS 84)
Lat. 50° 44.549' N
Long. 00° 55.285' W

Good shot location off to the west of the wreck (WGS 84)
Lat. 50° 44.541' N
Long. 00° 55.288' W

Stern (WGS 84)
Lat. 50° 44.538' N
Long. 00° 55.273' W

2013 multibeam sonar survey kindly provided by MSDS Marine & Swathe-Services

20cm photograph scale for your pictures

HMS/m A1 Submarine Protected Wreck Visitor Trail

Built: Vickers Sons & Maxim Ltd at Barrow-in-Furness
Length: 103 ft / 31m
Owner: Mr Martin Woodward

Launched: 9th July 1902
Discovered: 1989

Lost: In 1911 whilst being used for underwater target practice
Protected: By the Protection of Wrecks Act (1973) in 1998

Scorpion Fish

Dover Sole

Conger Eel

Tompot Blenny

In Depth Photography

During your visit to the HMS/m A1 submarine please feel free to help record the marine life that is so abundant on the site for the MCS Seasearch Project.

Please take photographs and video of the wreck and supply copies to either the NAS or directly to the wreck's licensee.

Finally, have a go at measuring or photographing the crack that runs up the forward face of the conning tower (see image below) and use the space to record your notes and observations. The photographic scale can help to record the size of this feature.

Notes / Observations / Measurements

15cm scale

Find out more about the HMS/m A1 submarine and the work of the NAS on

Did you enjoy your visit? Please remember to fill in a feedback form about your visit. Did you know that there are also diver trails on the Norman's Bay Wreck, HMS Colossus and on the wreck of the Coronation? Contact the NAS for more information on accessing these protected wreck visitor trails Tel: 02393 818419 nas@nauticalarchaeology.org

Figure 3. The front (left) and back (right) of the underwater guide for the HMS m/A1 submarine protected wreck diver trail. © NAS.

guide which can be used as a reminder; as an aid to navigation; as a way for divers to record observations, and as a photographic and measuring scale (Fig. 3). As with the Norman's Bay visitor trail, the underwater guides can be either downloaded (and then printed and laminated) from the project webpage or can be loaned from the NAS for a £5.00 refundable deposit.

The underwater guides serve many purposes and are divided up to cover different aspects of the site and assist any visitor to the wreck. The information includes:

- Finding the site – including GPS co-ordinates for the bow, the stern and the best location for deploying a diver access shot weight on the site. It asks visitors to not deploy their shot directly on the wreck as these risks damaging the historic wreck–.
- A north arrow –to aid navigation and orientation.
- A labelled multibeam sonar image of the wreck (kindly provided by Mark James from MSDS Marine and Swathe Services) – to facilitate observation and aid visitor understanding and navigation.
- A 20 cm photographic scale (divided by 5 cm colour bars) – to be used by underwater photographers when photographing particular features.
- General information – about the builder, launching and loss dates, length of vessel, the owner and the date the wreck was protected by the Protection of Wrecks Act (1973).
- Space for any notes and observations.
- A 15 cm scale (divided by 1 cm colour bars and numbers) for taking small measurements of particular features such as holes or cracks in the hull of the wreck.
- Four images of marine life found on the wreck.
- How to find out more about the HMS *m/A1* submarine and the NAS – including a Quick Reader (QR) code.
- Text which suggests that visitors could record marine life for the Marine Conservation Society Seasearch Project.
- Text which suggests that visitors take photographs and videos of the wreck and supply these to the NAS or directly to the wreck's licensee.
- Text (and a supporting image) which suggests visitors measure and photograph the width of the crack that runs up the leading edge of the conning tower.
- Text requesting that visitors complete a feedback form and contact the NAS if they are interested in visiting other protected wreck diver trails such as the Coronation or the Norman's Bay Wreck.

The information on the underwater guides was developed following two visits by diving groups in the summer of 2013. These visits involved divers from the Nautical Archaeology Sub-Aqua Club and Southsea Sub-Aqua Club, with a mixture of divers who had visited before and some who had not visited the wreck before. The biggest issue from these test visits was the group's ability to find the wreck and deploy their shot line in a safe location so as to avoid damaging the wreck but also close enough to actually find the wreck (NAS, 2014a).

As already stated one of the objectives of the project was to create an online visualisation of the HMS *m/A1* submarine. This had already been done for the protected wreck of the Holland N.º 5 submarine by the NAS and 3deep Media in 2012. The HMS *m/A1* submarine visualisation was created by providing 3deep Media with the engineer's general arrangement drawings, with multibeam sonar imagery, as well as up-to-date photographs and videos of the condition of the wreck provided by the NAS and by Martin Davies. The project was fortunate to be offered the use of a new multibeam sonar survey undertaken by MSDS and Swathe-Services during the summer of 2013. This survey data allowed the graphic artist at 3deep Media Ltd to build the seabed environment surrounding the wreck.

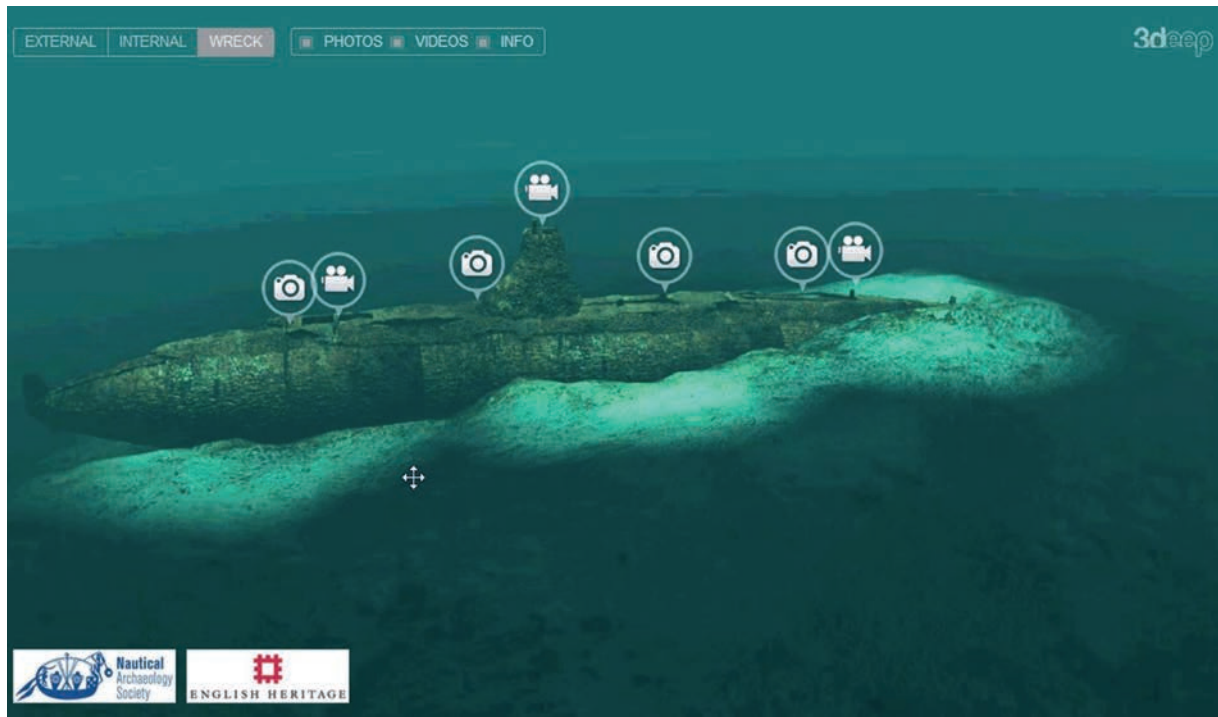


Figure 4. The online interactive visualisation of the HMS *m/A1* submarine, developed by 3deep Media Ltd and hosted by the NAS. © NAS.

The wreck visualisation allows the online viewer to spin the image around a horizontal axis by 360 degrees to view the site from every angle. Embedded in the wreck visualisation are four short video clips (the bow, torpedo loading hatch, conning tower and exposed exhaust pipes). There are also five embedded photographs that show details of the wreck along with descriptive text (Fig. 4).

During visits to the wreck of HMS *m/A1* submarine in 2013 the NAS dive team were joined by a professional marine biologist. The marine life surveys were undertaken to provide a baseline of marine life species abundance. Data was supplied to the Marine Conservation Society (MCS) via the SeaSearch Project. It is hoped that these marine life surveys can be repeated by trained SeaSearch divers who will be able to visit the wreck diver trail. The opportunity for visitors to contribute to our understanding of the marine life on the wreck is also emphasised on the waterproof diver guides (NAS, 2014a).

As with the Norman's Bay wreck trail the HMS *m/A1* submarine trail is supported by project web-pages with an online Google calendar and a Frequently Answered Questions section which aims to pick up on the questions that potential visitors may have prior to their visit.

Terry Newman, Assistant Maritime Designation Adviser for English Heritage, said of the HMS *m/A1* submarine diver trail: «We are diving into history with the launch of our first submarine trail. Protected wreck sites are as much part of our national heritage as castles and country houses, although they are not as widely accessible unfortunately. By giving licensed divers access to these historically and archaeologically important wrecks, we are encouraging greater understanding and recognition of England's underwater heritage» (English Heritage, 2014).

Creating a diver trail – lessons learnt

Naturally many lessons are learnt during the creation and management of a protected wreck diver trail. Some lessons are positive (what does work) and some are negative (what does not work). It is worth stressing that many lessons are specific for each particular site, in the particular location and with the resources available to the project and as such they are not rules, but «more like guidelines» (to mis-quote *Pirates of the Caribbean*).

In the project development stage the main lesson learnt has been in the design of a trail. It is vital to have a comprehensive understanding of your site and an accurate site plan. During some projects the author and the team from the NAS have discovered differences between the published site plans and what is actually on the seabed which could very easily result in confusion by visiting groups as well as the team establishing the trail.

Secondly it is vital that a site hosting a diver trail has a marker buoy to allow visiting divers to find and access the trail from the preferred starting point. Buoying the wreck would also serve to reduce the risk of potential damage caused by visiting diver shot weights and lines impacting on the wreck or the seabed around the wreck. If a wreck site is not buoyed then every visiting dive boat (whether carrying recreational divers or archaeologists) will need to deposit a large weight on the seabed near to the wreck. This weight is attached to a rope (or even a chain) to facilitate diver access directly to the wreck, rather than to a position on the seabed hopefully near to the wreck.

Every time this procedure is carried out there is a risk that the weight (weighing possibly up to 50 kg or even more) will impact directly on the protected wreck. This type of damage would not be acceptable or legally allowed on a protected monument on land and there would be an outcry by interested members of the public as well as the heritage community. Yet when a monument that is protected for its archaeological and historical importance is at sea, it is deemed an acceptable risk to damaging it just by visiting it (NAS, 2014c).

It is essential to have dialogue with other groups that are undertaking similar projects in the UK and overseas in order to learn from their experiences. It has also proved very beneficial to involve the local dive clubs who can then act as local custodians of the wreck. In the case of the HMS *m/41* submarine trail working collaboratively with Southsea Sub-Aqua Club and the licensee Martin Davies proved invaluable.

Local diving infrastructure is also crucial factor to consider when establishing a diver trail. Compared to the very successful dive trail on the *Coronation* wreck in Plymouth it become clear that diving from Eastbourne on the Norman's Bay Wreck does not come without its logistical complications. There is very limited diving infrastructure in or around Eastbourne, with perhaps the largest issue being the lack of a nearby public slipway for launching diving boats. The nearest public slip is in Newhaven some 33 kilometres from the wreck site. Launching boats at Sovereign Harbour, Eastbourne can only be achieved by crane which is expensive (over £60.00) and there are only a couple of charter boats operating out of Sovereign Harbour. In this situation it is vital to build good relationships with all the diving charter boats who could offer dives on the designated wreck trail as part of their offering to their clients.

It is recommended that online visualisations of protected wrecks should be created for every site that has a diver trail. These visualisations not only allow visiting divers to better understand the wreck they are visiting, but also allow non-divers to witness and appreciate what the site looks like. Online visualisations like the one on the HMS *m/41* submarine, along with their additional information, photographs and videos highlight the important

historic value of the site to the general public, to the SCUBA diving community and the fishing community to reduce criminal impact on the site such as trawling, fishing and illegal diving.

Finally it is recommended by the author that any group wishing to create a diver trail should be allowed a minimum of 2 years for the design, creation and administration of a diver trail. Inevitably, in England it is necessary to build in a contingency for days lost due to bad weather.

The Local Economic Benefit of a Protected Wreck

The *Coronation* was a 90-gun second-rate ship of the Royal Navy. She was launched in 1685, and wrecked off Penlee Point, the entrance to Plymouth Sound from the Cornwall side, in 1691. Her wreck, which consists of iron cannon and anchors, was discovered in 1977 and designated for protection the following year. In 2011, with the support of English Heritage local divers and archaeologists began operating a diver trail for visitors to the site.

During 2012 and 2013 the Nautical Archaeology Society, with funding from English Heritage (Project Number 6608) undertook a study into the economic impact of the *Coronation* diver trail (Fig. 5). The study aimed to determine the number of visitors to the site, and how much each visitor had spent money while in the Plymouth area. The aim was to determine the value of the protected wreck to the local economy (NAS, 2013; 2014b).

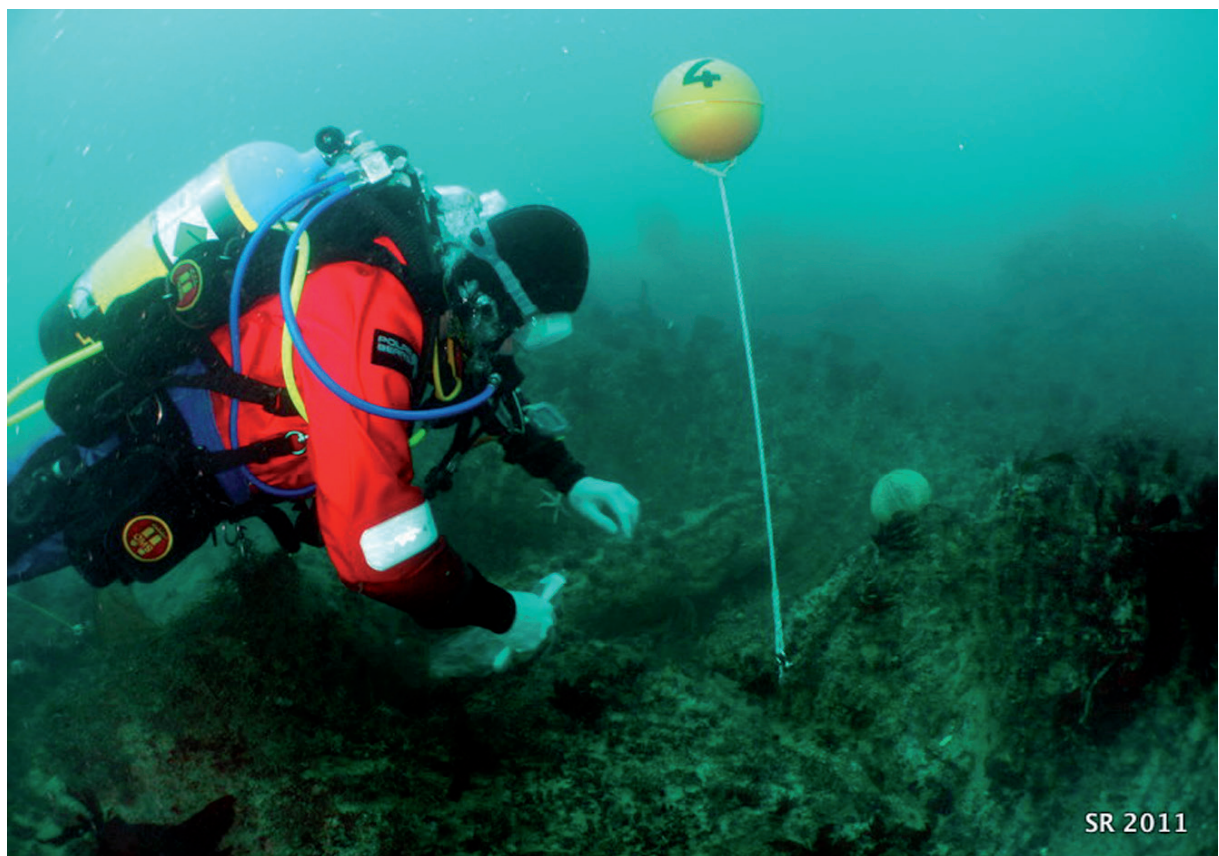


Figure 5. A diver visiting the Coronation Wreck Diver Trail. © Coronation Wreck Project.

The impetus for the study came in April 2012 after the author attended a meeting in Paris of the Scientific and Technical Advisory Body to Unesco's Convention on the Protection of the Underwater Cultural Heritage. Here the development of «models for managing underwater cultural heritage in a way that brings benefits for the sustainable economic development of regions» was proposed, in order to «increase the positive image of underwater archaeology and the involvement of the public in the awareness, the protection and enjoyment of the underwater cultural heritage». Recent studies by the Heritage Lottery Fund (for example, Oxford Economics, 2010: 3) have aimed to make comparable quantitative assessments of the economic benefits of heritage-related tourism, so that comparisons could be made to other sectors of the UK economy.

The study was funded by English Heritage, which, under its National Heritage Protection Plan, recommends «Ensuring that the public understand and agree that looking after our heritage is important both in terms of the economy of the country and the well-being of its people» (English Heritage, 2013: 7). English Heritage has had responsibility for the management of the 47 designated historic wreck sites since 2002, and it is a criminal offence for a person to dive on or interfere with these sites without a licence.

Alison James, English Heritage Project Assurance Officer for the study said that «the *Coronation* diver trail is an outstanding example of how heritage can really contribute to the local economy and it is thanks to the passing of the Protection of Wrecks Act forty years ago that we are able to protect it along with 46 other important wreck sites that bear witness to the country's remarkable maritime heritage. It is fantastic to be able to demonstrate that underwater heritage and tourism is a contributory factor to the growth agenda – a fact recognised by all of the UK Governments in the UK Marine Policy Statement» (NAS, 2014b).

The research data was obtained through an online survey (via *Survey Monkey*) of people who had visited the *Coronation* wreck in 2011 and 2012. The questions chosen aimed not only to understand visitors' economic spend, but also to assess the success factors of a diver trail of this nature. Due to current licensing procedures, both the numbers of individual visitors and the number of overall visits undertaken were difficult to calculate. Despite this, by comparing the figures for the three diver trails currently running on the *Coronation*, the Norman's Bay Wreck and on HMS *Colossus*, it was possible to demonstrate that the opening of a visitor trail had an immediate impact on the numbers of people interested in diving the sites (table 1). In the case of HMS *Colossus* site the number of named visitors rose from 166 to 257 (154% increase); on the Norman's Bay Wreck named visitors rose from zero to 65 and on the *Coronation*, the named visitors rose from 197 to 672 (341% increase).

Year	<i>Coronation</i> (opened 2011)	HMS <i>Colossus</i> (opened 2009)	Norman's Bay Wreck (opened 2011)	Total
2008	0	166	0	166
2009	22	257	20	299
2010	197	204	0	401
2011	672	218	65	955
2012	264	320	81	665
Total	1 155	999	166	2 320

Table 1. Number of named divers on licences issues for three designated wrecks in England from 2008 to 2012.

Seventy-four respondents took part in the online survey. Of these, 69 people undertook 105 visits to the *Coronation* as part of the diver trail in 2012. These 69 individuals spent a total of £8085, an average spend of £117 per person and of £77 per visit. In addition to the visits to the diver trail undertaken in 2012, the 69 respondents undertook a total of 49 visits to the site as part of the *Coronation* Wreck Project, which is researching the site, and which maintains the visitor scheme. Such respondents spent a total of £1388, or an average of £28.32 per visit. In summary, the study found that in 2012 alone over 700 visits were made to the wreck, generating £42 000 worth of benefits to Plymouth: over £60 per visitor to the city. The study demonstrates that underwater historic wrecks do not have to be a burden on the taxpayer and insists that with proper visitor access they can actually be a great benefit to local economies (NAS, 2014b).

The future for Designated Wreck Diver Trails in England

Launched in April 2014, the HMS *m/A1* submarine dive trial is the fourth underwater tourist trail for protected wrecks to open since 2009 and is part of an English Heritage project to create up to a dozen trails by 2018 for historic protected wreck sites dating from the 17th to the mid-20th centuries.

In the summer of 2014 the fifth designated wreck diver trail will open on the wreck of the *Iona* II which lies on the seabed off Lundy Island, Devon. The *Iona* II was a paddle steamer which foundered off Lundy after taking on water in heavy weather, having left the River Clyde for her first transatlantic voyage in 1864. At the time of her loss there was speculation that the *Iona* II was acting as a gunrunner for the Confederates in the American Civil War. Originally built as a ferry for the Clyde, she was constructed of iron with paddle wheels and a state-of-the-art twin cylinder oscillating engine.

The diver trail being designed by Wessex Archaeology is contributing to English Heritage's programme of interpretation of protected wreck sites. It is hoped that the dive trail will encourage responsible (and licensed) access enabling visiting divers to enjoy their experience whilst encouraging the feedback of information about the wreck as part of a heritage management strategy.

Peta Knott from Wessex Archaeology has stated that «the local dive clubs have been incredibly helpful in developing this dive trail with us. They are very happy that through the dive trail, the diving community will be able to learn more about the diverse history of the *Iona* II as well as participate in the ongoing preservation of the wreck through the monitoring scheme. There is already a great sense of custodianship of the *Iona* II which can only grow stronger through this dive trail».

The success of any designated wreck diver trail can only be evaluated in the long term. The NAS intend to continue to develop and administer the trails on the Norman's Bay Wreck and the HMS *m/A1* submarine and will continue to look for new mechanisms to promote the experience of diving on an underwater cultural heritage asset. The NAS believes that visiting, seeing and touching a real archaeological monument like a wreck site can be a wholly positive experience that can change people's perception of the value of the *in situ* preservation of our underwater cultural heritage (NAS, 2011). Licensed public access must remain a cornerstone of any underwater cultural heritage management strategy, a strategy that must receive long-term commitment from both the trail organisers and the heritage agencies.

Acknowledgements

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Underwater Cultural Heritage, Tourism and Diving Centers: The case of Pozzuoli and Baiae (Italy)

Patrimonio cultural subacuático, centros de turismo y buceo: el caso de Pozzuoli y Baia (Italia)

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Abstract: In Pozzuoli and Baiae, in the Gulf of Naples, villas, mosaics, baths, streets, houses and harbour structures of the Roman period were submerged by the sea, as a result of the volcanism. This unique environment, severely looted over the years, has been included in a Marine Protected Area since 2001. Since then, the Soprintendenza Archeologica has carried on some research and documentation works, while the Istituto Superiore per la Conservazione ed il Restauro has experimented with new techniques for the conservation of the underwater structures. The public access has been made possible with the opening of underwater archaeological trails, and through the involvement of the diving instructors active in the area, appropriately trained. Here we would like to analyse the effects of this strategy also through the lens of the tourism and diving industry, considering their needs and their expectations, together with the primary need to preserve the sites for the future generations.

Key words: Archaeological tourism, submerged sites, management of the UCH, Italy, Baiae.

Resumen: en Pozzuoli y Baia, en el golfo de Nápoles, villas, mosaicos, termas, calles, casas y estructuras portuarias de la época romana fueron sumergidos por el mar, como resultado de la actividad volcánica. Este ambiente único, severamente saqueado durante mucho tiempo, se ha incluido en un Área Marina Protegida desde el año 2001. Desde entonces, la Superintendencia ha llevado a cabo investigaciones y proyectos de documentación, mientras que el Instituto de Conservación y Restauración ha experimentado con las nuevas técnicas para la conservación de estructuras sumergidas. El acceso del público ha sido posible con la apertura de itinerarios ar-

queológicos submarinos, y mediante la participación de los instructores de buceo activos en la zona. Aquí nos gustaría analizar los efectos de esta estrategia también a través de la lente de la industria del turismo y del buceo, teniendo en cuenta sus necesidades y sus expectativas, junto con la necesidad de preservar los sitios para las futuras generaciones.

Palabras clave: turismo arqueológico, sitios sumergidos, gestión del patrimonio subacuático, Italia, Baia.

Rule 1: «The protection of underwater cultural heritage through in situ preservation shall be considered as the first option».
Rule 7: «Public access to in situ underwater cultural heritage shall be promoted, except where such access is incompatible with protection and management»

(Unesco 2001 Convention on the Protection of the Underwater Cultural Heritage).

The proper management of the Underwater Cultural Heritage, the correct preservation of the archaeological sites on the bottom of seas, rivers and lakes, their protection for the future generations and, where it is possible, their opening to the public and to the society are some of the greatest challenges of the contemporary underwater archaeological science. This was, for example, the main theme of the 2011 IKUWA 4 Congress (IKUWA 4: Managing the Underwater Cultural Heritage, Zadar-Croatia, September 29th, October 2nd 2011). This was also the principal topic of numerous Unesco regional meetings and of an interesting roundtable between young researchers held in Santiago de Compostela (Bombico/Cerezo/Fernández, 2013; see also Bombico/Fernández/Stefanile 2012); undoubtedly, one of the key-points of the 2001 Unesco Convention on the Underwater Cultural Heritage is the strong impulse given to the *in situ* musealization of the submerged archaeological sites.

While in the case of shipwrecks the issue of their *in situ* preservation and opening to the public is often very complicated, and requires the implementation of difficult solutions, archaeological sites characterized by the presence of submerged structures like ancient harbours, breakwaters, quays, quarries, buildings, villas, fishponds, seem to encourage musealization projects. The proximity to the coast, the shallow depth, the frequent closeness to modern urban centres, due to obvious environmental conditioning, the presence of types of artefacts less exposed to looting, make in many cases submerged ports and cities excellent archaeological diving tourism spots.

Nonetheless, the easy access to the site can cause big problems of protection against sacking and human damaging. This is particularly evident in countries like Italy, where sport diving had an early diffusion, and where these kinds of sites have often been victims of indiscriminate plunders over decades. Moreover, the proximity to the coastline and to the point of wave breaking, as far as the shallow waters, rich in marine life, make this category of archaeological contexts particularly vulnerable to the physical damage caused by waves, sea storms, tides and currents, and to the biological one caused by the marine organisms.

One of the examples of major interest for this discussion can be the rich archaeological area of *Baiae*, *Puteoli* and surroundings, a few kilometres away from the big city of Naples, in southern Italy.

Satellite images and aerial photographs may be useful to give an idea of the extension and complexity of the ancient structures submerged in the Gulf of Pozzuoli, in the Western part of the Gulf of Naples, in the middle of the stunning volcanic area of the so-called Phlaegrean (in Greek,



Figure 1. The submerged structures of the *Portus Julius* (aerial view).

«burning») Fields (Fig. 1). It is easily possible to recognize in the photos the coastal strip of one of the richest and most populated areas of the Roman world, a crowded wonderful *riviera* where concentrated the *villae* of the most eminent men of the Late-Republican and Imperial Rome (D'Arms, 1970).

Senators, powerful people and Emperors with their courts, established their luxury villas in this territory, attracted, as we know from the ancient sources, by the beautiful scenery, the mild climate, the proximity to the city of Rome (less than 200 km away), the abundance of natural hot thermal springs connected with the volcanoes present in the region (more than forty, many of them still in activity), and by the dream of a life of *otium* and pleasure.

A great part of this area, including roads, quays, thermal complexes, *villae*, fountains, walls, floors, columns and mosaics, is currently under the sea level due to the phenomenon of bradysism, which can cause, in the course of the centuries (even with fast movements as recognized in recent years too) the sinking and the emergence of the mainland with huge geo-morphological changes. Ascending and descending phases, easily visible through the observation of the holes generated by the marine *litophaga* in the now re-emerged marble columns of the *macellum* of *Puteoli*, have been studied in past years, giving us an idea of the events that brought about the present situation. In the same territory, the eruption of Monte Nuovo in 1538, was the cause of a massive change of the coastline in the area of Lucrino lake and Portus Julius.

Since 2001, a notable part of this complex, around the ancient *lacus Baianus* and the *Portus Julius*, on a total extension of 176.6 hectares, have been inserted in a protected sea-area (Benini, 2004; Benini, 2005; Stefanile, 2011; 2012): the traffic of commercial and recreational boats has been forbidden, areas of total, general, and partial reserve have been created, demarcation buoys have been placed, sea activities have been regulated, and the diving centers present on the territory have been entrusted with the management of the touristic flows and, at the same time, with the control of the site.

In this way the scientific community, which had already started to mobilize a few years before, during the congress *Forma Maris* (Pozzuoli, 1997), and a part of citizens aware of the importance of their common past, have actually tried to stop the shameful damages that the Phlaegrean Underwater Cultural Heritage was suffering because of human action: on one hand, the indiscriminate plunders started already in the 1960s and 1970s, when diving activity began to become popular and when hundreds of divers began to explore the ancient structures and to take away with them all the precious items that the sea had protected during millennia. On the other hand, the presence of some factories on the waterfront of Pozzuoli (some of them are still in activity) and the commercial harbour in the bay of Baia, connected with extraction and export of *pozzolana* (the same excellent volcanic ash used by the Romans to build their concrete piers underwater mentioned by Vitruvius), were responsible for a daily traffic of ships that, heavy with their cargoes, often scraped with their keels against the archaeological structures. Not to mention the rusty, modern shipwrecks, abandoned in the bay, with risks not only for the heritage, but also for the environment and the safety of people swimming in the area (now finally removed) (Fig. 2).

There is no need, here, to retrace all the steps of the archaeological research in the Gulf of Pozzuoli, sufficiently covered, in recent times too, elsewhere (Stefanile, 2011; 2012). It is however the case to remember that the discovery of submerged structures in this area is very old and surely not connected with the WWII (as sometimes it has been written), as evidenced by the findings recovered in the half of the 18th century, today in the collections of the Archaeological Museum of Naples, or by the voices of English poets (such as P. B. Shelley) and travellers of the *Grand Tour*.



Figure 2. The difficult situation of *Baiae* in the 80s, before the creation of the Marine Park.

Also the interest in the recovery of artefacts and archaeological excavation of the ancient *Baiae* is not very recent, and dates back at least to the 1920s, when the impressive marbles of a big palace, later interpreted as the Severian Palace (Maniscalco, 1997), discovered during some dredging operations, puzzled the attention of Benito Mussolini that even proposed to enclose and fence the Gulf of Baia and drain it (Race, 1994; Maniscalco, 1997), in order to make terrestrial excavations (the same idea later realized in the recovery of the Nemi lake ships).

In the following years, after some new findings in the 1950s (Napoli, 1953), and the call for a systematic exploration of the area by Maiuri at the *II Congresso di Archeologia Sottomarina* (Maiuri, 1961), Baia has been, together with the first Roman shipwreck found off Albenga, one of the major areas for the research and experimentation of new techniques of the emerging Italian underwater archaeology, notably with the work of Nino Lamboglia and Francisca Pallarés in the Imperial submerged *nymphaeum* off Punta dell'Epitaffio (Lamboglia, 1959; Lamboglia, 1971; Pallarés, 2001). In Baia for the first time has been tested the system of creating underwater plans by dividing the area in regular squares; in Baia, moreover, for the first time has been used the airlift in submerged buildings.

Volunteer divers, that before the advent of professional underwater archaeologists were the only people able to dive, were the protagonists of several discoveries and positive experiences in the 1960s and the 1970s (De Franciscis, 1967; De Franciscis, 1970); it's important to remember here at least the finding of the statues of Ulysses and his mate Baïos in Punta Epitaffio, of a Nabatean altar in Pozzuoli and of a collapsed storage room with thousands of Roman oil lamps connected with the commercial harbour of Puteoli (Ripa, 1967; Garcea *et alii*, 1994). During the 1980s, a part of this expert volunteers worked together with important archaeologists such as F. Zevi, P. A. Gianfrotta and B. Andreae in the extraordinary excavation of Emperor Claudius' *nymphaeum* in Baia (Zevi/Andreae, 1982; Andreae/Zevi, 1983; Frost, 1983; Andreae, 1992), with the discovery of all the statues now exposed in the Museum of the Campi Flegrei in the Aragonese castle of Baia (Felici, 1997; Miniero, 2000; Zevi, 2009). In 2009, synthetic copies of the statues were replaced *in situ*, for the entertainment of diving visitors that can swim within a highly suggestive environment (Fig. 3).

Other important works were made in the same years, till the end of the 1990s, through several campaigns of surveys (Di Fraia *et alii*, 1986; Di Fraia *et alii*, 1993; Scognamiglio, 1993; Scognamiglio, 1997): it was possible to locate, to map and draw a part of the underwater structures, the wide access channel of the *lacus Baianus* (Maniscalco/Severino, 2002), delimited by two thick wharves in *opus caementicium*, the baths of a semi-decagonal three-apsidal *nymphaeum*, the remaining part of the big Villa dei Pisoni, the stunning Villa con Ingresso a Protiro, the Severian Palace (Maniscalco 1995; 1996; 1997), the Roman fishponds at the basis of the hill of the Aragonese fortress. It was finally presented a concrete and trustworthy picture of the ancient coastline, and of the kinds of settlements on the shores of the *lacus*, with the several piers and docking structures of the maritime villas (Gianfrotta/Maniscalco, 2001).

Nowadays, after the creation of the Marine Protected Area, the Superintendence for Antiquities is directly engaged in the works through new researches, starting a fruitful collaboration with Institutions, Universities and Associations.

Since 2003 the technicians of the ICR (Istituto Centrale per il Restauro, now ISCR - Istituto Superiore per la Conservazione ed il Restauro), taking advantage of the good results of the first experiments of underwater restoration carried on in the fishponds of Torre Astura, have started working on the complex conservation problems of the submerged city (Petriaggi/Mancinelli, 2004; Petriaggi/Davide, 2005; 2007), and in the course of the years, rescue operations on



Figure 3. A copy of a statue in the *nymphaeum* off Punta Epitaffio.

the mosaics of *Villa dei Pisoni* and *Villa con ingresso a Protiro* have been undertaken as well as works on the submerged road from Baia to Puteoli and the restoration of sections of walls damaged by the sea, the streams and waves and by the erosion of biodeteriogen agents (Ricci *et alii*, 2007), between Baia and *Portus Julius*. For the first time an archaeological risk database (SAMAS) is created, to have knowledge of the deterioration of the structures and to make a good maintenance programme (Petriaggi/Davidde, 2005).

In a cooperation of the Authorities with Naumacos group, sonar bathimetric and seabed hardness maps have been realized and updated in recent years, delivering a useful tool for planning new operations in the area. The same research group was involved also in some new discoveries, like a precious marble statue from the *lacus Baianus* (Caputo 2015). In this same context, fruit of an agreement between Naumacos and the association Fillirea, LAB is a new reality, aimed at converting the Visitor Center into a Center for the coordination of research and valorization projects in the MPA of Baia, under the control and supervision of the Superintendence.

On this basis, even in a difficult moment for Italian underwater archaeology (Secci/Stefanile, 2015), there is a hope, for the near future, to continue the archaeological research and to improve the knowledge of an area so vast and still to be fully documented; in this sense, further work and collaboration with research institutes and Universities will be desirable. Considering Baia as an archaeological context unique in the world, with an incredible abundance of structures still needing a full documentation and study, interpretation and publication, only an open

strategy of involvement of all forces available can be successful on the long term. If the journalistic and popular definition of Baiae as a «Pompeii underwater» can't be truly considered as a scientific sentence, the Vesuvian site can provide us with a good parallel. In one of the most active moments in the recent history of research on the city of Pompeii, i.e. the decade 2001-2011, research groups (mostly Universities) from 13 different countries worked together in the ancient houses and roads in the shadow of the Vesuvius. Recent changes in the management system and several unfortunate events drove this season to an end, but the example of a long international cooperation in a big area, with the possibility to experiment all together new solutions and technologies in archaeology, can surely be considered as a highly positive one.

While the research can move some steps forward, the effort towards a good musealization of the structures goes on: the involvement of diving centers (see before) is creating a growing number of visitors; as announced in more than one occasion, new systems to improve the enjoyment of the site are ready to be realized, waiting for the necessary funding, among which the creation of an underwater video-control network, the opening of the *nymphaeum* to nocturnal visits and the setting up of a multimedia room on the mainland, from where the non-diving visitors will be able to watch their relatives or friends diving, and listen at the same time to the explications of the guide, who wears a mask with microphones.

Currently, the divers can visit five submerged spots, equipped with guidance ropes and explanatory PVC panels (Fig. 4), accompanied by official diving guides, instructors and divemasters; all these guides, members of the diving centres present in the territory, have been trained during three professional courses held by the technicians of the Superintendence. Due to the shallow depth, four of these spots can be visited also by snorkeling or on glass bottom boats; this latter solution is more and more popular among primary school groups. The submerged structures also allow to organize underwater archaeology training courses easily and field schools with activities of underwater survey, drawings and photos (Fig. 5). In recent years a lot of experiences like these have been carried on by the diving centres, with the collaboration of professional archaeologists, or by training organizations with the authorization of the Superintendence (see for example NAS courses or REITIA activities): more than two hundred people from different countries have received so far a training, basic or advanced, in underwater archaeology in Baiae, with courses of few days or even some months. Sometimes these activities are combined with seabed cleaning operations (Legambiente activities) or even with real research, with the final delivery of the results to the Authorities.

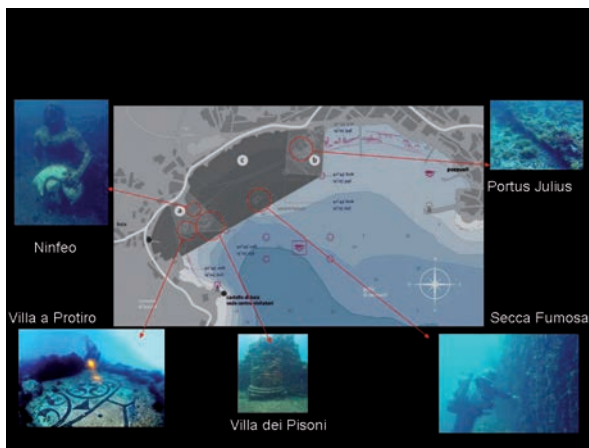


Figure 4. The first five diving spots in the park of Baiae.

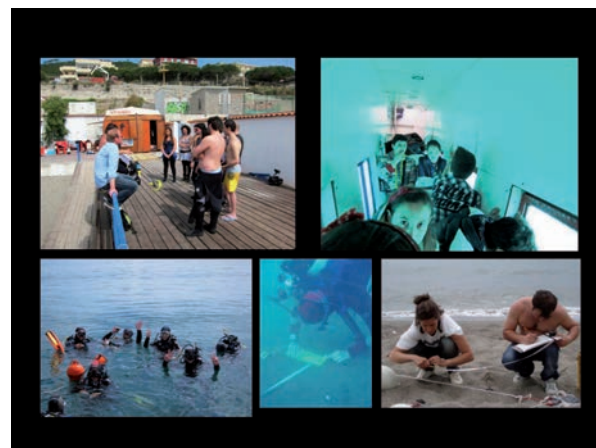


Figure 5. Activities directed to the general public in the park of Baiae.

The diving centres, made responsible and aware of the cultural heritage, pay a fee for each diver, and at the same time engage themselves in the operation of control: with the help of the Authorities, if necessary, they have the task of sending away the pleasure boaters, who, ten years after the creation of the Park, still keep on sailing in the forbidden area or even anchor directly on the ancient walls and columns. As it was expected, and as already seen in similar experiences, like in Sicily, the diving clubs have learned that heritage can constitute a source of inexhaustible wealth; for that reason, they converted themselves in the first and most fervent defenders of the underwater sites: they keep away unauthorized intruders, they report to the Superintendence every damage or problem, and, when necessary, they even check if anything from the seabed is in the pockets of visitors jackets.

In this moment there are five underwater spots open to the public. Visitor center and Superintendence are working together to make possible the opening of new fascinating trails.

The Villa dei Pisoni, an extraordinary Roman villa identified thanks to the epigraphic data on a lead pipe, at the depth of 6 meters, not far from the tuff rocks of Punta dell'Epitaffio, is equipped with a 45 minute long itinerary, marked by a rope and by numerated panels; here the divers can explore the structures of the *viridarium*, the garden, following a row of niches and half-columns, now restored, and can see some white-tessera mosaics, protected by sandbags that the divemasters can remove on purpose.

The Villa con ingresso a Protiro, very close to the seasonal operating floating wharves of the modern Baian Marina, full of «gardens» of spirograph worms and shoals of sargoes, welcomes visitors with its white marble threshold, a fascinating geometric white and black tessera mosaic (Fig. 6), a series of residential rooms, a thermal complex with terracotta *tubuli* and a forest of *suspensurae*.

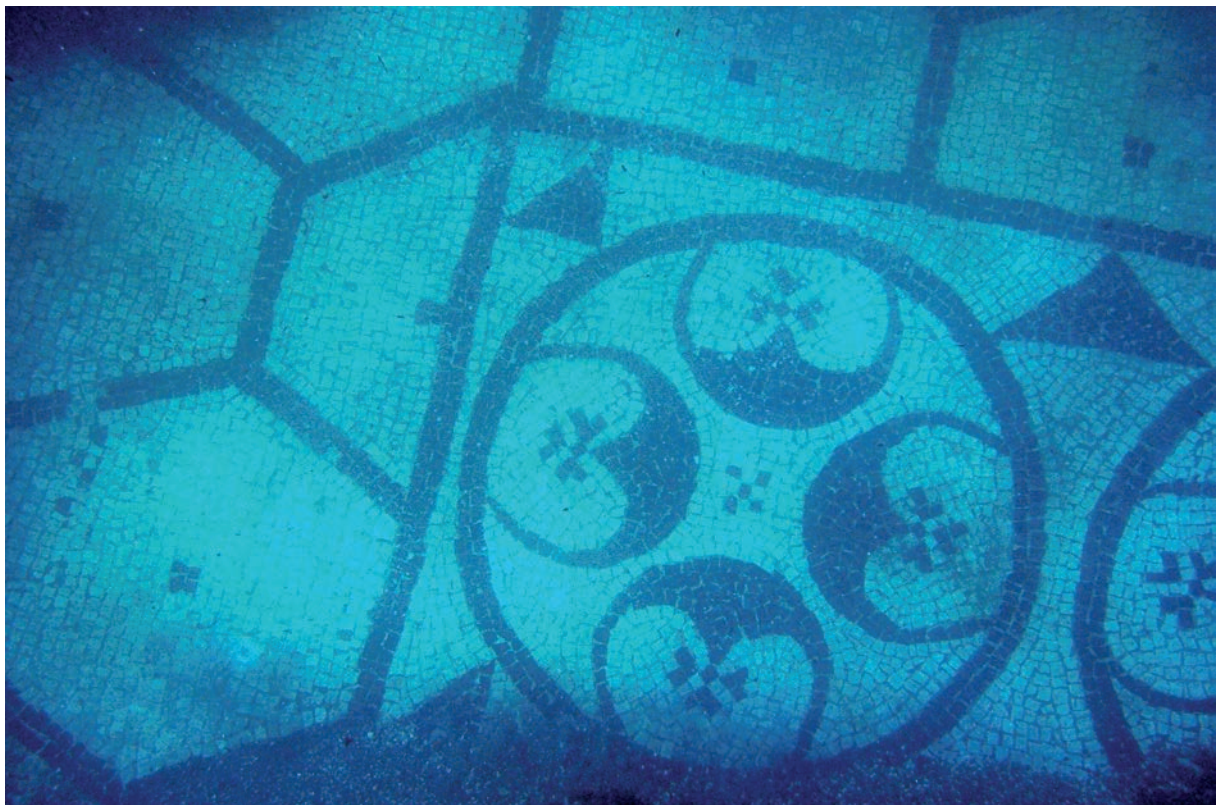


Figure 6. A mosaic preserved *in situ* in the submerged Villa con ingresso a Protiro.

The most impressive spot, probably, is the extraordinary Punta Epitaffio *nymphaeum*, where people can dive directly among the copies of the statues now exposed in the Museum of the Campi Flegrei, Ulysses and his mate Baios giving a cup of wine to the Cyclop (lost in ancient times), together with the members of the Emperor's family; here the divers can recognize easily the planimetric profile of the tricliniar room, and they can swim outside, following the paving stones of the ancient road, among which little octopuses and fish peep out, and exploring, under the supervision of divemasters and instructors, the nearby baths.

In the other side of the Marine Park, the Secca Fumosa, characterized by the huge piers in *opus caementicium* on the external border of *Portus Julius*, which, from a depth of 12 meters reach the surface of the sea; here, following the line of the Roman structures, in an environment incredibly rich in life, with sargoes, octopuses, moray eels, and brown meagres in every corner, the tourists can reach an amazing concentration of volcanic fumaroles, which heat the sand of the seabed with continuous emissions of hot bubbles, making the context unique for the proliferation of sulfobacteria, which sprout on everything creating a white layer.

Finally, the middle area of *Portus Julius*, the harbour built by Agrippa in 37 B.C. to face the menace of the pirates led by Sextus Pompeus, dismissed after a short time for the new military port of *Misenum*, then subsided because of the bradyseism, and finally affected by the closest eruption of Monte Nuovo; it was an ideal prosecution of the long waterfront of *Puteoli*, the ancient *Dicearchia*, the «city of the fair rule», founded in the 6th century B.C. by Samian exiles who were trying to build a utopian alternative to the tyranny of Polikrates; during the Roman time, the harbour underwent an impressive development, becoming, before the construction of the harbours of Claudius and Trajan, the real *portus annonarius* of Rome, the arrival station for huge cargoes from the whole Mediterranean. Here, at a depth of 2 meters, among walls in *latericium* that smoothly touch the surface of the sea, appear, one after the other, floors in *opus signinum*, decorated *a rosette* or *a meandro*, stairs, white-tessera mosaics, brick columns with traces of their *stucco* coating, doorsteps and dividing walls, all in a labyrinth of *horrea*, storage rooms full of pottery, *sigillata* fragments, handles and necks of amphorae, that the guides every time pretend to «discover» in front of the astonished visitors.

Almost fifteen years after the opening of the Park, the choice made by the Superintendence to entrust the diving centers with the visits, notwithstanding the difficulties that can arise (and that in some cases have actually arisen), among the members of a consortium who share a common aim, but are in commercial competition with each other, seems to be right: the site is undoubtedly more protected and exploited than in the past, and the visits, both of foreigners and locals, are increasing (Canoro/Izzo/Keller, in press). A result that, in a virtuous circle, rewards the diving centres that most have engaged themselves in the archaeological field: as an example, since it bet on the archaeology, one of the oldest centres in the territory, in less than five years has doubled its structures, has increased the number of boats, has created job opportunities for archaeologists, biologists and underwater photographers, has shifted from a week-end-only functionality to a full-week one, has promoted courses of introduction to the underwater archaeology and has obtained a special PADI reward for the big results in the growth of the OWD patents granted.

After decades of plunders, sacks and raids, and with the present situation that, in spite of the many difficulties, brings a wave of cautious optimism, a positive future seems to be really behind the corner. The potential of the Archaeological Marine Park of Baia is outstanding, both in term of scientific research possibilities, and in terms of touristic and economic resources. With the efforts of the Authorities and the Universities, the submerged area of the Phlaegrean Fields will be certainly studied and known more and more deeply. However, the future of this world heritage requires the commitment of everyone: the Italian Government, primarily, and those of the Phlaegrean

coastal cities, which definitely must have the courage to bet strongly on this site unique in the world, and to expand the borders of the protection area, protecting that heritage from any insane project of speculation: still today, indeed, periodically, every time there is a political change in the cities bordering the Gulf of Pozzuoli, there is who promises job opportunities and development through concrete and steel buildings, luxury marinas and new roads; construction works that undoubtedly could end up erasing every historical trace on the bottom of the sea, outside the Park boundaries. To explain to the people that wealth, for such areas, no longer comes from industry or constructions, but from the care and the preservation of the past, and from its correct exploitation, it's a really difficult task. It's a task that needs to start from below, from the diving centres, once again, from the press, the media, the internet, exhibitions and events connected with the history, not just created for specialists but for the people. The task of the archaeologist, who knows deeply the value of the cultural heritage to be protected, we are sure, is this too.

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Realidades y necesidades en un ejemplo de turismo arqueológico

Facts and needs in an example of archaeological tourism

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Resumen: ante el incremento de aficionados al buceo, preocupa su obsesión por conseguir algún objeto del fondo del mar, actitud corregible inculcando unos principios básicos de arqueología subacuática. Utilizamos como metodología la aportación al programa de títulos de buceo de unos conocimientos arqueológicos básicos impartidos por miembros formados en la Nautical Archaeology Society. Analizamos desde la escuela de buceo Mourosb de Santander tres pecios de diferente época histórica, dos restos de conflictos navales y tres baterías de costa. Observamos que el interés en la protección y conservación aportado por los alumnos que asistieron a estos programas, comparado con los que no, es claramente superior, como lo demuestran sus denuncias, fotos y opiniones que dejaron en nuestra web y redes sociales. Concluimos la necesidad de formación, coordinación de programas y colaboración nacional e intercambio internacional, para ampliar dichos conocimientos y concienciar a ese turismo cultural en auge antes de que se convierta en una moda destructiva.

Palabras clave: turismo, formación, protección, conservación, divulgación.

Abstract: With the increasing number of diving enthusiasts, we are concerned about the obsession of the amateur to get objects from the seabed. This attitude is rectifiable instilling basic principles of underwater archeology. The methodology used was adding its principles to the program's diving titles, taught by members trained in the Nautical Archaeology Society. The diving school Mourosb (Santander) evaluated three different historical era wrecks, two sites of naval conflicts and three coastal batteries. We observed that the interest in the protection and conservation provided by students who attended these programs compared with those who did not, is superior, as it was evidenced by their allegations, photos and opinions that were reflected on our website and social networks. We conclude that there is the need of coordinating the training programs and national collaboration, and international exchange, to expand the knowledge and raise awareness to the cultural tourism boom before it becomes a destructive fashion.

Key words: Tourism, training, protection, conservation, disclosure.



CARTAGENA 2014
IKUWA V

REALIDADES Y NECESIDADES EN UN EJEMPLO DE TURISMO ARQUEOLOGICO

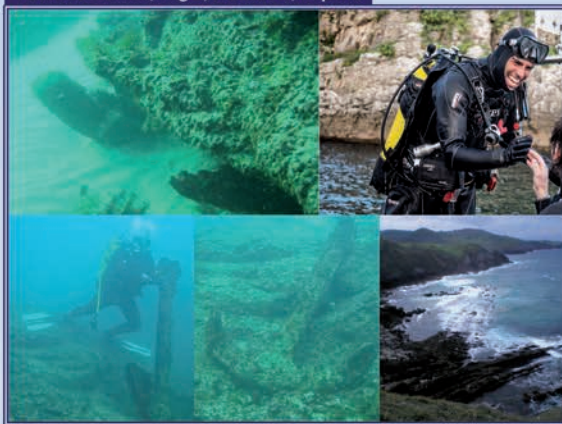
Leo del Rincón & Ramón Orrite Pinedo
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El presente estudio saca a la luz la necesidad de evolución del turismo de buceo deportivo hacia una concienciación por el patrimonio sumergido, formando en arqueología subacuática a buceadores y aficionados. La evolución y accesibilidad del material deportivo acerca las actividades subacuáticas a personas de todas las edades y condición, pero con asombro, nos preocupa la obsesión del iniciado por conseguir algún objeto del fondo del mar. Por suerte, esta actitud es rápidamente corregida en cuanto se le concienicia con unos simples principios básicos de arqueología.

Se estudiaron en concreto tres pecios a distinta cota y de diferente época histórica, dos restos de yacimientos testimonios de conflictos navales y tres baterías de costa. Se utilizó como metodología la complementación del programa para la obtención de títulos de buceo deportivo, con unos conocimientos básicos en arqueología subacuática impartidos por miembros formados en la *Nautical Archaeology Society*. Concluimos que el retorno en beneficio a la protección y conservación aportado por los alumnos que asistieron a estos programas fue claramente superior comparado con los que no lo hicieron, como lo demuestran sus denuncias, fotos y opiniones, que gracias a las nuevas tecnologías se reflejan en nuestra web y redes sociales. De todo ello se deduce una necesidad de formación, coordinación de programas y colaboración nacional e intercambio internacional, para ampliar dichos conocimientos y colaborar juntos con el fin de concieniciar a un turismo cultural en augé antes de que se convierta en una moda destructiva.

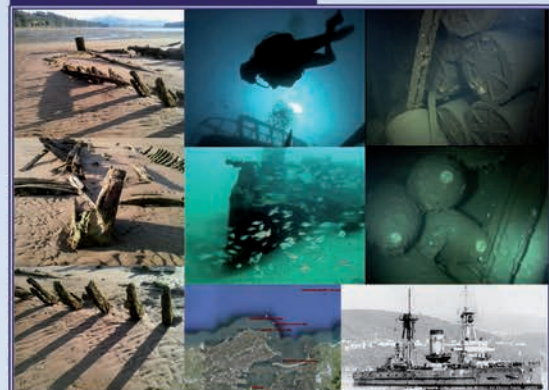
Pallebote Teresa, Tagle, Cantabria, España



Batería de La Maruca, Santander



Pecios en la Bahía de Santander



Baterías de costa de San Vicente, Laredo y Castro Urdiales



Difusión y protección del patrimonio arqueológico subacuático. Un análisis desde la práctica

Promotion and protection of underwater archaeological heritage. An analysis from the practice

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Resumen: el Patrimonio que se encuentra desprotegido no tiene sentido al margen de la sociedad. Su comprensión y disfrute deriva directamente de la gestión que hagamos del mismo. Teniendo en cuenta la delicadeza del patrimonio sumergido, cobra vital importancia la concienciación de toda la comunidad buceadora para que no se produzcan mayores deterioros que los propios del paso del tiempo. Desde el Club Universitario de Buceo Oceánides hemos puesto en marcha toda una serie de actividades cuyo fin es potenciar la concienciación sobre la delicadeza del PAS, el daño que puede ejercer en los materiales una mala actuación, cómo actuar y dónde acudir en caso de localizar restos arqueológicos subacuáticos... Analizando los resultados, cual-

quier organismo podrá adecuar las actividades y los medios a los distintos tipos de público, logrando con mayor efectividad, que todo aquel que pase por sus manos se convierta en protagonista de la difusión y protección del Patrimonio.

Palabras clave: patrimonio sumergido, divulgación científica, conciencia, gestión.

Abstract: Unprotected Heritage has no sense out of society. Its comprehension and enjoyment derives directly from its management. Given the delicacy of the underwater heritage it's extremely important to help the diving community to understand the damage caused by misused in order to avoid further deterioration than the one caused by time itself. From the University Diving Club Oceánides, we have launched a series of activities designed to strengthen awareness about underwater heritage, the damage than can be caused in the objects and materials due to an inappropriate manipulation, what to do and where to go in case of locating archaeological underwater remains... Analyzing the results, any organization could adapt their activities and resources to different audiences, achieving more effectively, that anyone who passes through the experience becomes protagonist of the spreading and protection of heritage.

Key words: Underwater Heritage, popularization of science, conscience, management.

Difusión y protección del Patrimonio Arqueológico Subacuático. Un análisis desde la práctica.

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Hoy día, el Patrimonio conocido que se encuentra desprotegido pierde su razón de ser si permanece al margen de la sociedad. Es por ello que su comprensión y disfrute deriva directamente de la gestión que hagamos del mismo. Si tenemos en cuenta la delicadeza de los bienes sumergidos, cobra vital importancia la concienciación de toda la comunidad buceadora para que no se produzcan mayores deterioros que los propios del paso del tiempo. Desde el Club Universitario de Buceo Oceánides entendemos que la protección y difusión del Patrimonio es fundamental. Potenciar la concienciación sobre la delicadeza del PAS, el daño que puede ejercer en los materiales una mala actuación, cómo actuar o dónde acudir en caso de localizar restos arqueológicos subacuáticos, son algunas de las cuestiones fundamentales que a nuestro juicio todo buceador debería conocer.

Partiendo de las premisas establecidas en el Libro Verde del Plan de Protección del Patrimonio Subacuático (2009), hemos puesto en marcha un proyecto conformado por actividades de diversa índole. El fin no es solo divulgar y concienciar, sino también realizar una valoración a todos aquellos que pasen por cualquier actividad, tanto antes como después, con el objetivo de poder determinar cuál es la iniciativa mejor recibida, cuál es la más instructiva en protección-concienciación, cuál es la que, a priori, tiene peor acogida, etc. Teniendo claros los resultados, cualquier organismo podrá adecuar mejor las actividades y los medios de los que disponga a los distintos tipos de público, logrando así, con mayor efectividad, que todo aquel que pase por sus manos se convierta en protagonista de la difusión y protección del Patrimonio.

PROYECTOS EN MARCHA

ESCÁPATE

1er Número: 2012
Periodicidad: Trimestral
Nº Publicados: 12

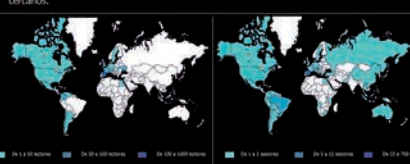
Escápate nació dentro de un marco relajado pero serio en el que cualquier persona, profesional o amateur, pudiera plasmar por escrito sus conocimientos y/o experiencias. Tanto el lenguaje distendido como su gran accesibilidad hace que cada vez sea más conocida dentro del mundo del buceo deportivo. El patrimonio subacuático tiene una importante presencia en ella, habiendo llegado más allá de nuestras fronteras.



LECTURAS		DESCARGAS
97	ABRIL	635
67	MAYO	961
156	JUNIO	1414
116	JULIO	1139
66	AGOSTO	732
345	SEPTIEMBRE	1748

* Datos recopilados en los últimos seis meses.

Dentro de los medios de difusión del Club Universitario de Buceo Oceánides se encuentra la revista electrónica y gratuita *Escápate* y el podcast *Bajo las Olas*, ambos con un mismo fin: hacer que todo lo que implica el submarinismo sea cercano y conocido para todos. Ambos nos permiten divulgar el respeto por la arqueología subacuática más allá de nuestros círculos más cercanos.



BAJO LAS OLAS

2014 1er Número
Aprox. mensual - Periodicidad
8 :Nº Publicados

Bajo las Olas surgió de cara a cubrir ese rango de personas que se sienten menos cómodas como la escritura, pero tienen muchas cosas que contar. Siguiendo los mismos parámetros que *Escápate*, ampliamos los medios y el campo de difusión. Además, nos brinda la posibilidad de grabar el audio de múltiples actividades y hacernos llegar a todas aquellas personas que no pudieron asistir. Por ejemplo, en el próximo número podremos escuchar un resumen de todo lo que nos contó Dña. Carmen Marcos visitando la exposición *El último supe de la Fragata La Mercedes* en el MAN.

SESIONES	
ABRIL	116
MAYO	151
JUNIO	125
JULIO	157
AGOSTO	103
SEPTIEMBRE	66

* Datos recopilados en los últimos seis meses.

VISITAS Y CUESTIONARIOS

Considerando nuestra experiencia y haciendo una valoración de forma generalizada, llegamos a la conclusión de que la divulgación que se realiza del patrimonio subacuático es menor de lo que sería deseable. Por eso es fundamental que al menos aquellos eventos que se hagan con este fin, sean lo más eficientes posibles. Un análisis en profundidad de todas las actividades efectuadas relacionadas directamente con la arqueología subacuática, nos lleva a conocer cuáles son los aspectos o ideas que deben reforzarse, cuáles fallan, cuáles hay que añadir, etc. El objetivo es conseguir que la población se interese e implique con el patrimonio. Conocer los errores que se producen en la difusión del mismo es la única manera para poder solventarlos.

En el Club de Buceo Oceánides se han realizado bloques de actividades: vistas a diferentes museos de temática subacuática más inmersiones en yacimientos de la geografía nacional, y cuestionarios después de las vistas.



Museo Arqueológico Nacional. *El último viaje de la Fragata Mercedes: Un tesoro cultural recuperado.*

Museo Naval. *El último viaje de la Fragata Mercedes: La razón contra el espólio.*



Museo Nacional de Arqueología Subacuática (ARQVA). *Exposición permanente.*



Ver yacimientos arqueológicos con un proyecto de investigación en pleno desarrollo es una de las actividades que más se demanda. En nuestro caso, hemos asistido al pecho **Bou Ferrer** (Villajoyosa, Alicante) y al **Proyecto de Isla Grosa** (San Javier, Región de Murcia).

El test realizado consta de diez cuestiones comunes a cualquiera de las actividades llevadas a cabo. Si bien es cierto que no contamos con un número de participantes lo suficientemente elevado como para realizar una estadística final, sí podemos advertir algunos resultados llamativos, tanto por el número diferencial de asistentes a los eventos como por los resultados de las encuestas:

- Tras tener más conocimiento sobre el patrimonio arqueológico, el 85 % considera que en los centros de buceo no encuentra información sobre cómo realizar inmersiones respetuosas con los bienes subacuáticos.
- A pesar de haberles explicado toda la problemática en torno a los diferentes peligros a los que se exponen los restos arqueológicos subacuáticos, siguen sin tenerlos de conceptos. Esto supone que hay un fallo en la cadena de comunicación que los profesionales de la cultura debemos solventar.
- Un importante número desconoce por completo cuáles son los organismos oficiales a los que acudir para advertir de la localización de nuevos restos o avisar de un posible daño o amenaza para el patrimonio subacuático, mientras que el resto sólo tiene una ligera idea.
- En cuanto a las actividades que demandan, todos reclaman poder visitar más restos arqueológicos in situ, a ser posible aquellos que se encuentren en proceso de excavación.



PROYECTOS INMEDIATOS

Una de las conclusiones más preocupantes que hemos advertido al inicio de esta experiencia, en la que sin duda debemos seguir trabajando, es la falta de conexión que existe entre el interés por el buceo y el interés en "profundidad" por el patrimonio. Al decir en profundidad, nos referimos a que resulta igual de importante la experiencia bajo el agua en sí, como entender los yacimientos, los bienes que en ellos se encuentran, por qué debemos protegerlos, cómo debemos conservarlos y qué debemos hacer para conseguir que esto sea una costumbre y no una excepción.

Sin embargo, por otro lado, al realizar los planteamientos sobre la difusión del patrimonio subacuático, en numerosas ocasiones nos olvidamos que aquellos amantes de la historia y la arqueología que sí llegar a sumergirse, estudian y comprenden este tipo de bienes. Satisfacer estos dos tipos de público es la razón de que estemos preparando unas charlas-coloquio de carácter breve y conciso que se realizarán de modo sistemático dentro y fuera del marco del Club Universitario de Buceo Oceánides, sin limitarnos a clubs y centros de buceo. Están diseñadas para realizarse en grupos reducidos. El objetivo es crear un ambiente familiar y de confianza que nos permita intercambiar y divulgar impresiones e inquietudes que nos ayuden a cubrir las necesidades de todas aquellas personas con algún tipo de interés o inquietud por la arqueología subacuática.

PROPUESTAS

- Concienciar e implicar a todos los profesionales relacionados con el submarinismo. La primera referencia de cualquier persona que quiera iniciarse en el mundo del buceo es su instructor y su centro de buceo. La forma de actuar de éste con el entorno y el patrimonio será la base de aprendizaje de sus alumnos. Si queremos inculcar respeto y buen hacer, debemos hacerlo desde la base.
- La creación de una red de yacimientos arqueológicos subacuáticos visitables. Condicionar los distintos tipos de bienes sumergidos para su visita siguiendo la línea de proyectos de Isla Grosa, en el que se puede hacer un recorrido guiado del yacimiento con carteles que señalan los puntos de mayor interés.
- Crear y divulgar cuál es el protocolo de actuación a seguir en caso de localizar nuevos restos o avisar de posibles daños al patrimonio arqueológico. A su vez, realizar una nueva y más amplia divulgación de la Campaña SOS para que todo submarinista sepa a dónde acudir si fuera necesario. Hemos comprobado que un alto porcentaje de buceadores y centros de buceo no conocen la existencia de dicha campaña.
- Ampliar el número de revistas de divulgación del Patrimonio que se difunden de forma gratuita por la red, al igual que se patrocinen más programas de carácter radiofónico.



En la actualidad, es tan importante la conservación del Patrimonio Arqueológico Subacuático como su puesta en valor. Hacer visible el pasado, haciendo que en el presente nos sintamos parte de él, es a nuestro criterio el mejor medio de difusión posible. Si bien las valoraciones realizadas parten desde la experiencia del Club Universitario de Buceo Oceánides, consideramos que no todos son aspectos exclusivamente valorables a nivel interno del club. Los datos analizados se pueden trasladar al funcionamiento general de las inmersiones arqueológicas en nuestro país.

Al igual que existen parámetros para el buen funcionamiento de cualquier museo o yacimiento, deben existir unos mínimos comparables para los yacimientos subacuáticos. Esta compleja maquinaria sólo puede funcionar si hacemos cómplices de la difusión a visitantes y profesionales del buceo.



Underwater tourism in Lake Zurich – an opening offer

Turismo subacuático en el lago de Zúrich – una primera propuesta

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Abstract: Five information panels are telling the story of a shipwreck in Lake Zurich. The underwater spot is part of an educational programme «Cultural Historical Hiking Tours of Canton Zurich». In the 1880s the City of Zurich decided to build continuous lakeside promenades and parks, which required huge amounts of gravel and other materials. Innumerable convoys of flat-bottomed, unpowered barges were transporting material, but one of these was hit by a sudden storm in the late summer of 1885 and sank near Stäfa-Kehlhof. Two of the lighters sank so deep that they could not be raised and have remained on the lakebed ever since. Easily accessible to divers, the wrecks at Stäfa are now an attractive and novel product offered by the «Kantonsarchäologie Zürich». The goal is that Scuba divers are aware of the existence of cultural heritage in Lake Zurich, are respectful of it – and will report in future own observations to the responsible archaeological services.

Key words: Shipwreck, Lake Zurich, tourism, information point, awareness.

Resumen: cinco paneles informativos cuentan la historia de un naufragio en el lago de Zúrich, dentro del programa educativo «Paseos histórico-culturales del Cantón de Zúrich». En la década de 1880 la ciudad de Zúrich decidió construir paseos y parques alrededor del lago, lo que requería enormes cantidades de grava y otros materiales. Innumerables convoyes de barcazas de fondo plano sin motor transportaban material. En 1885, una tormenta repentina alcanzó uno de ellos que se hundió cerca de Stäfa-Kehlhof. Dos barcazas más ligeras se hundieron tan profundamente que no pudieron recuperarse y han permanecido en el lecho del lago desde entonces. Fácilmente accesibles para los buceadores, los restos de los naufragios en Stäfa son un producto atractivo y novedoso que ofrece el «Kantonsarchäologie Zürich». El objetivo es que los buceadores sean conscientes y respetuosos con el patrimonio cultural en el lago de Zúrich y que informen de sus observaciones a los servicios arqueológicos responsables.

Palabras clave: naufragio, lago de Zúrich, turismo, punto de información, sensibilización.

Underwater tourism in Lake Zurich – an opening offer

Turismo subacuático en el lago de Zúrich – una primera propuesta

Switzerland – Canton Zurich – Lake Zurich, right shoreline – Stäfa, Kehlhof
Suiza – Cantón Zúrich – Lago de Zúrich, orilla derecha – Stäfa, Kehlhof



Convoy on Lake Zurich with a steam ship towing three lighters (dated 1883).
Convoi en el lago de Zúrich con buques de grúa, probablemente en el momento de la inauguración del puente.

PROJECT BRIEF

Education

Installation of a series of information panels telling the story of a shipwreck in Lake Zurich.

Advertising

The idea is to draw attention in the most practical and cost-effective way to the opportunity to dive on the wreck. Utilisation of suitable channels: diving shops, diving centres, Water police service, Tourist Board of Lake Zurich. Mailing of the pdf file to be embedded on websites and to be printed out for distribution.

MISIÓN DEL PROYECTO

Transmisión

Instalación de paneles informativos de la historia de un peco en el lago de Zúrich.

Publicidad

De la manera más oportuna y eficaz posible, se debe llamar la atención sobre la posibilidad de bucear en el peco. Uso de los medios adecuados: tiendas de buceo, bases acuáticas, Policía del lago, Turismo del lago de Zúrich. Enviar por email del pdf para que lo integren en sus páginas web y posibilidad de añadir un folleto impreso.



Shoreline site: Switzerland, Lake Zurich (Canton Zurich), Stäfa.
Línea de orilla: Suiza, lago de Zúrich (Canton Zúrich), Stäfa.



EDUCATING THE PUBLIC ABOUT THE OBJECTS AND THEIR HISTORY

A lot of gravel for Zurich

In the 1880s the City of Zurich and its neighbouring communities decided to build continuous lakeside promenades with tree-lined avenues, meadows and parks. By the standards of the time this was an enormous undertaking and required huge amounts of gravel and other materials. Zurich, located on the River Limmat since the Roman period, was quickly transformed from a river town into a city on the lake. The project was also the first step in Zurich becoming a major city.

Since antiquity, if not before, flat-bottomed barges propelled by oars, sails or poles were used for transporting both people and goods across Swiss lakes. In the late 19th century, so-called lighters, large, flat-bottomed, unpowered barges with a basic rectangular shape and usually vertical cargo hold walls were used on Lake Zurich.

They had been introduced in the 1880s to build the quay constructions on lower Lake Zurich and were towed, several at a time, by an engine-powered ship, the screw steamer called «Lerches».

One of these innumerable convoys transporting material was hit by a sudden storm in the late summer of 1885 and sank near Stäfa-Kehlhof. Two of the lighters sank so deep that they could not be raised and have remained on the lakebed ever since.

Easily accessible to divers, the wreck at Stäfa once belonged to a train of barges loaded with gravel for the construction of the quay. It was on route to the lower basin of Lake Zurich but never arrived at its destination. The cargo is still in the hold of the barge.

OBJETO E INTERPRETACIÓN HISTÓRICA

Mucha grava para Zúrich

En los años ochenta del siglo XIX la ciudad de Zúrich y los municipios colindantes decidieron construir un paseo a lo largo de la orilla del lago con avenidas, prados y parques. Este proyecto gigantesco para la época provocó una elevada demanda de grava y otros materiales de relleno. Zúrich, ubicada desde la época romana a la orilla del río Limmat, pasó rápidamente de ciudad fluvial a una ciudad orientada al lago. Este proyecto marcó el comienzo de la transformación posterior de Zúrich en una gran ciudad.

En todos los lagos suizos había desde la Antigüedad barcos de carga de suelo plano para el transporte de personas y mercancías, impulsados a remo, vela o pértiga. A finales del siglo XIX circulaban por el lago de Zúrich los llamados «lighters», grandes botes de transporte de suelo plano y laterales rectangulares. En el lago de Zúrich se empezaron a utilizar a partir de 1880 para la construcción del muelle en la cuenca baja del lago y eran remolcados por un barco a motor – el vapor de hélice «Lerches» – unidos a varios botes del mismo tipo.

Uno de esos numerosos convoys para el transporte de material fue fracturado y hundido al norte de Stäfa-Kehlhof por una tormenta repentina a finales del verano de 1885 – dos buques se hundieron a tal profundidad que no pudieron ser rescatados y desde entonces yacen en el fondo del lago.

El peco de Stäfa, de fácil acceso para los buceadores, pertenece a una flota de remolques cargada de grava para el muelle, en su camino hacia los cuencos bajos del lago de Zúrich, luego al que nunca llegó.

AIMS OF THE PROJECT

Image advertising

An attractive and novel product offered by the Kantonsarchäologie as part of its educational programme «Cultural Historical Hiking Tours of Canton Zurich».

Raising awareness

Scuba divers are aware of the existence of cultural heritage in Lake Zurich and are respectful of it.

Attractive task

A private association called «Archeodivers» regularly monitor the wreck and take care of the information panels.

Public relations

Making scuba divers feel more at ease with the archaeological services with one clear goal: The active reporting of observations and better supervision within diving circles.

OBJETIVO DEL PROYECTO

Publicidad de imagen

Oferta atractiva y original de la arqueología cultural en el marco de su ámbito divulgativo. «Sendemos historia cultural en el cantón Zúrich».

Sensibilización

Los aficionados al buceo toman conocimiento de la existencia de monumentos en el lago de Zúrich y aprenden a respetarlos.

Tarea atractiva

La Asociación privada «Archeodivers» controla regularmente el peco y cuida los paneles informativos.

Fomentar el contacto

Supervisión del fondo de los buceadores a: acercarse a zonas arqueológicas, con una clara intención: vigilancia activa, mejor control entre los buceadores.



Situation under water: impressions of the wreck.
Situación bajo el agua: impresiones del peco.



A side view image of both wrecks and a 3D visualisation of the measurements off the Stäfa shoreline.
Vista lateral de ambos pecos y visualización 3D de las mediciones de los pecos desde la orilla de Stäfa.

BUDGET

Investment costs: 4000 €
Running costs: none.

PRESUPUESTO

Costes de inversión: 4000 €
Costes actuales: ninguno.

Initiative / Iniciativa

• BD ARE Kantonsarchäologie (initiator)
• BD ARE Kantonsarchäologie (iniciador)



Kanton Zürich
Bundarchäologie
Amt für Raumentwicklung

beat.erschweiler@bd.zh.ch
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Partners involved / Colaboración

• City of Zurich, Underwater Archaeology (have managed the cultural heritage in Zurich's bodies of water on behalf of the central authorities since 1978).
• Ciudad de Zúrich, Arqueología subacuática (gestión del patrimonio cultural en los aguas de Zúrich por encargo del cantón como autoridad central, desde 1978).
• Swiss Underwater Archaeology Society: initial documentation as part of a course in 2004.
• Sociedad de Arqueología Subacuática Suiza: documentación inicial en el marco de un curso, 2004.
• Archeodivers: maintenance, from 2014 onwards.
• Archeodivers: Vigilancia, desde 2014.



CARTAGENA 2014
IKUWA V

The thin red line. Conservation vs tourism. The case of SS *Thistlegorm* (Red Sea, Egypt)

La delgada línea roja. Conservación vs turismo. El caso del SS *Thistlegorm* (mar Rojo, Egipto)

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Abstract: Nowadays diving pretends to be an activity respectful with the environment but it's actually truth that we don't consider the consequences of us being there. The SS *Thistlegorm* (Red Sea, Egypt), is of the cases where tourist and institutions seem to be ready to destroy it: ships mooring directly to the wreck damaging the structure, the lack of an inventory to avoid pillaging, the disrespectful divers and the acceleration of corrosion due to the diver's air trapped bubbles, are the main problems currently. The 2001 Unesco Convention on Protection of Underwater Cultural Heritage established that conservation *in situ* must be a priority. But as measures to make compatible both conservation and tourism are still not developed as they should be, we want to make a call for attention. Conservation and safety are currently a huge problem. If we don't do anything to change it we will soon cry its irreversible loss.

Key words: Conservation, Tourism, II World War, SS *Thistlegorm*, Egypt.

Resumen: actualmente, se aboga por un buceo respetuoso con el medio que le rodea sin pensar en los daños intrínsecos de nuestro paso. En el caso del pecio de la II Guerra Mundial el SS *Thistlegorm* (mar Rojo, Egipto) no solo no se piensa en ello sino que el hombre parece haberse propuesto su destrucción: los barcos amarran directamente en él, está altamente saqueado y el dióxido de carbono se va acumulando en los techos de su interior. La Convención de la Unesco sobre la Protección del Patrimonio Cultural Subacuático de 2001 establece que la conservación *in situ* sea prioritaria. Ya que las medidas adquiridas para compatibilizar conservación, protección y turismo no están desarrolladas como sería deseable, queremos hacer una llamada de atención sobre el preocupante estado de conservación del pecio, del riesgo que supone para sus visitantes y de la pérdida irreversible que lamentaremos si no se toman medidas.

Palabras clave: conservación, turismo, II Guerra Mundial, SS *Thistlegorm*, Egipto.

THE THIN RED LINE. CONSERVATION VS TOURISM . THE CASE OF THE SS THISTLEGORM (RED SEA, EGYPT).

La Delgada Línea Roja. Conservación VS Turismo. El Caso del SS Thistlegorm

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Nowadays, it is as important to value the heritage as its protection. Make compatible tourism and economy with preservation and conservation of past remains, is sometimes difficult if none of them ends harmed. Few times both sides come out ahead.

If we also consider the gradual increase of driver's certificate, the boom of the technical diving among regular divers and the Sidemount's insertion, which allows getting through narrower places, make us consider if the underwater helpless heritage placed in more accessible levels is suffering an irreparable damage.

Let's study the case of the SS Thistlegorm, a Merchant Navy ship on a mission to deliver supplies to the British Army, sunk in 1942 (Red Sea, Egypt) by a long range German bomber.

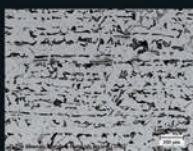


OWNER	ALBYN LINE	INSTALLED POWER	THREE CYLINDER, THREE EXPANSION, STEAM ENGINE, LOW OIL PRESSURE
BUILDER	JOSEPH THOMPSON & CO., Belfast, Ireland	BEAM	18 m.
LAUNCHED	04/09/1940	CREW	41
FATE	SUNK 10/06/1941	ARMAMENT	4 INCH (101MM) LOW ANGLE GUN
TONNAGE	LOW-CARBON STEEL		3 INCH (77MM) ANTI-AIRCRAFT GUN
LENGTH	128 m	DEPTH	MIN: 15 m MAX: 30 m

STEEL

Steel is material which comprises an alloy of iron and carbon plus other elements such as phosphorus, sulfur, silicon and more. The advantages for its use are the low cost, its ductility, the tensile strength, proper dimensions and that it is easily workable and welding. Carbon steel was employed for the cargo's construction with less than a 0,25% of carbon in it.

One of the main problems of this material is its ferrous component what gives it a low resistance to corrosion, especially underwater due to the action of humidity and marine salts.

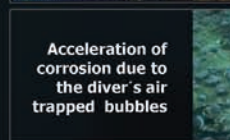


Steel sample under optical micrograph taken from Thistlegorm hull.

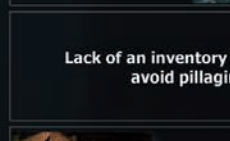
CURRENT PROBLEMS



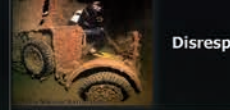
Ships mooring directly to the wreck damaging the structure



Acceleration of corrosion due to the diver's air trapped bubbles



Lack of an inventory to avoid pillaging



Disrespectful divers

CONSERVATION PROPOSAL

On December 2007 the NGO HEPCA carried out an intervention to break the recent deterioration of the wreck, caused mainly by anthropic factors. They installed a Manta Ray mooring system with different ascent and descent lines and they made a series of drilled holes to release diver's trapped air bubbles. However, due to the distance of the lines (5 m from the wreck) and the strong currents, the difficulty to find the buoys because they did not reach the surface, the excessive length of the lines that were drifting, crossing the wreck and shredding, and mainly the lack of commitment of some users, this new system has never been actually functional. Therefore it is required to make a new proposal.

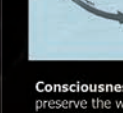
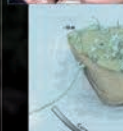
Direct measures

Sampling. Commonly higher accumulation of rust is focused on the outside of the wreck but due to the trapped air bubbles inside the SS Thistlegorm's rooms, we find here an exception. Proven as an effective method, with steel sampling can be valued the deterioration speed of the metal comparing the original thickness and the current one through the time lapse. Samples would be necessary on the outside, on the most accessible rooms and the ceilings holding heavy weight. Studies on the seawater around the wreck and the analytical techniques of rust deposits are also useful.

Maintenance of the holes. Proven their effectiveness it is necessary to keep them clean from organic and inorganic deposits. Despite the mechanical cleaning it would be important to coat the fracture with pH-neutral marine resin in order to avoid the new buildup as much as possible.

Indirect measures

Development of a safety plan. Due to the deterioration of the ceilings and walls and taking into account the presence of people inside, it is absolutely essential the consideration of the areas with more collapse risk. If necessary, it could be convenient the closure of some rooms and the intervention of specialized professionals to keep them secure.



Consciousness-raising. Without a doubt, none of these measures will ever be effective if there is not an involvement and a proper behavior to preserve the wreck. Authorities, operators and diver's teams should impart respect for the heritage to enjoy it as long in time as possible.

From the historical, economical, tourist point of view and due to its accessibility, this wreck is interesting in different levels. It is obvious that the current exploitation seems worthwhile; however, we have to keep in mind the assessment displayed before. **This is a call for attention:** if we don't take care of it we will soon be sorry for its loss.

It is very complicated to carry out in every located wreck a control like the one that we have suggested above, at least in a short/medium term. Nevertheless, we recommend this experimental proposal to those cases with such a tourist impact as it is the SS Thistlegorm. Going further than conservation, diver's safety can be a problem of vital importance that without a slightest doubt has to be solved. We cannot just think that quality diving tourism and conservation cannot be united. Because even if it is true that is impossible to give back the SS Thistlegorm to its initial state of conservation, we absolutely can avoid the current deterioration speed working all together: users, operators, technicians and authorities.



La sensibilización de las comunidades locales para el patrimonio cultural subacuático – Portugal y Cabo Verde: Kit Educativo Patrimonio Cultural Subacuático – Manual Pedagógico para profesores

Raising local communities awareness on underwater cultural heritage – Portugal and Cape Verde: Underwater Cultural Heritage Education Kit – Pedagogical Manual for Teachers

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Resumen: en respuesta a la necesidad de la preservación del patrimonio cultural subacuático como parte integrante del patrimonio común de la humanidad, los Estados parte de la Convención de 2001 siguen haciendo esfuerzos de colaboración internacional. Educar y crear conciencia sobre la herencia común, ese instrumento para promover cambios de valores, instituyendo mejores prácticas. En este supuesto en la Comisión Portuguesa para la Unesco, firmamos un protocolo institucional con el Centro de Historia d'Aquém e Além Mar de la FCSH-UNL, y hemos elaborado nuevos enfoques pedagógicos pioneros en proyectos orientados al cumplimiento de la Convención. Uno de los proyectos fue el Kit Educativo Patrimonio Cultural Subacuático.

Palabras clave: cooperación, educación, patrimonio, preservación, Unesco.

Abstract: In response to the need for the preservation of underwater cultural heritage as an integral part of the common heritage of mankind, the States parties to [of] the 2001 Unesco Convention, continue its [their] efforts for an international collaboration. Educate and raise awareness about the common heritage, is the instrument to promote changes of values, instituting best

practices. In this case the Portuguese Commission for Unesco, signed an institutional protocol with the Portuguese Centre for Global History-FCSH/NOVA-UAc and elaborated a new educational and pioneer approaches to projects which aimed the implementation of the Convention. One of the projects was the Educative Kit on Underwater Cultural Heritage.

Key words: Cooperation, education, heritage, preservation, Unesco.

LA SENSIBILIZACIÓN DE LAS COMUNIDADES LOCALES PARA EL PATRIMONIO CULTURAL SUBACUÁTICO PORTUGAL Y CABO VERDE KIT EDUCATIVO PATRIMONIO CULTURAL SUBACUÁTICO – MANUAL PEDAGÓGICO PARA PROFESORES

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INTRODUCCIÓN

Cada Estado Parte adoptará todas las medidas viables para que el público tome conciencia del valor e de la relevancia del patrimonio cultural subacuático, así como de la importancia que tiene su protección en virtud de esta Convención.

Artículo 20

Sensibilización del público

Convención 2001 de la UNESCO para la Protección del Patrimonio Cultural Subacuático

En respuesta a la necesidad de la preservación del patrimonio cultural subacuático como parte integrante del patrimonio común de la humanidad, los Estados Parte de la Convención de 2001 siguen haciendo esfuerzos de colaboración internacional con respecto a la conservación y la protección de este patrimonio.

Los yacimientos arqueológicos siguen objeto de saqueos, resultando la pérdida de su contexto histórico. Educar y fomentar la conciencia sobre la herencia, es el centro principal del trabajo sostenible, instrumento para promover cambios de valores y actitudes, y la institución de mejores prácticas.

En este supuesto, la Comisión Portuguesa para la UNESCO firmó en 2011 un protocolo institucional con el Centro de História d'Aquém e d'Além-Mar, y desde entonces se ha creado nuevos enfoques pedagógicos pioneros en proyectos específicos al cumplimiento de la Convención de 2001.

Uno de estos proyectos se llevó a cabo en escuelas de Portugal y de Cabo Verde en el ámbito del Kit Educativo "Patrimonio Cultural Subacuático".

El Kit Educativo, elaborado por la Comisión Portuguesa para la UNESCO, en colaboración con la UNESCO, y el Centro de História d'Aquém e d'Além-Mar (CHAM), es un manual de enseñanza para los profesores utilizaren en temas transversales en las clases. Sugiere el desarrollo de actividades con los alumnos que luego pueden ser adaptadas y modificadas de acuerdo con el contexto y las necesidades de cada escuela, localidad, y en cada país – actuar en el local y pensar globalmente.

Se pretende con el Kit, familiarizar a los más jóvenes para el contenido de la Convención de 2001 y su reto será el compromiso establecido por la comunidad educativa en la elaboración de proyectos y el desarrollo de buenas prácticas en la conservación del patrimonio cultural subacuático – se protege lo que se conoce.

El patrimonio cultural subacuático constituye parte integrante del patrimonio cultural de la humanidad y una de las importantes fuentes en la reconstrucción del pasado.

El lanzamiento pionero de este Kit Educativo en un Estado Parte de la Convención de 2001 de la UNESCO (Portugal), en el marco de la conciencia para la protección del patrimonio cultural subacuático y la Convención de la UNESCO de 2001, mereció elogios en la acta de la tercera sesión del *Advisory Body* de los Estados Partes en la UNESCO, en 2012. Por lo tanto, fue puesto en marcha en una escuela asociada de la UNESCO en Portugal – Agrupamento de Escolas de Ferreiras –, y generalizado en una acción de formación en la red de escuelas asociadas en Cabo Verde, con el apoyo del Ministerio de Ciencia y Educación Superior y la Comisión Nacional de Cabo Verde para la UNESCO. En 2014, el Kit Educativo ha sido puesto en práctica en una acción de formación en el Centro de Formación del Profesorado Dr. Rui Grácio, en Lagos – escuela asociada de la UNESCO, y que se unió a este proyecto en distintos niveles escolares en el currículo escolar.

Atendiendo a lo expuesto, nos parece esencial seguir ayudando a las comunidades a reflexionar sobre la importancia del patrimonio cultural subacuático como factor de fortalecimiento de la identidad cultural y de memoria, lograr la importancia de la diversidad cultural implantada en una perspectiva local y mundial, y el impacto social de hallazgos arqueológicos en cada comunidad. Fomentar el trabajo en equipo en el contexto de las comunidades involucradas, es un principio cívico. Envolver las comunidades en actividades arqueológicas, concienciar para el trabajo



CHAM e la Comissão Portuguesa para a UNESCO no Agrupamento de Escolas de Ferreira



8/17/2012 12:12



AÇÃO DE FORMAÇÃO CENTRO DA PRATA, CABO VERDE

CONCLUSIÓN

El barco no se hunde, se ahoga; El barco cuando se hunde no muere.

Son palabras de nuestros alumnos que han trabajado el Kit educativo y que nos ofrecen la fuerza continuada para creer que este trabajo siga a lo largo del tiempo, porque todavía hay un largo camino por hacer.

La educación es un derecho que puede transformar la vida de las personas en la medida en que sea accesible para todos, sea pertinente y esté sustentada en valores fundamentales compartidos. Puesto que una educación de calidad es la fuerza que más influye en el alivio de la pobreza, la mejora de la salud y de los medios de vida, el aumento de la prosperidad y la creación de sociedades más inclusivas, sostenibles y pacíficas, nos interesa a todos velar por que ocupe un lugar central en la agenda para el desarrollo después de 2015.

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Irina Bokova

Descubrir y aprender: el proyecto «Rita la Anforita» y el acercamiento del Patrimonio Cultural Subacuático a los niños de educación infantil (3, 4 y 5 años)

Discover and learn: «Rita la Anforita» project and the approach of Underwater Cultural Heritage to preschoolers (3, 4 and 5 years old)

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Resumen: el público infantil requiere una aproximación al Patrimonio Cultural Subacuático (PCS) muy distinta de la que se diseña para el resto de la sociedad, pero incluso en el ámbito infantil, las necesidades varían de forma considerable entre unas edades y otras. En este marco de acercamiento del público más joven al patrimonio se desarrolló en colaboración con el ARQUA el Proyecto «Rita la Anforita», dirigido a los alumnos de segundo ciclo de Educación Infantil, con el objetivo de facilitar la comprensión de aquello que podían ver en el Museo gracias a diversos recursos y actividades antes, durante y después de la visita. Se persigue que los niños comiencen a conocer, respetar y valorar el PCS desde una edad temprana, verdadera manera de educar desde la base a una sociedad en parte desconocedora de la riqueza patrimonial que se conserva bajo las aguas y que se valora para el conocimiento de todos.

Palabras clave: Patrimonio Cultural Subacuático, educación infantil, proyecto «Rita la Anforita», Museo Nacional de Arqueología Subacuática, actividades didácticas.

Abstract: Children require a different approach to Underwater Cultural Heritage from that given to the rest of the public, but even in the child domain, the needs vary considerably depending on age. In this context of trying to bring heritage closer to children, «Rita la Anforita» Project (Rita

the small amphora) was developed in collaboration with ARQUA Museum. It is aimed at students of the second cycle of pre-school education in order to facilitate their understanding of what they can see at the Museum through various resources and activities to be carried out before, during and after the visit. In this way, we try that children begin to know, respect and value Underwater Cultural Heritage from an early age, the only way to educate from the basis of society, often oblivious to this kind of patrimony.

Key words: Underwater Cultural Heritage, pre-school education, «Rita la Anforita» project, ARQUA-National Museum of Underwater Archaeology, educational activities.



DESCUBRIR Y APRENDER: EL PROYECTO RITA LA ANFORITA Y EL ACERCAMIENTO DEL PATRIMONIO CULTURAL SUBACUÁTICO A LOS NIÑOS DE EDUCACIÓN INFANTIL (3, 4 Y 5 AÑOS)

BENJAMÍN CUTILLAS VICTORIA, ANA MARÍA JEREZ BONACHERA, MARÍA JOSÉ VICTORIA PÉREZ¹



Presentar y dar a conocer el Patrimonio Cultural Subacuático al gran público es uno de los actuales retos dentro del mundo de la Arqueología y, por ello, numerosas labores de didáctica y divulgación se han llevado a cabo en los últimos años para conseguir dicho acercamiento a la sociedad. No obstante, estos recursos no deben ser iguales para todo el público, pues encontramos una importante diversidad y una distinción entre las necesidades de cada grupo, como puede ser el caso de los niños. El público infantil requiere una aproximación al patrimonio en general muy distinta de la que se diseña para el resto de la sociedad, pero incluso en el ámbito infantil, las necesidades varían de forma considerable entre unas edades y otras. En este marco de acercamiento al público más joven es donde se creó en el año 2012, en colaboración con el Museo Nacional de Arqueología Subacuática (ARQUA), el Proyecto *Rita la Anforita*, dirigido a los alumnos de Educación Infantil (3, 4 y 5 años) y que se oferta desde el Museo ARQUA cada vez que se va a realizar una visita de grupos de escolares de estas edades.

Su objetivo principal es dotar al profesorado de Educación Infantil que desee acudir al Museo de una serie de materiales didácticos adaptados a las edades de sus alumnos que ayuden a la motivación y a la mejor comprensión de lo que pueden ver en él. Además, el proyecto se encuentra disponible de forma pública y gratuita en la web del ARQUA y es igualmente recomendable su realización para visitas individuales fuera del marco escolar. A través de las actividades que se realizan antes, durante y después de la visita al Museo, se intenta acercar a los niños y niñas al mundo de la Arqueología Subacuática y de lo que esta estudia, así como aprender a cuidar cualquier forma de patrimonio y a considerarlo como algo nuestro. Y es que, el verdadero fin que se persigue, es que los niños comiencen a conocer, respetar y valorar el patrimonio cultural subacuático desde una edad temprana, verdadera manera de educar desde la base a una sociedad en parte desconocedora de la riqueza que se conserva bajo las aguas y que se pone en valor para el conocimiento de todos.

OBJETIVOS GENERALES EDUCATIVOS Y CULTURALES DEL PROYECTO.

- Observar y explorar su entorno familiar, natural y social.
- Descubrir y valorar el entorno natural más próximo e interesarse por algunas de las principales manifestaciones culturales y artísticas de la Región de Murcia. En este caso concreto, conocer y visitar el Museo Nacional de Arqueología Subacuática.
- Observar y explorar de forma activa su entorno, generando interpretaciones sobre algunas situaciones y hechos significativos, y mostrando interés por su conocimiento y respeto hacia ellos.
- Conocer y valorar los componentes básicos del medio natural y algunas de sus relaciones, cambios y transformaciones, desarrollando actitudes de cuidado, respeto y responsabilidad en su conservación.
- Reconocimiento de algunas señas de identidad cultural del entorno e interés por participar en actividades sociales y culturales. Costumbres, folklore y otras manifestaciones culturales y artísticas de la región.
- Identificar algunos cambios en el modo de vida y las costumbres en relación con el paso del tiempo.

OBJETIVOS ESPECÍFICOS EDUCATIVOS Y CULTURALES DEL PROYECTO.

- Dar a conocer a los más pequeños el patrimonio arqueológico subacuático de una forma adaptada y adecuada a su edad.
- Educar en patrimonio desde las edades más tempranas, creando una concienciación de respeto hacia, en este caso, el patrimonio arqueológico subacuático y todo lo que de él se desprende: museos, materiales, especialistas...
- Transmitir unos conocimientos básicos pero fundamentales para crear una base cultural desde la que se comience a desarrollar un conocimiento de la Arqueología Subacuática: qué estudia, cómo y dónde lo hace, el por qué de su existencia...
- Conocer aquello que ha sido estudiado por los investigadores y arqueólogos y que se puede visualizar en el museo.
- Obtener unos conocimientos básicos sobre el oficio de arqueólogo subacuático, restaurador y conservador, además de conocer los lugares donde llevan a cabo su trabajo (el medio acuático, el laboratorio, el museo).



Fig. 1. Rita la Anforita en la entrada del Museo Nacional de Arqueología Subacuática. Lámina 1 del power point del Proyecto Educativo.

DESARROLLO DEL PROYECTO

I. ACTIVIDADES PREVIAS.

La primera fase comienza en el aula, pues es necesario preparar a los alumnos y despertar su interés por lo que van a ver en el Museo ARQUA. Por ello se realizan una serie de tareas colectivas e individuales que cumplan este fin a través de los materiales y las fichas que se han diseñado (fig.3).

Actividades de motivación:

- Presentación del cuento *Rita, la anforita* con apoyo visual a través del power point del mismo, realizando la adivinanza: *el ánfora*.

Creación de conocimientos previos:

- ¿Qué sabemos de las ánforas?: se recogerán los datos aportados por los niños en la asamblea.
- ¿Qué queremos saber de las ánforas?: se anotarán aquellos aspectos sobre los que los niños muestran curiosidad. El docente puede incorporar otros que no se hayan planteado y que sean interesantes.
- ¿Qué es un museo?: definimos un museo y los tipos de museo que existen, terminando con la explicación de qué es el Museo ARQUA.
- ¿Dónde podemos conseguir la información?: se realizará un listado con las preguntas y se entregará una nota informativa para llevarla a casa y recopilar información sobre ARQUA y las ánforas. Posteriormente, se confeccionará un panel en clase con la información aportada por los alumnos.

Actividades de aula:

- Dibujar a Rita, la anforita, y trabajar el vocabulario específico: arqueólogo, buzo, ánfora... Confeccionar un mural con las palabras más representativas, su imagen y su significado.
- Visitar la web ARQUA: dialogar sobre el lugar de ubicación y su nombre.

II. ACTIVIDADES DE DESARROLLO EN EL MUSEO

Una vez finalizada la primera fase, la segunda se inicia con la preparación en el aula de la salida al Museo, explicando las normas a seguir en la visita. Ya en el Museo, los alumnos y alumnas llevarán a cabo las siguientes actividades con los profesionales del Museo y la colaboración y participación del profesorado:

Visita guiada al Museo de Arqueología Subacuática:

- Se desarrollará la visita y explicación por parte del personal del Museo, aspecto positivo para los alumnos al tener que derivar su atención hacia una persona que no sea el docente, levantando su expectación por ser alguien del propio Museo. Además, se utiliza el power point del proyecto como apoyo para el desarrollo de la visita, lo que permite al alumnado reconocer imágenes e informaciones sobre las que ya han tratado anteriormente.

Actividades didácticas en el aula del Museo.

- Localización, por parte de los alumnos, de elementos vistos a lo largo del recorrido por el Museo, sobre varios paneles fotográficos de zonas destacadas del mismo.
- Selección y colocar todos los accesorios necesarios de la indumentaria de un buzo sobre una imagen dada.
- Colorear y decorar unas gafas de buzo troqueladas, poniéndole papel celofán como cristal. Esta ficha sirve como recuerdo al alumnado, ya que se la llevan posteriormente a casa.

Entrega de un diploma para la clase.

- El Museo hará entrega al profesor/tutor de un diploma para la clase, nombrándolos "Arqueólogos submarinos honoríficos" y que será colgado en el aula.

III. POSIBLES ACTIVIDADES POSTERIORES DE AULA

En la asamblea, se recuerda lo visto en el Museo con el objetivo de continuar el proceso de aprendizaje sobre la Arqueología Subacuática y el Patrimonio Subacuático. Se realizan nuevas actividades que afiancen los conocimientos del alumnado:

- Modelar un ánfora en plastilina y hacer un barco de papel de periódico donde meter el ánfora de plastilina.
- Colorear un dibujo que representa al buzo siguiendo desde que se hunde el barco hasta que se presenta el ánfora restaurada.
- Experiencia científica: hacer subir un objeto (en representación del ánfora) dentro de un subacuático, coloreados por los niños: barcos, recipiente con agua, para demostrar que el aire pesa menos.
- Indagar sobre ¿qué hace un restaurador? Pegar una foto y dibujarlo.
- Realizar una secuenciación de los pasos barco y los niños colocarán de forma correcta su ánfora, para que no se caiga (este contenido se ha visto en el Museo).
- Decorar la clase con una cenefa de elementos subacuáticos, coloreados por los niños: barcos, buzos, ánforas, mano sábaca, etc.



Fig. 2. Rita la Anforita en una de las vitrinas sobre ánforas del Museo ARQUA. Lámina 14 del power point del Proyecto Educativo presentado.

CONCLUSIÓN

El Proyecto *Rita la Anforita* se ha convertido en una herramienta de referencia en cuanto a lo que la divulgación y aprendizaje del Patrimonio Arqueológico Subacuático se refiere. Su repercusión en el ámbito educativo está siendo muy positiva, y numerosos grupos escolares pueden visitar y conocer el Museo Nacional de Arqueología Subacuática a través de una metodología que engloba a los más pequeños, transmitiéndoles que el museo también es su casa. Muestra del éxito del trabajo realizado hace dos años, es que el proyecto sigue vivo y, próximamente, va a comenzar la ampliación de los materiales y del proyecto en su conjunto para dar cabida a los nuevos hallazgos y salas que se han inaugurado en estos últimos años, respondiendo así a las nuevas inquietudes de educadores, padres y alumnos.

El fin de presentar este póster no solo se resume en un aspecto meramente informativo, sino que pretende divulgar lo que aquí se ha realizado para que sirva, en primer lugar, de llamamiento a la creación de proyectos de este tipo en otras áreas del patrimonio, no sólo en el arqueológico subacuático; y, en segundo lugar, como propuesta metodológica de la colaboración que se puede establecer entre museo y equipos docentes, y cuyos resultados pueden ser de sumo interés para todos. Además, no debemos olvidar que gracias a una buena experiencia en el museo y durante la realización del proyecto, los propios niños y niñas pueden convertirse, en este caso concreto, en pequeños embajadores de la Arqueología Subacuática, de la importancia del Patrimonio Subacuático y del Museo Nacional ARQUA.

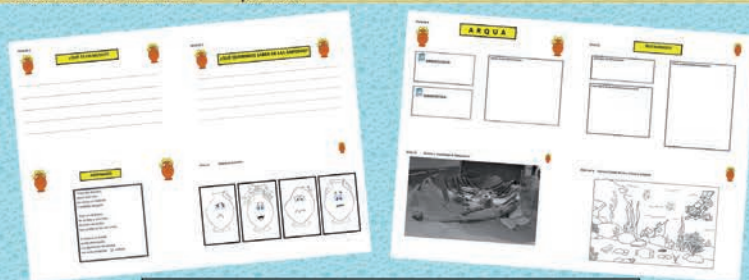


Fig. 3. Recopilación de algunas de las fichas a desarrollar por el público infantil en relación con la Arqueología Subacuática y lo aprendido en el Museo ARQUA.

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La preservación del patrimonio sumergido y la valoración de la arqueología subacuática como base del trabajo de investigación en el aula: un caso práctico aplicado al bachillerato¹

The preservation of underwater heritage and the appreciation of underwater archeology as a basis for research in the classroom: a case applied to high school

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Resumen: la lucha contra el expolio submarino ha sido una constante del trabajo arqueológico que siempre ha buscado la concienciación de la ciudadanía sobre el conocimiento y valoración del patrimonio cultural. El ciudadano formado sobre el respeto de este patrimonio, debe construirse desde una primera base sólida. Por tanto, en el presente trabajo reivindicamos el valor que la didáctica de la arqueología subacuática y la preservación del patrimonio tendría en los niveles básicos de la educación. El bachillerato, en su aspecto más preuniversitario, es la etapa ideal en la que actuar sobre los futuros alumnos, para despertar vocaciones y facilitar el acceso a los centros de investigación. Proponemos aquí un ejemplo de investigación real, desarrollado con alumnos de bachillerato, al objeto de formar a futuros investigadores, partiendo del trabajo de campo (incluyendo primer contacto con el buceo), el conocimiento directo del patrimonio y el fomento de la investigación interdisciplinar en centros punteros.

¹ El trabajo general que este póster sintetiza, ha sido galardonado con el Premio Nacional Giner de los Ríos 2016, a la Innovación Educativa.

Palabras clave: arqueología subacuática, patrimonio, difusión cultural, didáctica de la arqueología, didáctica de la ciencia.

Abstract: Fighting against cultural underwater plundering is becoming a common issue in the archaeology work, which includes trying to create public awareness and appreciation for cultural heritage. Informed citizens should be educated from the beginning about cultural heritage and its importance. Therefore, in this paper we discuss the value and importance of educating others about Underwater Archaeology and Cultural heritage preservation. In this way, we feel that high school is the ideal level in which students can work and learn in order to awake interests and provide a first contact with research centers. Thus, we propose in this paper a real example of research developed with high school students, in order to educate future researchers and promoting an interdisciplinary research, using field work (even diving) as the starting point at the most prominent research centers.

Key words: Underwater archaeology, cultural heritage, cultural diffusion, archaeology education, natural science education.

Red de exposiciones modulares de arqueología subacuática: hacia un nuevo modelo museográfico

Underwater archaeology net of modular exhibitions: towards a new museum model

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Resumen: este póster propone la creación de una red de micro-museos modulares, transportables, autónomos y de bajo coste, que sirvan de puerta de acceso a un corpus de información en red sobre el patrimonio arqueológico subacuático. El objetivo de este proyecto es la creación de una propuesta museográfica que fomente la integración y aumento de la visibilidad del patrimonio arqueológico subacuático en la sociedad, utilizando los últimos avances en el campo de la museografía y las nuevas técnicas de información y comunicación (TIC). Por tanto, proponemos la reutilización de un contenedor de transporte marítimo Dry Van de 20 pies como espacio expositivo, incorporando pantallas táctiles; recreaciones; elementos sensoriales para fomentar la experiencia del visitante; objetos interactivos y una conexión virtual a los contenidos de la exposición a través de *tablets* y *smartphones*. Por tanto, cada módulo expositivo contará con todos los elementos necesarios para la musealización de uno o varios yacimientos.

Palabras clave: museo, museología, patrimonio arqueológico subacuático, contenedor marítimo, arqueología subacuática.

Abstract: This poster proposes the creation of a transportable, autonomous and low-priced modular micro-museum net, which works as an access to a body of on-line information about Underwater Cultural Heritage. The main goal of this project is the creation of a museographical proposal which fosters the integration and magnification of visibility of the Underwater Cultural Heritage in our society, as well as boosting its protection and preservation, using the ultimate advances in the field of museology and the new information and communication techniques (ICT). So, we propose to reuse a 20 feet Dry Van sea transportation container as exhibition space, adding touch screens; recreations; object handling and a virtual connection to the exhibition through *tablets* and *smartphones*. Likewise, the stimulation of senses and sensations will be fundamental during the visit of the exhibition. Therefore, each exhibition module contains all the necessary elements for the musealization of one or several archaeological sites.

Key words: Museum, museology, Underwater Cultural Heritage, maritime container, maritime archaeology.

RED DE EXPOSICIONES MODULARES DE ARQUEOLOGÍA SUBACUÁTICA (R.E.M.A.S.) HACIA UN NUEVO MODELO MUSEOGRÁFICO UNDERWATER ARCHAEOLOGY NET OF MODULAR EXHIBITIONS (R.E.M.A.S.) TOWARDS A NEW MUSEUM MODEL



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QUÉ ES R.E.M.A.S.?

R.E.M.A.S. es una red de micro-museos modulares, transportables, autónomos y de bajo coste, que sirven de puerta de acceso a un corpus de información en red sobre el Patrimonio Arqueológico Subacuático. Cada módulo expositivo contiene todos los elementos necesarios para la musealización de uno o varios yacimientos, pudiendo ser combinados entre sí para crear exposiciones de mayor tamaño.

WHAT IS R.E.M.A.S.?

R.E.M.A.S. is a transportable, autonomous and low-priced modular micro-museum net, which work as an access to a body of on-line information about Underwater Cultural Heritage. Each exhibition module contains all the necessary elements to the musealization of one or several archaeological sites, they could be combined among each other to create bigger exhibitions.

OBJETIVOS DEL PROYECTO

El objetivo principal de este proyecto es la creación de una propuesta museográfica que fomente la integración y aumento de la visibilidad del Patrimonio Arqueológico Subacuático en la sociedad, al igual que favorezca su protección y conservación, utilizando los últimos avances en el campo de la museografía y las nuevas técnicas de información y comunicación (TIC).

AIMS OF THE PROJECT

The main goal of this project is the creation of a museological proposal which fosters the integration and the magnification of visibility of the Underwater Cultural Heritage in our society, as well as boosting its protection and preservation, using the ultimate advances in the field of museology and the new information and communication techniques.



MICRO-MUSEO MODULAR

Con el fin de crear un micro-museo innovador, de bajo coste, sostenible y que permita su fácil transporte, se ha elegido como espacio expositivo la reutilización de un contenedor de transporte marítimo Dry Van de 20 pies. Así mismo, la reconversión del contenedor en una exposición modular permite su fácil emplazamiento en zonas de gran afluencia de personas, como pueden ser: puertos, paseos marítimos, plazas, recintos feriales, etc. Por tanto, la captación de visitantes aumenta enormemente con cada nuevo emplazamiento. Gracias a la instalación de una placa solar, el suministro eléctrico necesario para el funcionamiento de la exposición queda totalmente cubierto, convirtiéndolo en un módulo 100% autónomo.

MODULAR MICRO-MUSEUM

So as to create an innovative, low-priced, sustainable micro-museum which allows its easy transportation, it has been decided as exhibition space the reuse of a 20 feet Dry Van sea transportation container. Furthermore, the conversion of the container into a modular exhibition site permits its easy placement in large influx people areas such as harbours, promenades, squares, exhibition grounds, etc. Therefore, the capability of receiving more visitors enormously enhances with each new placement. Likewise, thanks to the installation of a solar panel, the necessary electrical supply for the proper working of the exhibition is guaranteed, becoming a 100% independent module.

MUSEO ON-LINE

La creación de una red virtual de conexión On-line permite el almacenaje y presentación de gran cantidad de información (textos, videos, reconstrucciones 3D, etc.), por lo que el espacio físico de la exposición ya no limita la cantidad de información presentada en el museo. Igualmente, es posible la creación de colecciones virtuales de objetos, que de otra manera sería imposible reunir en un mismo espacio, así como lugares de participación activa para los visitantes, como pueden ser: foros de debate, libros de visitas virtuales, etc. De esta manera, se da total control al visitante a la hora de elegir el tipo y cantidad de información que desea recibir en todo momento, convirtiendo la exposición en un espacio libre y adaptable a todo tipo de visitantes.

ON-LINE MUSEUM

The establishment of an on-line virtual network permits the storage and presentation of a huge amount of information (texts, videos, 3D reconstructions, etc.) and therefore, the physical space of the exhibition does not restrict the amount of information presented in the museum. Likewise, it is possible the creation of virtual collections of objects which would be impossible to join in the same site, as well as places of active participation for visitors as debate forums, virtual guestbooks, etc. In this way, full control is provided to visitors to choose when, which type and the amount of information which they wish to receive at all times, turning the exhibition into a free, adaptable space to all kind of visitors.



PRESENTACIÓN DE INFORMACIÓN Y MATERIALES

Cada micro-museo cuenta con diferentes áreas de exposición e interacción de acceso libre. Vitrinas y escaparates sirven para la presentación de reconstrucciones y réplicas de objetos arqueológicos, mientras que pantallas táctiles y códigos QR permiten el acceso a información en red. En este sentido, la incorporación del Mobile Learning cobra gran importancia dentro de la propuesta museográfica. Una vez conectados a la red wi-fi del micro-museo, los visitantes pueden seleccionar y visualizar un gran abanico de información (audioguías, juegos infantiles, videos, etc.) a través de sus smartphones y tablets. De este modo, la utilización de estos dispositivos favorece el aprendizaje mediante el juego, la interacción y la participación de los visitantes.

PRESENTATION OF INFORMATION AND MATERIALS

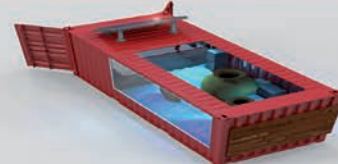
Each micro-museum has different exhibition and interaction areas. Glass cabinets and shop windows are used for the presentation of reconstruction and replicas of archaeological objects, whereas tactile screens and QR codes allows the access to on-line information. The incorporation of Mobile Learning gets great importance in the museum proposal. Once connected to the micro-museum Wi-Fi net, visitors can select and visualize a wide variety of information (audio-guides, children games, videos, etc.) through their smartphones and tablets. Therefore, the use of these devices facilitates the learning through the interaction and participation of visitors.

EXPERIENCIAS SENSITIVAS

La estimulación de los sentidos y sensaciones durante la visita de la exposición es clave para la formación de la experiencia del visitante. La creación de ambientes sensoriales a través de luces ambientales, sonidos y olores, transportan y conectan al visitante con el medio físico que caracteriza la disciplina subacuática –el fondo marino-, así como con el material expositivo –pecios, estructuras sumergidas, etc.- De igual modo, la interacción táctil de reproducciones facilita el acercamiento y conexión con el material arqueológico.

SENSITIVE EXPERIENCES

The stimulation of senses and sensations during the visit of the exhibition is fundamental to the visitors' experience. The creation of sensitive atmospheres through ambient lights, sounds and smells, take and connect the visitor to the physical environment which defines the underwater discipline –the seabed- as well as to the exhibition material –shipwrecks, sunken structures, etc.- Likewise, the introduction of object handling eases the approach and connection with the archaeological material.



Y LA TIENDA DE RECUERDOS?

Uno de los mecanismos de obtención de ingresos más utilizados por galerías y museos es la apertura de pequeñas tiendas de recuerdos para los visitantes. Dado que el espacio del micro-museo es muy limitado, se ha optado por la creación de pequeños quioscos transportables, emplazados en comerciantes locales, para la venta de recuerdos y merchandising. Igualmente, una pequeña tienda On-line facilitará la compra de productos desde el propio módulo expositivo.

WHAT ABOUT THE SOUVENIR SHOP?

One of the most popular mechanisms to obtain income for galleries and museum is the opening of small souvenir shops for visitors. Due to the fact that the area provided for the micro-museum is really limited, it has been considered the possibility of tiny, transportable kiosks, allocated in commercial premises, to sell souvenirs and merchandising. In the same way, a small on-line shop will make easier the sale of products from the exhibition module itself.

CONCLUSIONES

La creación de espacios expositivos singulares, que respondan tanto a las demandas de los investigadores así como del público, es posible sin la inversión de grandes cantidades de dinero. Así mismo, la incorporación de las nuevas tecnologías y del Mobile Learning, permiten una comunicación entre exposición y visitantes mucho más dinámica, interactiva y divertida. De igual modo, sólo captando la atención del visitante, mediante la estimulación de sus sentidos, se logrará que el mensaje recibido durante la visita perdure en su memoria de manera efectiva. No obstante, sigue siendo necesario un mayor estudio sobre los procesos de aprendizaje así como de las motivaciones e intereses de los visitantes, que permitan la creación de exposiciones de mayor atractivo para el gran público.

CONCLUSIONS

The creation of singular exhibition areas which meet the demands of investigators as well as public is possible without the investment of huge amounts of money. Furthermore, the incorporation of new technologies and Mobile Learning eases a much more dynamic, interactive and entertaining communication between exhibition and visitors. Likewise, only catching the visitors' attention, through the stimulation of their senses, will ensure that the message received during the visit effectively lingers on their minds. However, it is still necessary a detailed study about the learning processes as well as the motivations and interests of the visitors, which will allow the establishment of more appealing exhibitions to the public.

METODOLOGÍA: NUEVAS TECNOLOGÍAS

METHODOLOGY: NEW TECHNOLOGIES

El uso de nuevas tecnologías para el acceso a la información histórica manuscrita en soporte digital. El Proyecto Galeón

The use of new technologies to access to handwritten historical information in digital form. Galeón Project

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Resumen: la investigación histórica en archivos obliga a realizar un amplio trabajo de revisión de miles de documentos que, en muchos casos, no tienen relación con el tema de estudio, generando un importante gasto en tiempo y recursos. Para dar respuesta a este problema en relación al estudio del patrimonio arqueológico subacuático, desde el CAS-IAPH se ha ideado el Proyecto Galeón, cuyo objetivo es desarrollar soluciones innovadoras para consultar grandes conjuntos digitalizados de documentos históricos manuscritos. Actualmente no es posible la transcripción automatizada de un gran volumen de imágenes de documentos manuscritos, pero

el desarrollo tecnológico en el campo del reconocimiento formal de palabras, puede simplificar este proceso. Para ello se ha ideado un modelo teórico de Búsqueda de Palabras Claves (BPC) basado en Grafos de Palabras (GP), que, además de para el patrimonio cultural marítimo, podría utilizarse para otros temas de investigación.

Palabras clave: técnicas de reconocimiento de textos manuscritos, grafos de palabras, búsqueda de imágenes e indexación, patrimonio cultural, arqueología subacuática.

Abstract: Historical research in archives forces to realize an extensive work of reviewing thousands of documents that, in many cases, have no connection with the subject matter, generating a significant expenditure of time and resources. To address this problem in relation to the study of underwater archaeological heritage, from the CAS-IAPH has been devised the Galleon Project, which aims to develop innovative solutions to query large sets of historical documents digitized manuscripts. Nowadays It is not possible the automated transcription of a large volume of images from handwritten documents, but the development in the field of formal recognition of words, can simplify this process. For this we have developed a theoretical model to identify Keywords based on Graphs of Words (GP), which, as well as in the maritime cultural heritage, could be used for any research topic.

Key words: Handwritten text recognition technology, word-graph based keyword spotting, image spotting and indexing, cultural heritage, underwater archaeology.

Introducción

Desde la más remota Antigüedad hasta la invención del tren y el avión, el barco fue el principal medio de transporte. Por diferentes causas (accidentes durante la navegación, tormentas, huracanes, conflictos armados, etc.) muchos de ellos no llegaron a puerto, preservándose en el fondo de los océanos, ríos y lagos un gran número de pecios históricos que esconden buena parte de la historia marítima y comercial de diferentes países. En los últimos años se ha producido un gran desarrollo técnico en el campo de la exploración marina, lo que está permitiendo conocer mejor este importante legado cultural, cuyo atractivo histórico, significado, belleza y autenticidad, le convierten en un recurso más a tener en cuenta en los programas regionales de desarrollo económico.

El patrimonio arqueológico subacuático, sin embargo, conforma una de las realidades patrimoniales peor conocidas. Frente a la arqueología terrestre, ampliamente representada por multitud de proyectos y líneas de investigación, la subacuática se encuentra escasamente apoyada y desarrollada, fruto, entre otros factores, de la juventud de esta disciplina. Durante los últimos años el número de yacimientos arqueológicos subacuáticos conocidos, inventariados y protegidos ha ido en aumento, si bien este es aún escaso si atendemos al alto potencial de naufragios históricos que pone de manifiesto la investigación de las fuentes de información custodiada en archivos y bibliotecas. Unos pecios que, al igual que los inventariados y estudiados con metodología arqueológica, debemos conocer y documentar para protegerlos y, paulatinamente localizarlos, estudiarlos y conservarlos como parte de nuestro legado histórico-cultural.

Todo proyecto de investigación histórica debe fundamentarse sobre el estudio de las fuentes de información que, en función de la naturaleza de los bienes que hay que analizar y del periodo histórico al que pertenecen, pueden ser de diferente naturaleza. Recuperar la historia económica de un antiguo asentamiento del Valle del Nilo, de Mesopotamia, el Egeo, etc., pasa imprescindiblemente por el análisis multidisciplinar de las evidencias materiales

conservadas en los contextos arqueológicos. Pero también, allá donde se han conservado textos escritos en cualquier tipo de soporte, es necesaria la lectura y estudio de estas fuentes históricas, al objeto de conocer el testimonio de las personas que directamente se vinculaban con esa actividad.

Dependiendo del pasado cultural de la zona del planeta en que nos encontremos, estas fuentes de información escrita pueden remontarse a momentos más o menos antiguos. Para el caso de España, a pesar de contar con una importante tradición literaria greco-latina y una abundante información epigráfica, la información histórica que proporcionan es bastante escasa y sesgada para analizar aspectos tales como el que nos ocupa: la actividad comercial marítima en general y el estudio de los naufragios en particular.

Conocer la navegación y el comercio marítimo de cualquier zona del territorio español con anterioridad a la Baja Edad Media pasa, casi con exclusividad, por un análisis arqueológico de los restos conservados en yacimientos terrestres y subacuáticos, única fuente de información con la que cuentan los historiadores ante la escasez y parquedad de datos recogidos en las fuentes escritas, hasta ese momento más preocupadas por asuntos tales como los político-administrativos y los religiosos.

A partir del siglo XIII se produce un cambio de la situación. El desarrollo de la vida urbana y de las transacciones comerciales a gran escala fueron imponiendo cada vez más la necesidad de dejar constancia escrita de, entre otros temas, los acuerdos y negocios entre los Estados, los particulares o entre ambos, favorecida a partir del siglo XV con el desarrollo de la imprenta.

En España este punto de inflexión lo conforma la promulgación en 1503 por parte de la reina Isabel la Católica de la pragmática de Alcalá de Henares, en la que se regulaba, entre otros asuntos, el registro y conservación de toda la documentación administrativa. Desde ese momento este tipo de registros debían custodiarse encuadrados, siendo considerado este hecho para muchos investigadores como la partida de nacimiento de los archivos notariales.

Si bien el estudio arqueológico de los restos materiales conservados en cualquier naufragio antiguo nos permitía recuperar datos sobre las mercancías objeto de comercio, las rutas comerciales, los conocimientos náuticos y el sistema constructivo y, en el mejor de los casos, determinados aspectos relacionados con la vida a bordo, para momentos posteriores al siglo XIII la interpretación de este tipo de yacimientos se ve reforzada con la riquísima información recogida en los archivos históricos. Su análisis permite descubrir la vida del buque, desde su salida de la grada de construcción hasta su hundimiento, además de aspectos tales como los propietarios de los barcos, nacionalidad, nombre del piloto y de toda la tripulación, propietarios, características y valor de las mercancías, seguros marítimos que la cubrían y compañías que se dedicaban a ello, procedencia de la artillería, sistemas constructivos, además de aspectos tales como las costumbres y mentalidades de la gente del mar.

Una amplia y variada documentación repartida en multitud de archivos de diversa naturaleza (generales, municipales, militares, privados, etc.) que, por su origen (administrativo, judicial, religioso, privado, etc.), generó a lo largo de los siglos una gran diversidad de tipos y series documentales específicas que es preciso caracterizar y localizar como paso previo a cualquier proceso de estudio. Un fondo documental de millones de documentos que se encuentran ordenados y sistematizados según criterios archivísticos diferentes, provistos irregularmente de instrumentos de descripción (guía, índices, inventarios y catálogos) para facilitar el acceso y recuperación de los mismos y cuya base es el uso de términos normalizados (descriptores) de carácter, principalmente, onomástico, cronológico, geográfico, numérico y temático, este último, sin duda, el de mayor interés para los investigadores.

En función del nivel de descripción alcanzado para cada una de las secciones o series de archivos, y de la particularidad de la temática que se desea analizar, los términos normalizados de carácter temático pueden convertirse en un importante aliado del investigador, restringiendo considerablemente la ingente labor de búsqueda y lectura de documentos. En caso contrario, la búsqueda se hace más compleja, al tener que enfrentarse el investigador a la siempre ardua tarea de consultar miles de documentos que, en su mayor parte, no suelen ser de interés para la temática de estudio, con importantes consecuencias para el investigador en tiempo de dedicación y recursos.

Justificación del proyecto

Cuando se descubre un barco hundido, uno de los principales problemas para los arqueólogos consiste en identificarlo, determinando su nombre e historia. Partiendo de la información proporcionada por los escasos restos materiales hallados, es preciso rastrear en los archivos históricos aquellos datos que permitan su identificación, a partir de la nacionalidad, propietario, detalles de la artillería, sistema constructivo o el inventario de la carga que transportaba en su último viaje. Encontrar estos datos entre cientos de miles de documentos no indexados es una labor que consume gran cantidad de tiempo y recursos de investigación.

Los archivos guardan la historia de cientos de miles de naufragios históricos aún por localizar, datos que son la base para definir zonas de alto valor patrimonial y priorizar estrategias de investigación y/o protección. Junto a ello, la documentación cartográfica náutica, analizada desde una perspectiva espacial (ya sea diacrónica o sincrónica), es de gran utilidad para conocer cómo era el paisaje por el que navegaba cuando aconteció el naufragio, además de identificar la evolución que ha tenido a lo largo de los siglos, definiendo zonas de riesgo para la navegación (asociado a zonas de concentración de naufragios), nivel de aterramiento-erosión del lecho marino y, por ende, de enterramiento o exposición de los pecios (vinculado a la posibilidad de localizar pecios mediante técnicas de prospección superficial), etc. Líneas de investigación que consideramos imprescindibles para perfilar una correcta política de gestión de este patrimonio en relación con su investigación, protección y preservación y frente al posible impacto negativo asociado a procesos naturales o de obras en el litoral.

Desde el Área de Documentación del Centro de Arqueología Subacuática del Instituto Andaluz del Patrimonio Histórico (en adelante CAS-IAPH) se ha venido trabajando desde 1998 en esta línea, desarrollando un amplio proceso de investigación documental con cuatro objetivos bien definidos (Alonso/Márquez, 2013):

- Identificar las fuentes documentales relativas al patrimonio arqueológico subacuático andaluz, analizando su distribución geográfica y caracterizando las series documentales de mayor interés.
- Diseñar estrategias para la investigación y explotación de estas fuentes documentales.
- Sistematizar su información mediante el uso de herramientas de gestión normalizadas en cada uno de sus campos temáticos.
- Desarrollar proyectos propios de investigación para identificar el patrimonio cultural subacuático andaluz.

La labor directa de investigación realizada por el CAS-IAPH desde su creación ha sido amplia y productiva, si bien la limitación de los recursos disponibles para estos fines y la imposibilidad de realizar acuerdos de colaboración con grupos de investigación específicos, debido a la escasa implantación de la arqueología subacuática en el ámbito académico universitario, han condicionado considerablemente su desarrollo. Tras el proceso de identificación,

localización y caracterización de las instituciones y series documentales de mayor interés para el objeto de nuestro trabajo, se puso en marcha un amplio proyecto de investigación para la explotación de las mismas en diferentes fases y niveles. En la actualidad nuestro sistema de gestión de la información (SIGnauta) cuenta con cerca 1600 registros de naufragios para aguas andaluzas (Alonso *et alii*, 2007), superando los 377 inicialmente conocidos a través de diferentes trabajos de investigación (Chaunu, 1983; Serrano, 1991; García-Baquero, 1988; Lakey, 1987, entre otros).

Abordar una línea de estudios tan compleja y extensa como la de explotar la ingente documentación custodiada en los archivos históricos (nacionales e internacionales) es una labor que, con la metodología actual de estudio, solo es posible tras muchos años de esfuerzos por parte de un amplísimo equipo humano de trabajo, motivo por el que, desde 2012, el CAS-IAPH se planteó, en colaboración con el Centro de Reconocimiento de Formas y Tecnologías del Lenguaje (PRHLT) de la Universidad Politécnica de Valencia¹, diseñar un proyecto basado en el uso de las nuevas tecnologías para la indexación de términos no transcritos a partir de imágenes de documentos manuscritos, estrategia en la que nace el Proyecto Galeón que aquí presentamos.

Objetivos del proyecto

Los fondos de los archivos históricos conforman un importante legado cultural en los que se guardan aspectos aún no conocidos de nuestra historia política, social, económica y científico-tecnológica. La necesidad de conservar la herencia cultural escrita y hacerla accesible a la sociedad ha impulsado, en las últimas décadas, numerosos proyectos de digitalización y de mejora de la accesibilidad a través de buscadores y portales web especializados en el marco de una política de *Open Access*. Como resultado de ello, están disponibles para su visualización y estudio gran cantidad de imágenes digitales (cientos de terabytes de memoria de almacenamiento). Sin embargo, el verdadero problema, el de la accesibilidad selectiva a los contenidos textuales de dichas imágenes, está aún pendiente de resolver. Nos referimos a la posibilidad de buscar y encontrar entre millones de imágenes aquellas páginas que específicamente contienen los datos o informaciones que interesan para cada línea de investigación.

Con este fin nos planteamos desarrollar una propuesta teórica para buscar soluciones innovadoras, escalables y de bajo coste, que permitan realizar consultas documentales en grandes colecciones de imágenes de textos históricos manuscritos. Las herramientas a desarrollar deberían permitir para ello la localización de palabras previamente definidas entre una gran cantidad de legajos y documentos de series concretas. Como ámbito de aplicación se ha definido la posibilidad de trabajar sobre series específicas de los fondos del Archivo General de Indias (AGI), sin duda uno de los de mayor interés desde la perspectiva nacional e internacional para la arqueología subacuática.

El AGI conforma un depósito documental de gran valor que ilustra la historia del Imperio español de las Américas y las Islas Filipinas. Este archivo, declarado por la Unesco patrimonio de la humanidad en 1987, está compuesto por 43000 legajos, distribuidos a lo largo de ocho kilómetros de estanterías, con unos 80 millones de páginas. Entre sus series de mayor interés para la arqueología subacuática, están las de Indiferente de Justicia y Gobierno (1492-1870), generadas en base a los pleitos habidos entre armadores, aseguradoras y comerciantes en demanda de resarcimiento por pérdidas causadas por naufragio de la embarcación.

¹ <https://www.prhlt.upv.es/> [Acceso 21-01-2015].

El AGI tiene buena parte de sus fondos digitalizados, pero en la actualidad la cantidad de páginas transcritas en comparación con la ingente masa documental histórica que custodia no es significativa. Debido a la dificultad para segmentar estos textos en caracteres tampoco es posible realizar búsquedas con técnicas tradicionales de reconocimiento óptico (OCR). Es obvio que la transcripción completa de los archivos es una tarea colosal, tan cara desde una vertiente económico-temporal que no es realista a medio plazo. Por otro lado, las técnicas que se utilizan actualmente para la transcripción automatizada o asistida aún no están suficientemente desarrolladas. Habrá que esperar años para comenzar a obtener resultados en este campo, por lo que la solución debía venir por otra vía.

Las palabras son elementos importantes del lenguaje que aportan, de manera directa, una información explícita acerca del asunto o temática sobre la que versan los documentos. Definir el número de términos o palabras de interés para efectuar búsquedas temáticas encaminadas, por ejemplo, a la localización de información sobre naufragios históricos, es una labor bien definida y abarcable a corto plazo, pero incluir los mismos en los instrumentos de descripción al uso en cada archivo se convierte ya en un proyecto difícilmente ejecutable a medio o largo plazo, máxime si se hace extensible a muchos otros campos de investigación, más allá de los de interés exclusivo para la arqueología subacuática.

Los avances que a nivel de las nuevas tecnologías se están produciendo en los últimos años de la mano del reconocimiento automatizado de caracteres impresos y manuscritos en soporte digital y de la traducción automatizada, introducen nuevas perspectivas de desarrollo en este campo que es necesario explorar. Hoy día es posible indexar imágenes de documentos manuscritos de forma que se pueda realizar sobre las mismas búsquedas de texto libre. En este tipo de búsquedas es difícil predecir de antemano cuáles son los términos o palabras claves que van a ser útiles al usuario de la herramienta para localizar la información deseada. Lo ideal sería permitir al investigador o usuario una búsqueda libre, es decir, utilizar en dicha operación cualquier palabra. Sin embargo, como comentaremos más adelante, por motivos de eficacia la mejor opción es partir de un lenguaje normalizado previamente. Es decir, de un glosario de palabras claves o descriptores definidos previamente para un campo específico de estudio, en nuestro caso, términos vinculados al naufragio o a la recuperación de buques históricos.

Metodología de trabajo. Situación actual

Hasta el momento actual, la búsqueda de información textual sobre cientos de miles o millones de imágenes de manuscritos históricos se suele considerar inviable, pues las tecnologías prevalentes para esta tarea conllevan costes prohibitivos en términos computacionales y/o de recursos humanos. Por ello, se suele abordar a través, principalmente, de dos tipos de estrategias:

- La primera consiste en usar técnicas de reconocimiento óptico (OCR) sobre texto electrónico. Pero para esto el paso previo es convertir las imágenes en texto; es decir, hay que realizar un proceso previo de transcripción manual o semiautomática.
- La segunda se basa en técnicas conocidas en inglés como *Key Word Spotting* (KWS), a las que nos referiremos por su traducción directa como «Búsqueda de Palabras Clave» (BPC).

El punto débil de la primera aproximación es el coste prohibitivo en recursos humanos necesarios. Esto es obvio si la transcripción se lleva a cabo de forma puramente manual (como suele ser el caso generalmente). Pero aún en el caso de usar la tecnología del Reconocimiento de Texto Manuscrito (RTM), estas no están lo suficientemente desarrolladas para producir resultados utilizables en el campo de la investigación documental histórica. Los productos comerciales de transcripción están basados en la tecnología de reconocimiento de caracteres aislados

(OCR en inglés) desarrollada durante las dos últimas décadas. Esta tecnología requiere una segmentación de las imágenes a nivel de carácter, que es prácticamente imposible aplicar en la documentación textual manuscrita.

Por otro lado, las aproximaciones holísticas modernas al RTM (Bazzi/Schwartz/Makhoul, 1999; Marti/Bunke, 2001: 65-90; Toselli *et alii*, 2004: 519-539) no necesitan ningún tipo de segmentación a nivel de carácter o palabra. En el actual estado de desarrollo, los prototipos del RTM pueden alcanzar niveles de precisión que oscilan entre el 60% y el 90% de palabras bien reconocidas (Marti/Bunke, 2001: 65-90; Toselli *et alii*, 2004: 519-539) para textos manuscritos de gran calidad. Sin embargo la precisión suele degradarse muy significativamente para textos históricos. En las figuras 1, 2 y 3 se muestran algunas imágenes de textos de interés para el Proyecto Galeón. En general la precisión esperada es demasiado baja para ser usada directamente en sistemas de búsqueda de texto convencionales. Además, dada la elevada tasa de error, el coste humano de corregir los errores también es prohibitivo para los grandes volúmenes de imágenes involucrados. Lamentablemente, esto sigue siendo cierto incluso si se utilizan técnicas recientes de transcripción interactiva con las que el esfuerzo humano se puede reducir notablemente (Romero/Toselli/Vidal, 2012).

Una alternativa reciente que puede abaratar considerablemente los costes humanos de transcripción es el planteamiento de colaboración conocido como *Crowdsourcing*. En este mar-



Figura 1. Los protocolos notariales son una fuente de gran valor para localizar información sobre testamentos de náufragos o contratos de compraventas de embarcaciones y mercancías (Fondo gráfico CAS-IAPH. Foto: L. Márquez).



Figura 2. El Archivo General de Indias es el organismo en el que se conserva un mayor volumen de información sobre naufragios históricos.

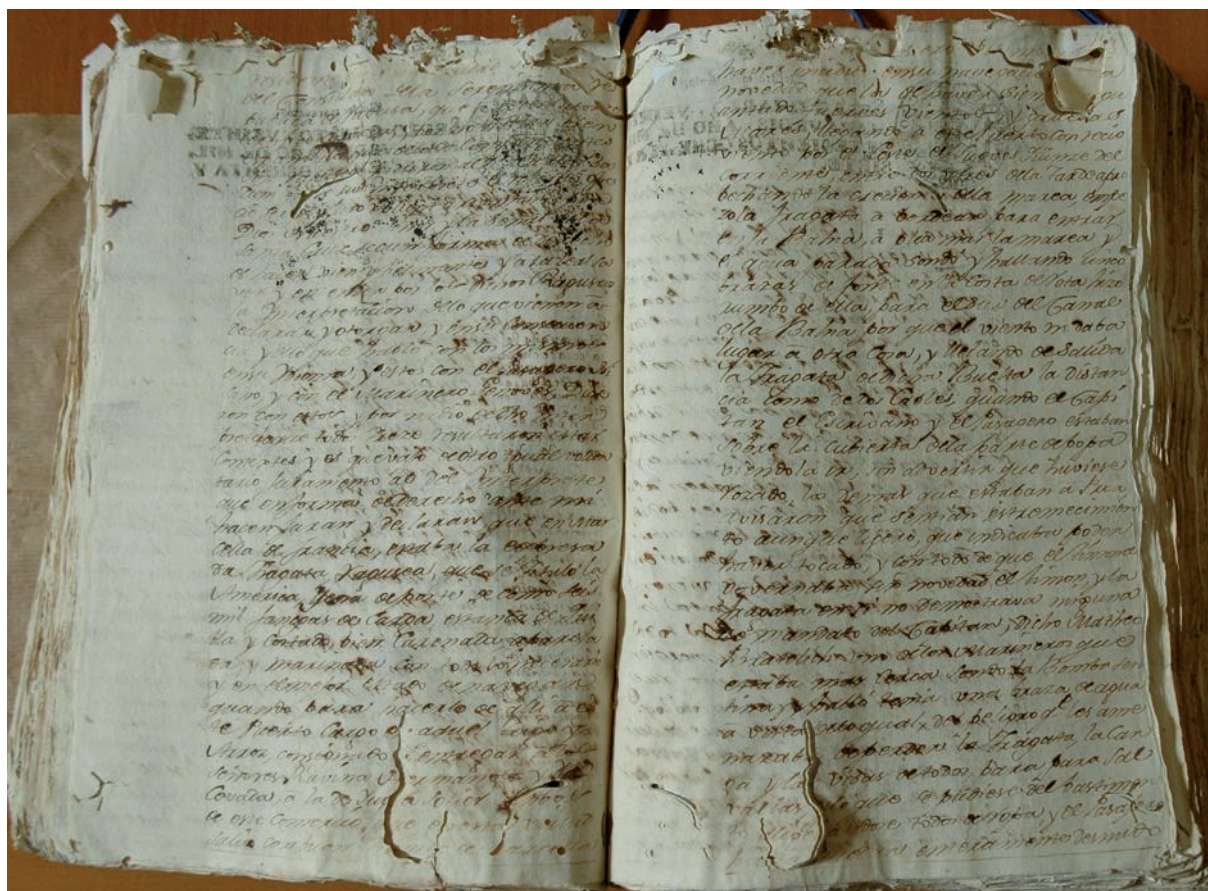


Figura 3. El mal estado de conservación de los documentos es uno de los problemas que se plantean para la aplicación de reconocimiento formal de caracteres manuscritos.

co, una gran cantidad de personas, no necesariamente expertas, colaboran de manera voluntaria y gratuita, anotando, editando, corrigiendo, transcribiendo o traduciendo grandes colecciones. Este sistema ha logrado notables éxitos en otros campos, como por ejemplo en la comunidad Galaxy-Zoo², que ha contribuido a clasificar millones de galaxias, o en el programa de digitalización de prensa llevado a cabo por la Biblioteca Nacional de Australia³ donde se han corregido centenares de miles de páginas producidas por sistemas de OCR. Recientemente se ha utilizado en proyectos de transcripción de textos manuscritos tales como «Old Weather»⁴ y «Ancestry.com's World Archives»⁵ donde el material se presentaba en forma de formularios, segmentado o al menos de manera fácil de descifrar y comprender.

Un paso más allá lo dan los proyectos «Transcribe Bentham»⁶ y «TranScriptorium»⁷. En el primero de ellos se realiza la transcripción manual directa de los manuscritos del famoso filósofo y reformador inglés del siglo XVIII y XIX Jeremy Bentham. Mientras que en TranScriptorium, los voluntarios utilizan un prototipo de asistencia predictiva de tal manera que interactúan con el sistema automático guiándolo para encontrar la transcripción perfecta de los textos (Romero/Toselli/Vidal, 2012).

Lamentablemente, el sistema de *Crowdsourcing* no es directamente utilizable en los documentos de interés para la arqueología subacuática pues el volumen de imágenes de interés que hay que transcribir es muchísimo mayor y de mucha mayor dificultad que en los casos comentados.

La segunda aproximación arriba indicada, de «Búsqueda de Palabras Clave» BPC, consiste en localizar las posiciones en documentos o colecciones donde es probable que una (o varias) palabra(s) dada(s) aparezcan. Con esta técnica, el grado mínimo de probabilidad, o «confianza», de cada búsqueda lo especifica el usuario de forma más o menos explícita. En BPC podemos encontrar dos planteamientos, llamados *query-by-example* y *query-by-string*. El primero de ellos necesita una imagen de ejemplo para encontrar imágenes similares.

Encontrar imágenes adecuadas de una palabra de interés en los citados documentos es una tarea ardua. Generalmente, para localizar un ejemplo del término que se busca hay que examinar una ingente documentación hasta encontrar una muestra suficientemente representativa. Además, la grafía de las palabras puede ser variable en función de la cronología. Incluso para un mismo periodo de tiempo, se observa una gran variedad de estilos, dependiendo del escribano; e incluso para un mismo escritor, dependiendo del momento y posición en que escribió, si el texto era original o copia, etc. Por otra parte, por motivos computacionales la escalabilidad de las técnicas de *query-by-example* es muy limitada, no permitiendo obtener ventaja del contexto textual en el que está escrita la palabra que se busca para aumentar la precisión de la búsqueda.

El planteamiento de BPC mediante *query-by-string* es más reciente. En este caso, el usuario especifica el término que busca como una cadena de caracteres (o *string*) (Frinken/Fischer/Manmatha, 2010: 352-357; Khurshid/Faure/Vincent, 2012: 2598-2609; Marinai/Marino/Soda, 2006: 1187-1199; Rodríguez-Serrano/Perronnin, 2009: 351-355; Vamvakas *et alii*, 2008: 525-532). La mayoría de estas técnicas requieren una presegmentación a nivel de carácter o de palabra, obteniéndose buenos resultados principalmente en documentos impresos. En el caso de textos manuscritos, solo unas pocas aproximaciones (Rodríguez-Serrano/Perronnin, 2009: 351-355;

² <http://www.galaxyzoo.org> [Acceso 21-01-2015].

³ <http://trove.nla.gov.au/system/stats#corrections> [Acceso 21-01-2015].

⁴ <http://www.oldweather.org> [Acceso 21-01-2015].

⁵ <http://landing.ancestry.com/wap/learnmore.aspx> [Acceso 21-01-2015].

⁶ <https://www.ucl.ac.uk/Bentham-Project> [Acceso 21-01-2015].

⁷ <http://www.transcriptorium.eu> [Acceso 21-01-2015].

Frinken/Fischer/Manmatha, 2010: 352-357) han sido probadas con un éxito relativo. La mayoría de estas técnicas se basan más o menos explícitamente en información derivada de algún proceso de RTM. Entre los trabajos recientes que siguen esta tendencia hay que reseñar los siguientes (Fischer *et alii*, 2012: 934-942; Frinken *et alii*, 2012: 211-224; Toselli *et alii*, 2013). De ellos, las mejores prestaciones de BPC se obtienen con el método propuesto por Frinken y otros (Frinken *et alii*, 2012: 211-224), basado en redes neuronales recurrentes.

Este método resulta inviable en la práctica, debido al exorbitante coste computacional de su fase de entrenamiento. Además, el método que se propone en Fischer y otros (2012: 934-942) se basa en un modelado morfológico de los caracteres mediante modelos ocultos de Markov (en inglés *Hidden Markov Models*, HMM) de caracteres. Aunque sus prestaciones de BPC son inferiores, su coste de entrenamiento es muchísimo más bajo. No obstante la búsqueda «sobre la marcha» inherente a este método, resulta prohibitiva, incluso para colecciones relativamente pequeñas. En un trabajo posterior (Toselli/Vidal, 2013: 501-505), Toselli y Vidal reducen este coste drásticamente gracias a una representación de las imágenes de texto mediante grafos de caracteres, manteniendo las prestaciones de BPC originales.

Como conclusión podemos decir que las aproximaciones tradicionales BPC requieren altos costes computacionales debido, sobre todo, al proceso de entrenamiento necesario, o bien, a la necesidad de explorar todo el espacio de búsqueda en tiempo de consulta. En cualquiera de los dos casos, la puesta a punto del sistema sería prohibitivamente lenta.

Como opción, nos planteamos que una aplicación de estas características debería fundamentarse en las técnicas introducidas por Toselli, Vidal y otros (en Toselli *et alii*, 2013), basadas en Grafos de Palabras (GP) derivados de RTM. Estas técnicas tienen la ventaja de facilitar el uso de un modelo de lenguaje durante el proceso de reconocimiento, gracias al cual se dispone de valiosa información derivada del contexto léxico, lo que permite realizar búsquedas mucho más precisas.

Objetivos del proyecto

Como se acaba de mencionar, nuestro principal objetivo va encaminado a diseñar un modelo teórico de trabajo para desarrollar y adaptar la tecnología de Búsqueda de Palabras Claves (BPC) basada en Grafos de Palabras (Toselli *et alii*, 2013) a la localización de información en documentación histórica de carácter textual manuscrita relacionada con el patrimonio cultural subacuático (si bien aplicable a cualquier otro campo del saber) en fondos de archivos. Para ello apostamos por un modelo que, partiendo de la indexación de un conjunto de términos suficientemente amplio para permitir trabajar sobre grandes volúmenes documentales, sea capaz de realizar búsquedas probabilísticas y recuperar la información jerárquica no convencional de manera rápida con diferentes niveles de granularidad (línea, página, legajo, etc.) y con un parámetro de confianza que ayude a definir el equilibrio deseado entre precisión y cobertura.

Resultados esperados

El modelo propuesto de BPC puede desarrollarse según medidas probabilísticas sobre la confianza de que una palabra aparezca (o no) en una línea, página, documento, legajo o colección. Usando estructuras de datos adecuadas (construidas en una fase preparatoria) que soporten los índices y la correspondiente información probabilística, la carga computacional necesaria para cada búsqueda puede ser insignificante y prácticamente independiente del número de imágenes de las colecciones consideradas. Incluso para inmensos volúmenes de documentos, los tiempos de búsqueda esperados pueden ser de alrededor de unos pocos segundos.

Con Galeón queremos estudiar el alcance de estas técnicas, así como su escalabilidad y viabilidad para ser usadas en aplicaciones a gran escala. Una técnica que permitiría, en un futuro:

- Realizar búsquedas de manera automatizada sobre grandes volúmenes de imágenes de texto manuscrito sin necesidad de transcribirlas previamente.
- Obtener resultados empíricos sobre la viabilidad y escalabilidad del uso de estas técnicas en tareas de indexación en colecciones de gran volumen documental.
- Orientar la planificación de futuras propuestas de proyectos de indexación y búsqueda de gran envergadura.
- Generar índices jerárquicos para conjuntos representativos de imágenes de texto manuscrito de series de interés para la investigación del patrimonio arqueológico subacuático.
- Y, sobre todo, reducir considerablemente el coste de la fase de investigación documental necesaria para, en este caso, el estudio del gran número de naufragios que reposan en las aguas de España, Portugal y América, si bien, es evidente que este modelo podría ser aplicado a cualquier otro fondo documental manuscrito (independientemente de la temática de investigación), previa definición de las correspondientes palabras claves y del imprescindible proceso de enseñanza-aprendizaje del sistema.

Sin duda una base firme para futuras acciones de transferencia tecnológica a la industria o para otros posibles modelos de explotación.

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Successful use of temporary underwater 3D documenting methodology: Early Roman barge from Ljubljana river, Slovenia

Uso exitoso de la metodología de documentación 3D subacuática: una embarcación romana del río Ljubljana, Eslovenia

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Abstract: After a long period of learning photogrammetric methodologies for documentation of underwater archaeological sites, which we started in eastern Adriatic 15 years ago on the island of Silba, we finally got an opportunity to replace old site documenting methods based on measuring with contemporary possibilities offered by rapidly progressive development of 3D documentation. Despite our desire to carry out simultaneously also the previous standard documentation procedure using tape measurement to demonstrate the many advantages of using 3D documentation, due to the lack of time and adverse weather conditions it had to be abandoned. On this early Roman barge site in river Ljubljanica we demonstrate and prove that the new methodology of documenting underwater sites extremely facilitates archeological fieldwork. As it was expected, it turned out that contemporary approaches are much cheaper due to significantly shorter underwater data acquisition, more accurate documentation and due to shorter diving times required for data acquisition also greatly increased safety.

Key words: Photogrammetry, 3D modeling, comparative analysis, early Roman barge, river Ljubljanica.

Resumen: después de un largo periodo de aprendizaje de metodologías fotogramétricas para la documentación de sitios arqueológicos subacuáticos, que iniciamos en la isla de Silba (Adriático Este) hace 15 años, finalmente nos dieron la oportunidad de reemplazar los viejos métodos de documentación –basados en mediciones– por las nuevas posibilidades de documentación 3D. Pretendíamos realizar al mismo tiempo ambos procedimientos para demostrar las muchas ventajas del uso de documentación 3D, pero no pudo ser por falta de tiempo y condiciones meteorológicas adversas. En esta barcaza romana ubicada en el río Ljubljanica, demostramos y probamos que la nueva metodología para documentar yacimientos subacuáticos facilita extremadamente el trabajo de campo arqueológico. Resultó que era un procedimiento más barato debido a que la adquisición de datos bajo el agua es más rápida, la documentación más precisa y además en gran medida se aumenta la seguridad al necesitar tiempos de buceo más cortos para la adquisición de datos.

Palabras clave: fotogrametría, modelado 3D, análisis comparativo, barcaza fluvial romana, río Ljubljanica.

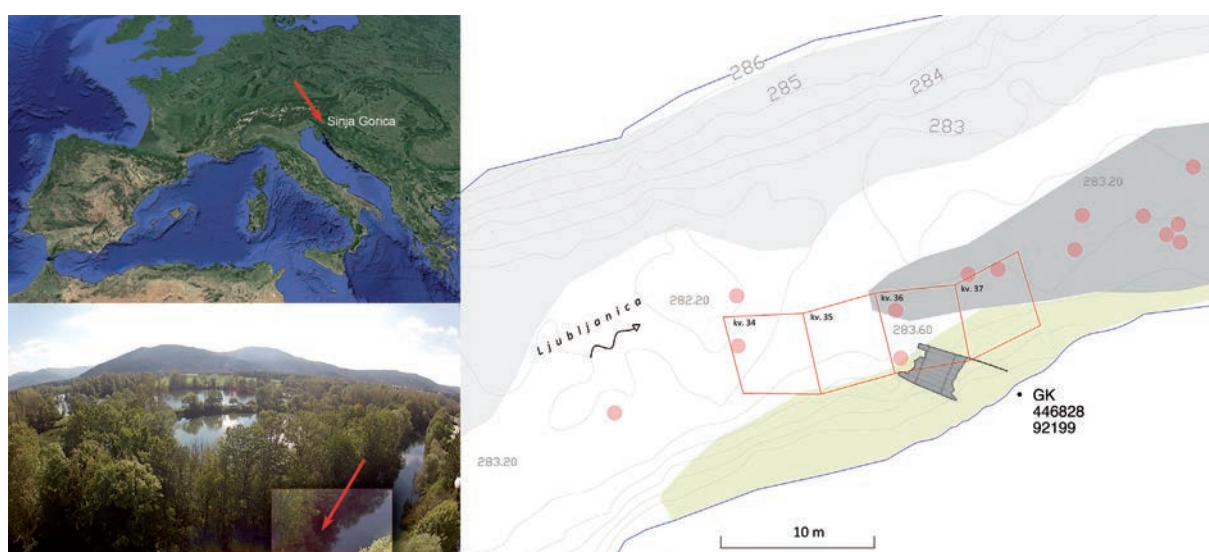


Figure 1. [Right] Position of explored part of early Roman barge in river Ljubljanica. Red squares shows the area of intensive underwater survey and red dots are positions of other findings. [Left bottom] Aerial landscape view of the site. View towards the south with the Javorč hill and Ljubljanski vrh hill from right back. (GoPro clip: Aleš Jaklič).

Introduction

A preventive underwater survey in September 2008 of the river bed of Ljubljana near Sinja Gorica (Vrhnika, Slovenia) revealed remains of a vessel (Fig. 1). A closer inspection of the exposed cross-section of the vessel indicated that the vessel could be a more than 16 m long barge with flat bottom and nearly vertical side planks coupled with iron clamps. A preliminary radio-carbon analysis of the wood indicated that it was built and used ca. 2000 years ago, when the nearby *vicus* Nauportus was controlled by important Aquileian merchant families and played also an important role in military shifts and in passing supplies.

Recently, reliable and fast open source photogrammetric software solutions for acquiring, processing, analysis and display of 3D layers of data appeared. These tools are of enormous help in modernizing the methodology of underwater archeological surveying to get better and much more accurate results that in the end result in better protection of underwater cultural heritage. These tools were tested for the first time in Slovenia on the site of the Roman barge in river Ljubljana at Sinja Gorica in October 2012. Data for the photogrammetric reconstruction was collected using underwater photography. The reconstructed 3D point cloud set then served for 3D modelling.

The Roman barge that had no cargo or other objects was first cleaned of recent sediments. Then the shape of the visible part of the barge was documented using in parallel manual survey and photogrammetry. The 3D model derived from the photogrammetric reconstruction was much more accurate and informative than the manually drawn documentation that contains 2D floor and side views, 2D cross sections and detailed drawings of individual construction elements. The 3D model enables almost as detailed examination and analysis of the vessel as observation *in situ*. Even archive photographs of extremely good quality, which are still needed, cannot match the 3D model.

Methodology

Contemporary photogrammetric methodology in underwater archaeology has a long history (Drap *et alii*, 2013), on the eastern coast of the Adriatic Sea as well (Erič *et alii*, 2013: 282, fig. 3-4). Its beginnings had the same limitations as photogrammetry on dry land conducted by remote sensing and GIS studies used primarily for geodetic purposes. Taking of underwater photographs in a manner to assure a precise alignment of photographs used to be a lengthy process, which was followed in the laboratory by marking corresponding points on stereo image pairs. This made underwater photogrammetric documentation more expensive than the manual or classic documentation, both because of the extensive underwater work and of the painstaking laboratory processing. Because of the limitations of time and money, the amount of photogrammetric measurements was, in the past, never sufficient for them alone to form the basis of field documentation and drawings of small finds and thus completely replace classic documentation.

Modern computer-based photogrammetric methods and tools, however, allow enough data to be captured to create a range of 3D images consisting of a dense point cloud where each point has all three coordinates. These image based 3D modelling methods are gaining a foothold also in land archeology (De Reu *et alii*, 2014).

Today, underwater photogrammetric collection of data is not only much more accurate and faster than classic documentation, but because of the shorter diving time necessary for taking photographs also faster, less expensive and safer. Of all the methods of underwater 3D

documentation, photogrammetry has become the most useful. To document the Early Roman barge from Sinja Gorica, we used a photogrammetric recording method to obtain a 3D model for the first time in Slovenia. The photogrammetric reconstruction from a set of photographs is completely automatic and consists of the following stages: identification of discriminative points in individual photographs, search of stable correspondence among these points in different photographs, automatic calibration of a set of photographs, construction of a dense cloud of 3D points that best describes the information available on input photographs and finally creation of a triangulated textured network.

Traditionally, photogrammetry consisted of two phases, photographic data acquisition, which can be performed very efficiently, and manual registration of photographs done on a computer, requiring tremendous effort by an experienced archaeologist. In order to ascertain whether the data are reliable photogrammetric 3D documentation we conducted also a comparative analysis of the two models recorded in two different days.

Acquisition data by photography

For the purposes of underwater 3D photogrammetry and acquiring a high detailed 3D model of the site, it is important to use proper equipment. It is true, that in ideal conditions you can work with almost any decent digital capturing device that is available to you, but it is always wise to get the most data out of the site and collect it with the best equipment one can get. There are many reasons to do so: (I.) you can document underwater and other sites in demanding, often low light and low visibility conditions in high detail. (II.) With the right equipment the workflow is smooth, dive times are shortened and best results are achieved. (III.) High detail images are important for later off-field analysis and future 3D modeling, when the algorithms will get even better. (IV.) Only high detail images, with low noise and no lens distortion will produce the best 3D models with the densest 3D point cloud. Currently (January 2015), we use a full frame (FX) digital SLR camera with 36MP with very low noise even at high ISO. At the time of documenting the Roman barge (October 2012) we used a cropped (DX) digital SLR camera with 12MP, with sharp lenses in a heavy-duty full aluminum casing. For 3D documentation no camera-mounted strobes can be used. Due to computing hardware limitations we processed all the photo sets in 1360×2050 pixel resolution, although we had captured them at 2850×4290 pixels.

For archeological field work and underwater documentation heavy duty and sturdy equipment is needed. Demanding environmental conditions can obstruct the work and push the limits of the camera. With low-end and mid-level cameras, the safety of divers and accuracy of 3D models will be in question. To shorten the time of the dive and keep accurate and valid data for further processing, high-end fast performing gear should be used. Before capturing any data one must be sure to use proper settings. If possible, use aperture f8.0 to f11.0, shortest possible shutter times no slower than 1/60 and lowest possible ISO not exceeding ISO 800 on DX or ISO 1500 on FX cameras.

These are the best settings for highest possible data input. In order to get enough light on the sensor when the conditions are not good, it is necessary to make compromises.

Opening the aperture will result in a shallow depth of field (DOF) making it impossible for the 3D software to determine corresponding points in image pairs and produce a dense 3D point cloud. Since DX cameras, which have a smaller sensor, have a greater DOF, it is possible to adjust the aperture for a level or two lower.

Prolonging the shutter time will result in shaken and blurry images, which will reduce the accuracy of the model and the number of stitching points. So the only option left is a higher ISO setting what will result in more noise. Some smaller noise corrections can be done in post processing without a great loss of information. Depending on the type of the camera, ISO may be increased, but it is better for further processing to remain as low as possible.

Five 3D models (a-e) were produced in different phases of the excavation. The first model (a) was made with a 10 mm fish-eye lens (see figure 2 for more about camera settings). It covered a wide area in a single frame, but had strong lens distortions which pushed the Mementify®PHOV software to several days of computing before a cloud of 3D points emerged. The second and the third set were captured with the same lens but tested and processed with a different algorithm, which produced a lower detail model (b and c). The fourth set was captured with a 12 mm wide-angle lens, which despite lower DOF images, produced a high detail 3D model (d) with more than 3 million faces. The fifth set was captured in the same manner and lower DOF, but still produced a 3D model (e) with 3.3 million faces.

Set	Model	Date	Day	DT	Nr.Sh	Method of sequence shots	Lens	F	t	ISO	Faces
1	A	1.10.2012	2	4'	55	6 lines	10mm	8.0	1/50	640	0.12M
2	/	2.10.2012	3	20'	334	10 lines + 6 rows	10mm	4.0	1/50	640	
3+	B	4.10.2012	5	30'	57	3 side lines	10mm	7.1	1/50	800	0.2M
3	C	4.10.2012	5	30'	450	10 lines + 7 rows	10mm	7.1	1/50	800	0.8M
4	/	9.10.2012	9	20'	912	9 lines + 8 rows	12mm	6.3	1/50	800	
4+	/	9.10.2012	9	5'	205	Detailed line	12mm	6.3	1/50	800	
5	/	11.10.2012	10	20'	586	6 lines + 9 rows	12mm	7.1	1/50	800	
5+	/	11.10.2012	10	15'	702	Detailed line	12mm	7.1	1/50	800	
6	/	15.10.2012	12	2'	39	Planar photomosaic	12mm	6.3	1/50	640	
6+	D	15.10.2012	12	10'	314	5 lines + 5 rows	12mm	6.3	1/50	640	3.03M
6++	/	15.10.2012	12	10'	578	Detailed 8 lines + detailed 7 rows	12mm	6.3	1/50	640	
7	/	22.10.2012	14	6'	278	Detailed line	12mm	5.6	1/50	800	
7+	E	22.10.2012	14	10'	502	8 lines + 7 rows	12mm	5.6	1/50	800	3.3M

Figure. 2 Table presents the ID number and names of 3D models (Set #, Model), dates and sequential working day numbers, dive times (DT), number of shots (Nr. Sh) captured during the dive, methods of sequencing the shots, camera settings (F – focus, t – time and ISO – sensitivity) and the number of faces in the 3D model in millions (M).

The taking of photographs for all sets took place in murky water and at low light conditions, so it was very difficult to obtain data of necessary quality for the 3D model processing

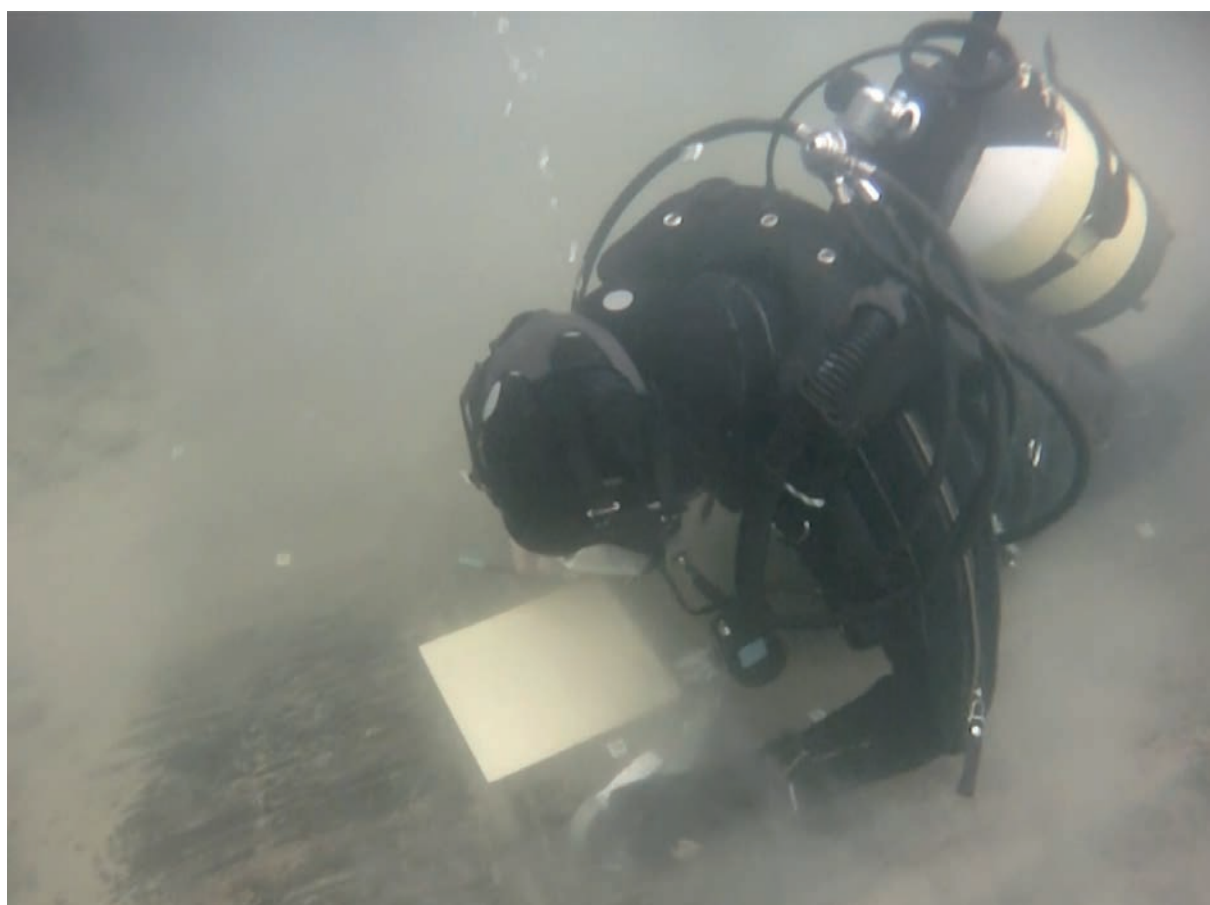


Figure 3. In murky water and low light conditions diver prepares the vessel for the study and documentation of ship construction technology and 3D modeling (GoPro clip: Rok Kovačič).

(Fig. 3). Because of the site conditions, the equipment was pushed to the limits. The shooting settings were set at 1/50s and F as low as 4.0 but most of the time F was 6.3, which is still a bit low for perfect results. Underwater visibility varied from 1 m to 2 m at best. Still, in these difficult circumstances we were able to document each phase of the excavation in detail and in under 30 minutes, which is an amazing shortening of dive time and great tool for later analysis and measurements.

Groups of purposely taken images from different viewpoints allow the reconstruction of more or less complete 3D models. All the constraints regarding the accurate placement of cameras thus fall off. The camera can be held in the hand without any additional equipment, one must only capture a large enough set of photographs with a roughly 75% pairwise overlap.

Photogrammetric 3D modeling with Mementify®PHOV Software

Powerful computer algorithms and software applications already exist enabling 3D model reconstruction of scenery from digital photographs as well as, due to significant improvements to digital sensors in recent cameras, from high-definition video recordings. Compared to the classic methods of documentation, such as laser scanning and manual drawing, this approach offers significant simplification of the entire process of capturing and modeling, thus making it increasingly more interesting and useful even in archaeological research.

The service used in this paper, Mementify®PHOV, is based on a series of phases analysing input photographs, determining the relative positions and orientations of photographs, and then building a triangulated mesh of a dense 3D model. The first phase of the process uses a feature detector to extract distinct features from input photographs, and looks for matches thereof. Matching of detected features, i.e. finding correspondences between photographs, is performed by a stochastic algorithm comparing arbitrary subsets of features found in two different photographs to minimise the effect of mismatches, i.e. pairs of features that should not be matched. Distinctiveness of features and the expressive power of corresponding feature descriptors is required for the matching algorithm. For the models presented in this paper, SIFT (Scale Invariant Feature Transform) algorithm (Lowe, 2004) have been chosen due to its ability to match features even under significant transformations, such as scale and orientation, within photographs. Stable correspondences are used in the second phase of the process extracting relations between subjected photographs based on the Structure from Motion (SfM) algorithm Bundler (Snavely *et alii*, 2010). The algorithm seeks the configuration of cameras minimizing the error of applying perspective projection to detected 3D points when compared to 2D points found in photographs. The SfM algorithm incrementally increases the number of used photographs and updates the configuration in each step of the process to build the final representation of the scene. Photographs that cannot be matched sufficiently to others, or those that introduce a significant amount of error are rejected. Although the resulting camera configuration also details intrinsic parameters of cameras, we have found that unwarping input photos significantly improves the end results. Unwarping is based on a manual calibration of the camera. The so updated camera configuration forms the input to the next phase of the reconstruction process building a dense point-cloud representation of the scene based on the Patch-based Multi-View Stereo (PMVS) algorithm (Furukawa/Ponce, 2010), and the triangulated approximation of a surface using Poisson surface reconstruction algorithm (Kazhdan *et alii*, 2006) building a watertight model, i.e. the manifold without holes. The last phase of the automated 3D reconstruction uses camera configurations to project input photographs onto the reconstructed mesh and producing color (texture) of the mesh. Parts of the resulting mesh that are not covered by a significant amount of input photographs are also removed in this phase detailing only the part of the scene that has been captured properly by input photographs.

Resulting models have been analysed and further distilled using the MeshLab, a tool for 3D mesh visualisation, processing and editing developed with the support of the 3D-CoForm project, freely available for all major operating systems. The power of the MeshLab lies in its ability to visualise and manipulate large 3D models containing several millions of vertices. It also comes with a large number of predefined filters based on extensive research in the field of computer vision facilitating analysis and automatic mesh corrections.

Although models reconstructed by the aforementioned approach offer an important novel analytical tool, we see numerous potential improvements in the archaeological workflow, in particular, for the post-processing of resulting models. Examples of such tools are (semi-)automatic segmentation of 3D models allowing archaeologists separating 3D models into distinct sub-parts performing analysis to each individual part, e.g., based on the work of Solina *et al.* (Solina/Baycsy, 1990; Jaklič/Leonardis/Solina, 2000), context-aware measuring tools, surface analysis and sketch generators.

Analysing of different 3D models of the barge

When one is faced with more than one model of the same object, there is a question of how to compare and evaluate different models. This is usually done visually by a human operator. The model that looks more complete and visually appealing is selected as a better one. However, the

approach is not objective and not useful if one would need to compare two models in an automated chain of processing.

The problem of comparing two different models in quality is an easy task only if ground-truth is available (a high-quality model obtained in ideal environment, usually in artificial setup), which is in field archeology normally not the case. One way to do the comparison is by comparing inherent properties of each model: number of points in the point cloud, number of faces in the mesh model, absolute point/vertex density, point density variance, number of outliers, fractal dimension, edge and plane smoothness, number and size of «holes» in the point cloud, etc. By comparing and combining this metrics, it is possible to construct a heuristic distance function for comparing two models.

However, in practice, especially in underwater archaeology, the situation is more complex due to the changing environment and challenging model reconstruction. If an object is partially covered with other artefacts or mud, it is impossible to automatically determine if the measured «noise» is there due to the poor model as such or to artefacts on the actual surface of the object.

Due to the nature of the problem at hand, we have decided to evaluate different models using a semi-automated approach. First, the two models to be compared are scaled to the same scale and aligned. Next, a 2D heat map is computed in the following way: a 2D plane is placed in parallel to the river bed. The distance between the two models in the axis perpendicular to this plane is computed and stored in a heat map (a colour represents the distance between models). This heat map is then mapped to a 3D space (where both point clouds are merged together for visualization). This gives a 3D representation of the difference of two models as seen in figure 7. Using this representation an educated user can easily see where the two models differ, evaluate and understand the difference and provide a better assessment on the quality of both models. Although this approach does not provide a clear metric for selecting a better model, it gives a better insight into their quality which is not obtainable merely by visual inspection.

Case: Early Roman barge from river Ljubljanica

In advance of maintenance work involving the consolidation of the right bank of the river Ljubljanica, the Underwater Archaeology Division (hereinafter UAD) of the Institute for the Protection of Cultural Heritage of Slovenia (hereinafter IPCHS) surveyed in 2008 a 200m long section of the river at Sinja Gorica (Erič/Gaspari, 2009). The intensive underwater survey of the potentially endangered riverbed (Heritage Register Number 11420) along plots Nos. 1100, 1125, and 1865/1, cadastral municipality Verd, was performed under the auspices of the ZVKDS (Fig. 1; *left*).

Field work

The survey of 44 square grids revealed 2500 small finds, mostly fragments of prehistoric, Roman, medieval, early modern, as well as modern pottery and construction materials. Noteworthy finds included an Early Roman Aucissa fibula, an undated iron ingot weighing roughly 10 kg and a wooden Palaeolithic point, presumably part of a 45 000-year-old hunting weapon (Gaspari/Erič/Odar, 2011; 2012). In the easternmost part of the surveyed area, along Grid Squares 35 and 36, the survey also revealed the remains of a wooden barge at a depth of 2.5 m under mean water surface, at an absolute altitude of 284.11 m and GK coordinates of y 446827, x 92200. Its remains, consisting of left and right chine-girders, five planks of the flat bottom and iron clamps, are lying horizontally and continue at an angle into the sediments of the right river bank. Probably also belonging to the vessel are the 15 iron clamps and two wrought nails found scattered in close

vicinity. The survey determined the approximate width between the chine-girders at 2.4 m, which, together with the obtained radiocarbon age, pointed to a 12 to 15 m long barge from the closing decades BC or the early decades AD.

In May of 2009, the IPCHS UAD conducted non invasive documentation of the barge also aimed at establishing the state of its wooden remains eight months after discovery. Documentation was performed by M. Erič and R. Kovačič, authors of this article (Erič, 2009). These were found to be exposed to water flow erosion due to the maintenance of the right river bank and therefore exceedingly endangered.

On the initiative of the IPCHS, the Slovenian Ministry of Education, Science, Culture and Sports in October 2012 provided intervention funds for documenting the barge and transferring it to the state depository for waterlogged wood which was in preparation in the nearby ponds. The task of the ZVKDS SPA research team was thus to document the remains of the vessel and to transfer them to the depository. The team was made up of several groups of collaborators and advisers. A considerable contribution to the fieldwork was provided also by donations by the local community. It took eleven members of the field team and several assistants 150 diving hours in 23 days to document the wreck and 36 hours to prepare the wooden support construction of the depository. The barge without cargo or any other objects identifiable as boat equipment was cleaned of recent sediments in the length of 4.2 m (Fig. 1; *right*). On the eastern side of the barge, the side plank could be followed for another 3 m, but was not documented due to safety concerns (Erič *et alii*, 2014).

The surviving part of the barge was substantially larger than expected and investigations showed that the wood is poorly preserved. Consequently, the lifting of the barge out of water and its conservation would be highly demanding and very costly. Therefore, the initial plan to transfer the barge to the depository for waterlogged wood was abandoned (Čufar/Merela/Erič, 2014). We decided for protection *in situ*; the cleared part of the barge was documented and afterwards protected with a thin layer of silt and sand, which was covered first with a degradable anti-flood net made of jute and then with sandbags.

Why we decided to use the methodology of 3D documentation?

In recent decades we have devoted in Slovenia a lot of time and attention to understand and develop methods for collecting and acquiring data on underwater archaeological sites. These efforts are illustrated in several articles on underwater archaeological sites in Slovenia (e.g. Gaspari, 2015; Erič, 2015).

Our first experience with the process of 3D documentation and underwater data acquisition on an archaeological site is from 2001. This was during fieldwork research of a Roman shipwreck from the 1st century AD at the cliffs of Grebeni near the island of Silba, led by Smiljan Gluščević from the Archaeological Museum of Zadar (Gluščević, 2009; Gaspari/Erič, 2001; Erič *et alii*, 2013: 282; fig. 3-4).

During this period our understanding of the benefits of 3D documentation in underwater archeology has evolved, as well as the realization that a change in underwater recording methodology was necessary to reap these benefits. Instead of producing first two dimensional plans and documentation to gain an understanding of a site in three dimensions, the new image based 3D modeling does not require any intermediate transmission between 2D and 3D. Further, these new automatic image based 3D modeling methods are financially accessible and open source solutions exist.

Based on our experience in underwater archeology, we are particularly impressed by the advantages in accuracy, financial affordability and increased safety at underwater field work.

1. Analog documentation was mainly recorded using single measurements and therefore systematic errors or mistakes in the recordings could not be corrected during subsequent analysis. These problems were mitigated only in the last decades by introducing triangulation techniques which enables the creation of 3D documentation consisting of sparse morphological properties combined with 2D photographs of surfaces. Such documentation enabled a rough 3D reconstruction or at least correct basic orthographic views (Holt, 2003). The latest image based 3D recording technology enables in principle very accurate documentation, with errors on the order of millimeters, however, adverse environmental conditions such as the turbidity of water influence the recording of images and subsequently the accuracy of 3D models.
2. A smaller amount of diving hours results also in smaller cost of field research since, in general, the cost of diving operations is much higher than the cost of post processing analysis which can be done on the ground. The correlation between quality of documentation and the cost to record it, is therefore incomparable with this ratio in the past.
3. The safety of divers during underwater field work is of utmost importance. Therefore, research should be organized in such a way that the hours spent underwater should be kept at a minimum. The latest technological advances enable enormous time savings during the site recording. To illustrate this large difference, we can use the project of documenting the Late Roman Sarcophagi Shipwreck which lies at the depth of 30 m conducted by Igor Mihajlović from the Department for Underwater Archaeology, Croatian Conservation Institute (Mihajlović, 2013). To produce the analog documentation which consists of a 2D floor plan, 2 or 3 cross sections and 2 or 3 longitudinal sections, about 25-30 diving hours were required. The taking of photographs for the photogrammetric reconstruction, for a single set or phase in the excavation about 700 photographs are needed, required less than one (1) diving hour.

Results and discussion

3D models of investigated part of barge

In order to test the image based 3D modeling we first performed a series of rapid tests, increasing the number of photos used in the reconstruction and proportionally increasing the area covered by the set of photos (Fig. 4a, 4b, 4c). The main reason for experiments was to analyse the water conditions and determine whether the capturing process is well defined and executed by the photographer under water. The top part of figure 4 (a-c) depicts resulting 3D models and the estimated area. Although the exact shape in figure 3a is hard to see, it can be clearly seen that with a set of 55 properly aligned photographs it is possible to cover a part of the model and extend that to the entire area (Fig. 4b, 4c). Having confirmed the approach and the methodology two series of photographs were captured in similar lighting conditions (Fig. 4d, 4e) after the site has been cleansed. The 3D reconstruction of the latter models took approximately 6 hours on a parallel computer system and approx. 30 hours on a single processor. Based on the optimised solution we could improve the capturing process and focus on parts that have not been sufficiently covered in the first session.

Figure 5 depicts different stages of the reconstruction process described in the subepigraph «Photogrammetric 3D modeling with MementifycPHOV Software». A dense point cloud is displayed in (a) providing an excellent overview of the entire scene as seen by captured photographs. Areas in the middle are covered almost completely while those on the boundaries are

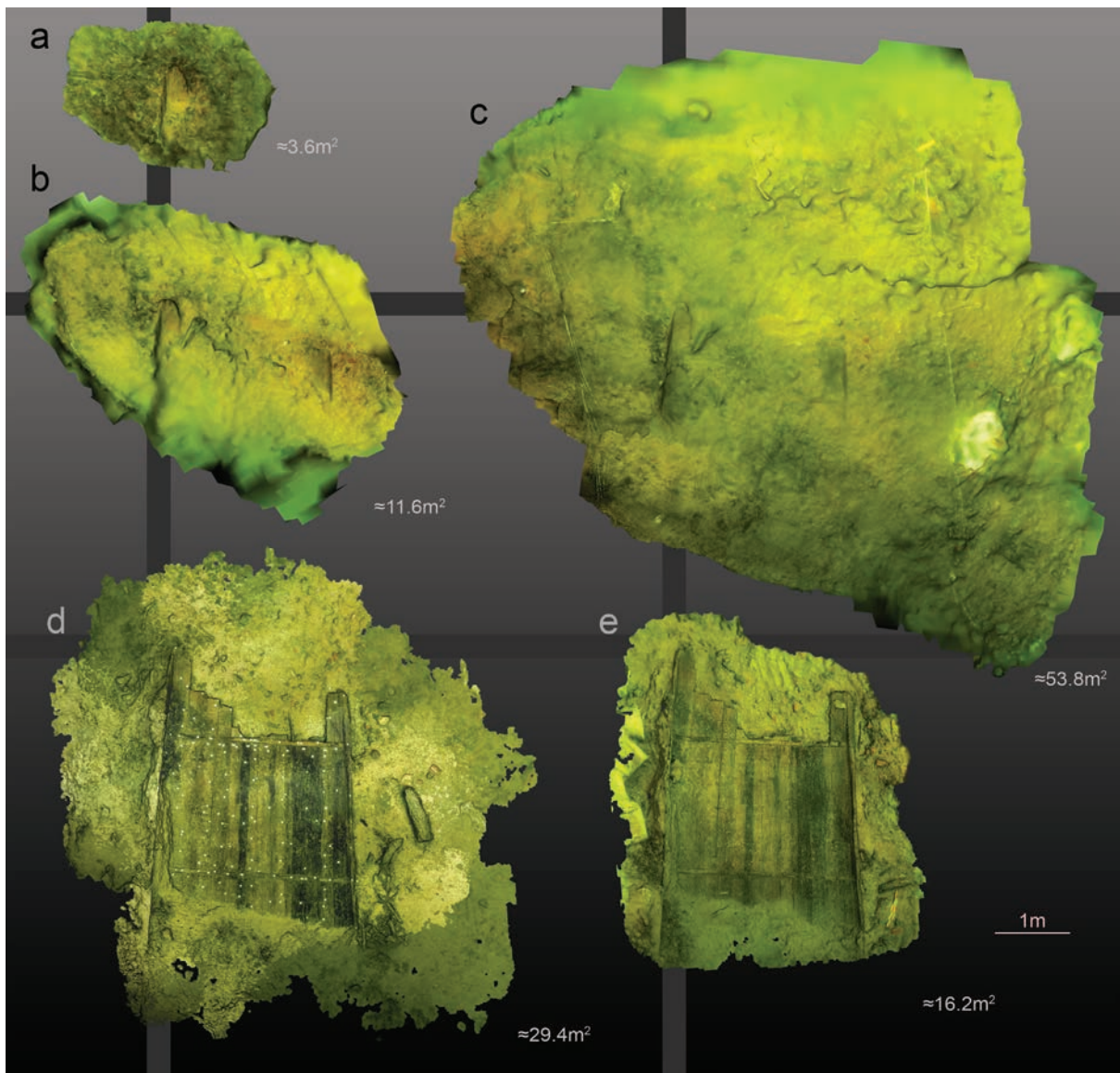


Figure 4. Before final photogrammetric reconstructions a few sets of photographs were taken for testing of 3D modeling. Early at the beginning of excavation we took a set of 55 shots of the site (model a), 57 shots (model b) and approximately 450 shots (model c) to prove that the methods of photogrammetric 3D modeling will be successful at the end. After demonstrating that expected results will be achieved, the final two sets of photographs were taken on 13 October (314 shots; model d) and 15 October 2012 (502 shots; model e). (photo: R. Kovačič; 3D models: G. Berginc; processed with Mementify[®] PHOV).

significantly more sparse giving an insight of where additional photographs might be required. Figure 5b shows the triangulated mesh based on the point cloud from (a), and (c) shows how the texturing works. Since the set of photos focused on the middle part the texture is very detailed while becoming more granular when looking further from the centre.

Differences detected during comparative analysis between the 3D model and corresponding geodetic measurements indicate the weakness of using TLS measurements for documenting underwater sites. All TLS measurements were influenced by the direction of the river stream since the divers performing the measurement were influenced by it. Human error is unpredictable and above all, uncontrolled (Fig. 6).

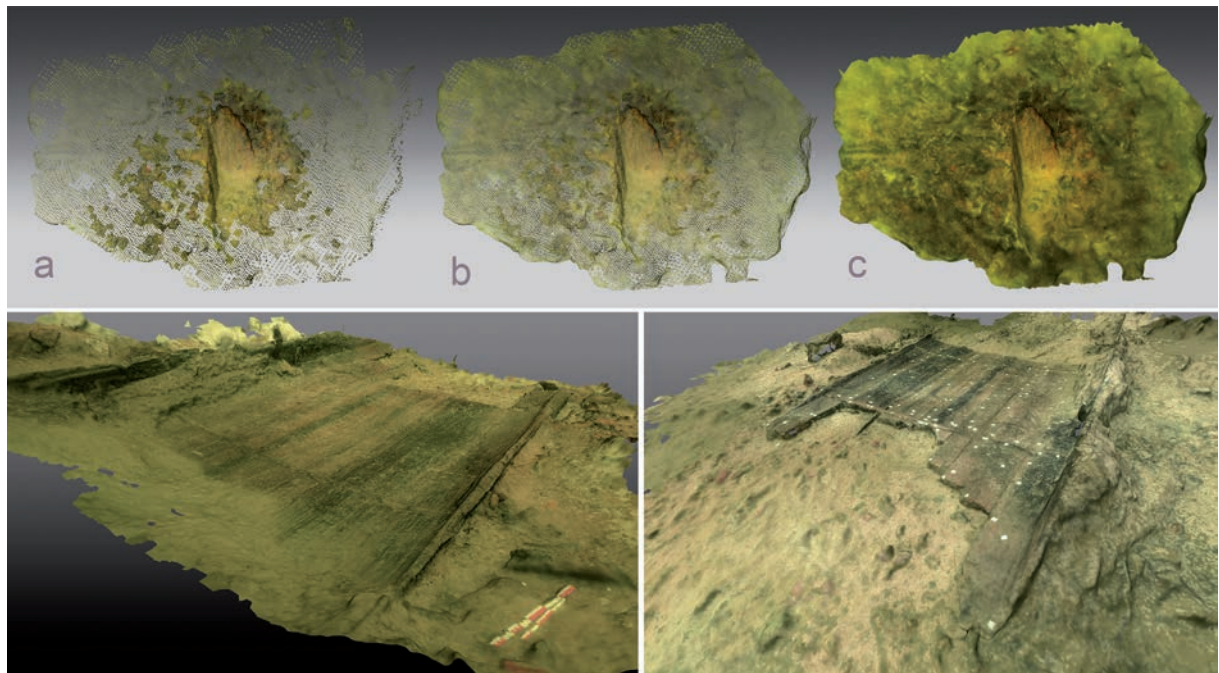


Figure 5. Testing the quality of 3D model (see Fig. 4, model a.) was done with MeshLab software. [Top: a] shows the number of points in cloud generated from set of 40 shots, [Top: b] shows the triangle mesh model and, finally [Top: c], we can see the surface reconstruction with texture. [Bottom left] Perspective view of 3D models: last model with 3.3M of faces and view from east towards west with field of view (FOV) of 53° degree. [Bottom right] model from 15 October 2012 with 3M of faces and the view from west towards east with FOV of 90° degree.

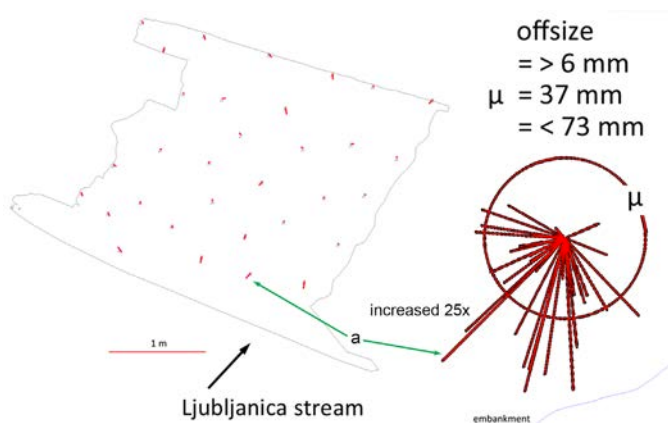


Figure 6. Differences detected during comparative analysis among the 3D model and the corresponding geodetic measurements indicate the delicacy of using TLS measurements for underwater site documenting. All TLS measurements were influenced by the direction of the river stream since the divers performing the measurement were influenced by it.

Results of comparative analysis of 3D models

Figure 7 a gives a visualization of the difference of two models. Visualization is done using methodology described in the subepigraph «Photogrammetric 3D modeling with Memen-tificPHOV Software». Red areas (or «hot spots») represent areas where the two models differ most (the colour is more intense, where the difference is bigger). Based on the visualization, we can make several observations. First, the error is larger on the edges (around the object) because of the changes in river bed (mud). Next, a stone (bottom left) is present in one model and not in the other. Regarding model quality, there are some visible differences on the edges of the model which could indicate errors in the integration or lack of images from certain angles. Furthermore, the difference on some long edges (left and right) and the slight difference on the flat

surface in the middle of the model indicates that the integration process failed to exactly reproduce flat surfaces with scarce visual cues. This usually happens due to error accumulation and is a known problem in 3D model reconstruction. It is also possible that some of the difference at the edges is caused by misalignment of the model. However, we were not possible to confirm this.

Figure 7b and c represent the point density of the model taken on October 15 and October 19, respectively, and point density if we merge both points clouds (d).

As both models are fairly similar and have similar statistical properties, it is (in this case) hard to determine which model is better. Although model (b) has a better point density distribution, we can confirm is that there are no big defects in either of the two models. Lastly, it would be interesting to see if it would be possible to improve the quality of the model by integrating both models – the motivation for this is visible in figure 7 (d) as the point density is clearly better than on merged model in relation to each of the individual models. This task is left for future research.

Conclusion

Image based or photogrammetrically derived 3D models have proven to be very accurate, representative and usable for further analysis. For a manual documentation of the approx. 8 m² large surface of the barge, at least 25 hours of diving time would be required, while it took only 3 hours to take dedicated photographs in five different stages of investigation. Sets of photographs were used to reconstruct four different 3D models of the site. A comparison of two of them, made in the Computer Vision Laboratory, Faculty of Computer and Information Science, Univer-

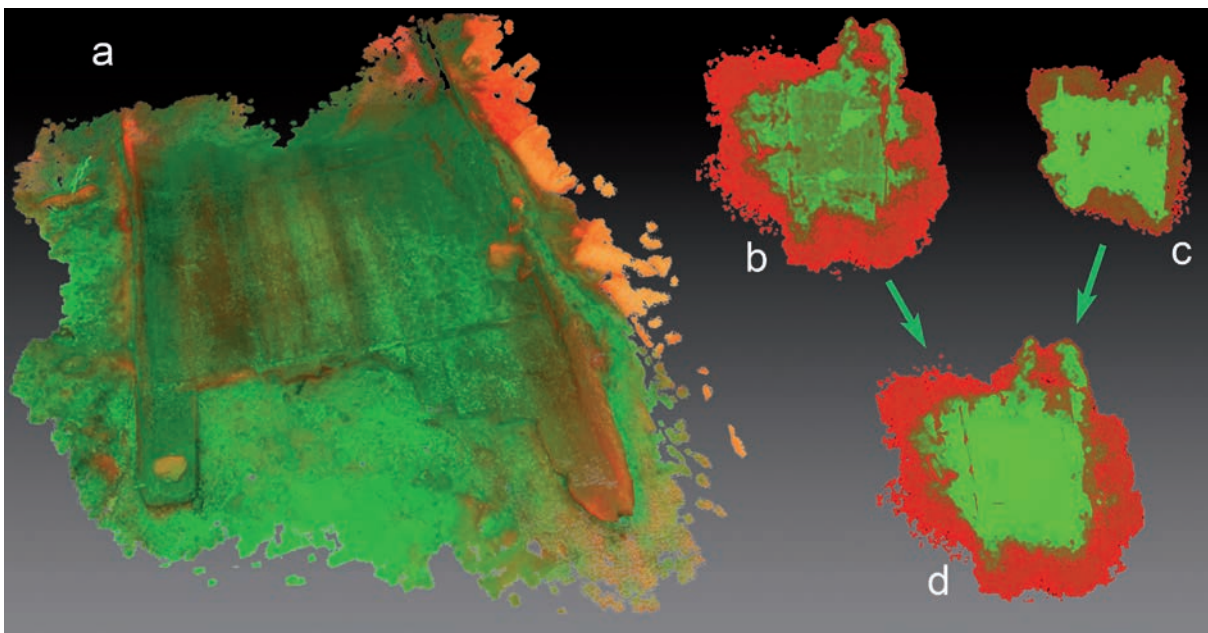


Figure 7. Comparison of two photogrammetric 3D reconstructions. Sets of photographs for the 3D model were taken on 15 and 19 October 2012. [a] – Complete correspondence of the morphology of both models (green); negligible deviations possibly related to the movement of the barge construction (orange hues). [b] Model taken at 15 October [c] Model taken on 19 October [d] shows very good (green) correspondence of both models [b and c]. (Comparative analysis: M. Pugelj; photo: R. Kovačič; 3D model: G. Berginc; processed with Mementify® PHOV).

sity of Ljubljana, confirmed the accuracy of the documentation. The accuracy can be also confirmed indirectly, during the preparation of the graphic documentation from the obtained data. To verify the process of documentation, all measurements were also taken with a surveying instrument. The potential of the data acquired in this way is not limited to visualizing 3D models. In contrast to 2D photographs, where the viewpoint is fixed, and the already interpreted 2D plans, a 3D model enables a simulated observation for study purposes from any virtual viewpoint and of any recorded surfaces and objects (Erič *et alii*, 2013; Stopinšek *et alii*, 2013). The morphological properties of 3D point clouds, which are a complete recording of the present state, open up countless options for further analyses of the 3D model. This is especially important because the investigation of an archaeological site is usually physically limited to the duration of the fieldwork and is later, if preserved *in situ*, difficult to access or most often destroyed. 3D models allow us to systematically and in a planned way study, segment and classify selected surfaces. Using automatic analysis of 3D surfaces, we can search for specific features that could otherwise easily be overlooked *in situ*. Also important is the archival sustainability of digital archaeological documentation, which forms the basis for later study, interpretation and promotion.

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On Digital Nautical Archaeology

Arqueología náutica digital

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Abstract: A seismic paradigm shift is occurring in methods for disseminating archaeological information. Recent developments in innovative digital presentation are creating new techniques for how nautical research can be disseminated in the 21st century. Furthermore, in a period of shrinking resources it is imperative to share the results of nautical archaeological work in ways that can better engage the general public in meaningful ways. By using the recent 3D capabilities of Adobe PDF files, Flash, VRML and QTVR interactive programming, as well as game environments such as Unity, nautical archaeologists are now able to enhance the presentation of their research. By posting the data as open-access resources on the internet it is possible to reach the larger lay community, which is crucial for continuing support of our work. This paper will discuss examples of my own work emphasizing the great potential in virtual reality for the nautical archaeology community.

Key words: 3D, nautical archaeology, shipwrecks, Unity game environment, virtual reality.

Resumen: se está produciendo un cambio de paradigma radical en los métodos de difusión de la información arqueológica. Las innovaciones en la presentación digital están creando nuevas técnicas para difundir la investigación náutica en el siglo XXI. Además, en un periodo de reducción de recursos, es imprescindible compartir los resultados de los trabajos de arqueología náutica de forma que el público en general pueda involucrarse más. Mediante el uso de las últimas posibilidades 3D de Adobe, Flash, VRML y QTVR de programación interactiva, así como entornos de juego como Unity, los arqueólogos náuticos ahora son capaces de mejorar la presentación de sus investigaciones. Mediante la publicación de datos como recursos de libre acceso en internet es posible llegar a una comunidad más grande, lo que es crucial para que nuestro trabajo continúe. Este artículo discutirá ejemplos de mi propio trabajo enfatizando en el gran potencial de la realidad virtual para la comunidad de la arqueología náutica.

Palabras clave: 3D, arqueología náutica, pecios, entorno de juego Unity, realidad virtual.

«Sphere. Why will you refuse to listen to reason? I had hoped to find in you –as being a man of sense and an accomplished mathematician– a fit apostle for the Gospel of the Three Dimensions, which I am allowed to preach once only in a thousand years: but now I know not how to convince you. Stay, I have it. Deeds, and not words, shall proclaim the truth. Listen, my friend.»

From *Flatland: A Romance of Many Dimensions* by Edwin A. Abbott (1992:62).

These are amazing times. There now exist a number of methods to substantially enhance the delivery of visual archaeological information both from the field and in the publication of archaeological research results. While many nautical archaeologists are striking out in innovative manners to present their materials, others seem still locked into two-dimensional representations supplemented by photographs. Thus, it was gratifying for me to listen to the previous lectures in the session on new technologies discussing methods for incorporating creative methods of representing archaeological information (McCarthy, 2014: 32; Merin, 2014: 33; Olkhovskiy, 2014: 33).

Decades from now future scholars may very well look back at our times, scratch their heads and wonder why in this age more scholars did not make better use of the «explosion» of digital possibilities that are washing over us now, in the opening decades of the 21st century.

Some scholars seem to labor under the misconception that the more obscurely that they can present their materials the more validity they will accrue, but as George Orwell's Law of Language states (Rawson, 1997: 174), «The great enemy of clear language is insincerity. When there is a gap between one's real and one's declared aims, one turns as it were instinctively to long words and exhausted idioms, like a cuttlefish squirting out ink».

My own incorporation of virtual/digital modules in my publications derives specifically from my conviction to make my publications as «user friendly» as possible, irrespective of whether I intend them for scholarly peers or for the general public. If, then, one adopts a «user-friendly» approach to the publication of imagery, it follows naturally that one should strive to replicate our common three-dimensional (3D) perception of reality when possible. To this end, for the past 15 years I have been working with Donald Sanders, the President of the Institute for the Visualization of History (VIZIN). Together we have selected and constructed different digital solutions for various forms of publication

I discuss below a few methods that I have found useful in the publication of my own research, both in the past and ongoing. I present them solely as examples of approaches to these issues: these techniques may not be right for everyone, and they are certainly not the only ones available to consider in your own publication plans.

Website publication supplements

A common concern in scientific publications, and an unfortunate one for a discipline as visually-dependent as is archaeology, is that editors normally set limitations on the number of illustrations that authors are allowed to submit with their manuscripts. Color figures are often eschewed in scientific books as publishers try to keep their costs down: images are at times so reduced in the publication process as to make them all but useless (Wachsmann, 2014: 205).

The internet, however, offers an elegant solution for publishers to enable authors to include as many high-quality color photos as they wish by creating dedicated web sites to host any number of images and other pertinent materials (Wachsmann, 2014: 205). For example, in



Figure 1. A) The Gurob ship model. B) The four wheels found with the model. Photos: S. Wachsmann. Courtesy the Petrie Egyptological Museum.

my most recent book, entitled *The Gurob Ship-Card Model and Its Mediterranean Context*, I deal with a remarkable wooden painted ship model from the site of Gurob, Egypt (Fig. 1; Wachsmann, 2013). The model represents the most detailed representation known of the type of Aegean-style galley used both by the Bronze Age Mycenaean Greeks as well as by the Sea Peoples during the upheavals at the end of the Bronze Age and the beginning of the Iron Age (ca. 1300-1100 B.C.). For our understanding of the evolution of early Mediterranean naval warfare this is a crucial ship-type, as it is the progenitor of many types of later warships including the triremes of both the Greek and Phoenician traditions (Wachsmann, 1998: 174; 2013: 80, 82-83). There are, however, no actual ships of this ship type known in the archaeological record to date.



Figure 2. The homepage of *The Gurob Ship-Cart Model's* website (<http://www.vizin.org/Gurob/Gurob.html>).

The *Gurob* book has its own dedicated open-access website, which contains downloadable high-resolution color photos, paralleling those of the model that appear in black and white format in the book itself (Fig. 2; URL: <http://www.vizin.org/Gurob/Gurob.html>). The website is intended for use together with the book: indeed, the reader is advised at the outset that the digital supplement is an integral part of the book (Wachsmann, 2013: xxiii). In addition to the photographs, the site contains rotatable 3D models of the Gurob model in its present condition and in two possible reconstructions, in addition to maps, satellite photos and other materials (Fig. 3). The site is designed for both Mac and PC viewing: in the latter version users are able to make changes to one of the reconstructions, such as changing the distance between the wheels, inverting the direction of the stem ornament, and varying the height of the stanchions. VIZIN hosts this website, but one may hope that in the future the standard will be that publishers of nautical archaeological reports incorporate supplemental web sites as intrinsic elements of their publications in which contributing authors may include as many images—color, black and white, maps, plans, etc.—as they wish, as long as the authors remain responsible for the necessary copyright permissions.

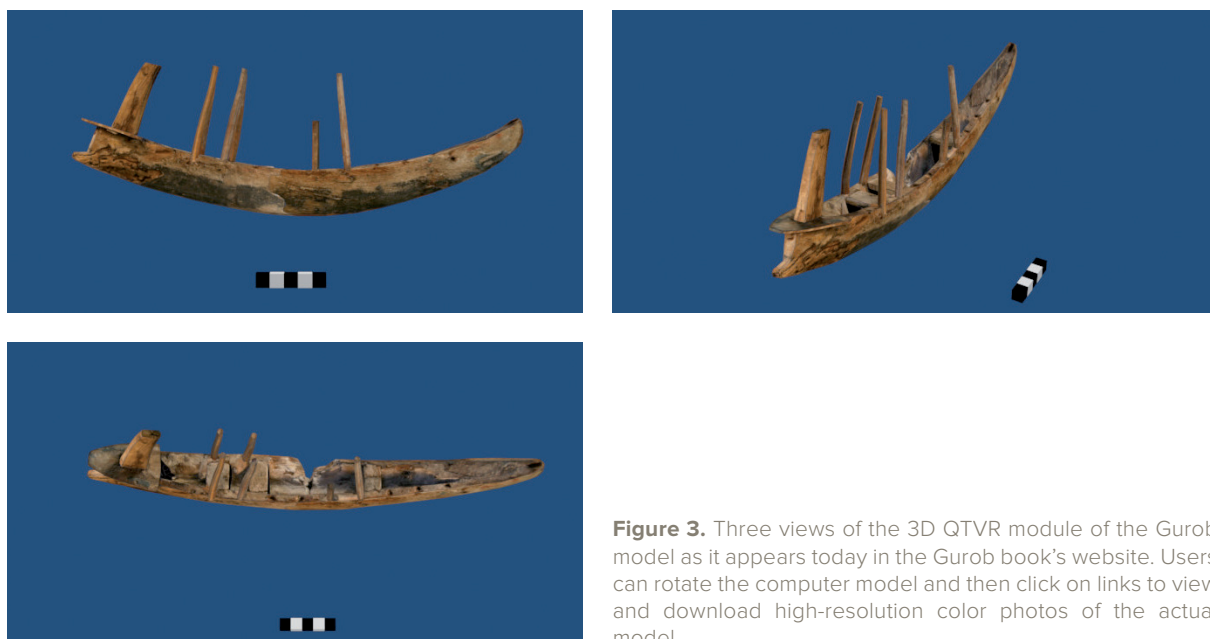


Figure 3. Three views of the 3D QTVR module of the Gurob model as it appears today in the Gurob book's website. Users can rotate the computer model and then click on links to view and download high-resolution color photos of the actual model.

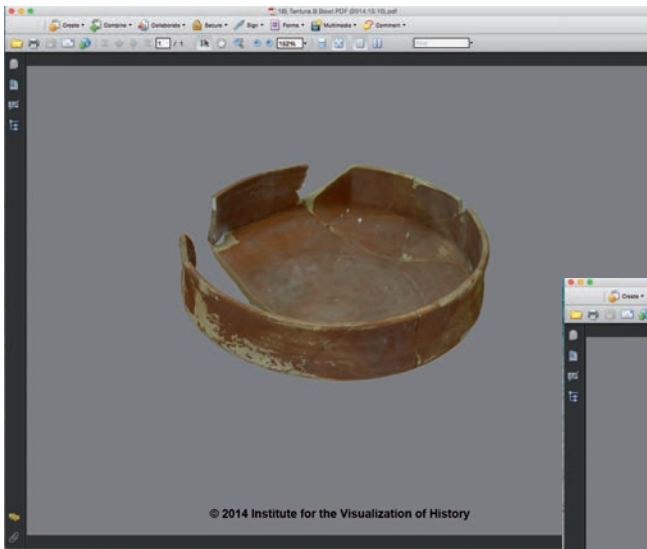


Figure 4. Two views of a 3D image of a large bowl found in the Tantura B shipwreck (early 9th-century A.D.) embedded in a PDF.

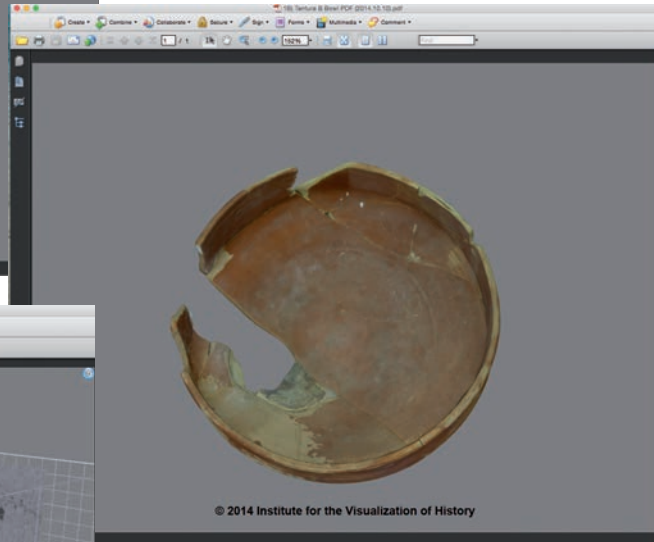


Figure 5. Three-dimensional image of a hypothetical reconstruction of a generic Greek Archaic-period Dionysian ship cart. The viewer is able to add and remove the ship-cart's elements.

Adobe Acrobat 3D

Adobe Acrobat's™ PDF (Portable Document Format) is a highly versatile cross-platform file type that has gained wide acceptance. Arguably, today, one is more likely to read a recent scholarly article as a PDF, or as a printout of one, than in a hardcopy version of a journal. PDFs also represent a convenient –not to mention a bookshelf/filing cabinet space-saving– manner for aggregating publications, particularly when filed in a computerized bibliographical database, such as Thomson Reuter's Endnote™ application, for example.

Since the appearance of Adobe Acrobat 9.4, the application has had the ability to import and display rotatable 3D images created in other programs (Fig. 4; Anonymous, n.d.). Simply put, this may be the single most important and valuable development for the digital publication of archaeological materials. Consider this: as most respectable journals are now available online as downloadable PDFs, this will allow archaeologists to publish any artifact—or site plan for that matter—as a 3D image to be included in the PDF version of her/his publication. In its simplest form, this solution can be applied to any artifact, but it is possible to take this process one step farther by organizing attributes of a single object into categories and then, to make elements appear or disappear by simply clicking.

For example, I am currently working with Sanders and VIZIN on a manuscript in which we attempt to reconstruct in 3D a generic Greek Archaic-period (6th century B.C.) Dionysian ship cart based almost entirely on contemporaneous evidence (Fig. 5)¹. Creating virtual models also allows for discovering errors in hypothetical reconstructions. For example, in this case we realized that the ship-cart's oar panels, which are depicted along the sides of the ship-cart's hull, must have been positioned there almost vertically and that the panels' upper edges had to be placed at a small distance from the hull, otherwise the wheels would intersect the oar panels. Our intention is that anyone perusing the PDF version of the published article will not only be able to fully rotate the image and view it from any direction desired, but will also be able to peel away the digital reconstruction's layers, allowing the evaluation of the validity of our ship-cart reconstruction.

Virtual Reality

Finally, we should not ignore the possibilities of digital environments specifically designed for gaming. The same platforms that permit players to fight monsters or save princesses in imaginary worlds also can allow a reader of a shipwreck excavation report to digitally «dive» the same vessel on a computer.

In 1994-1996 at Tantura Lagoon, near Tel Dor on Israel's Carmel Coast, I directed the discovery, survey and, in some cases the *in situ* excavation, of seven wrecked ships, all of which were bunched together in an area about the size of a regulation basketball court². I envision the Tantura publication with an open-access website that will constitute an integral supplement to the publication of the hard copy excavation report and am currently working with VIZIN to design a Unity game environment in which a user will be able to navigate the wreck (Fig. 6A). Clicking on select artifacts will display them in 3D Quicktime™ movies, forming a virtual museum (Fig. 6B).

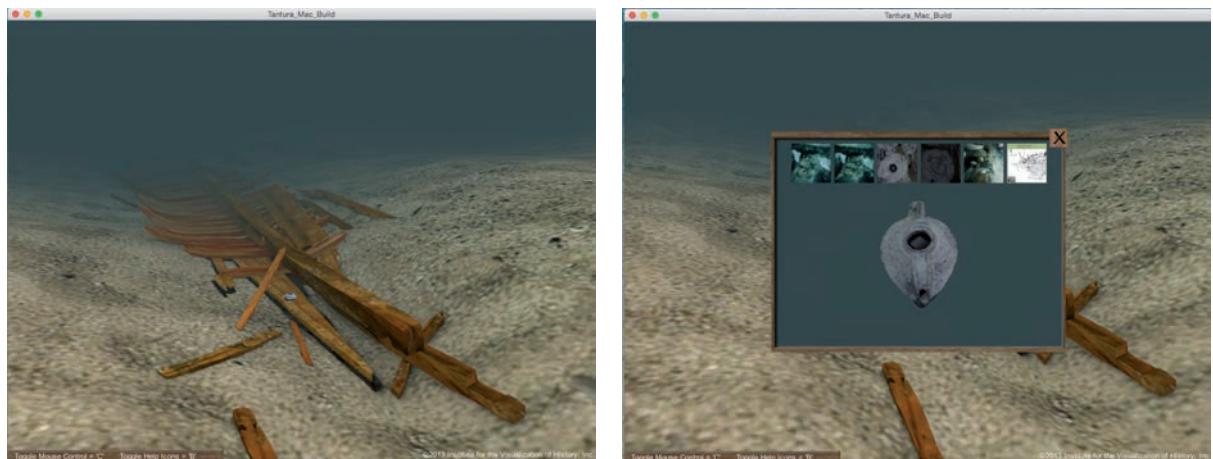


Figure 6. A) A view of the Tantura B shipwreck in the Unity game environment, which allows the user to virtually «dive» the vessel on a computer. Note the oil lamp lying on the near garboard strake. B) Clicking on select artifacts, in this case the oil lamp, brings up a window that contains a 3D image of the artifact along with relevant photos and metadata.

¹ On the Dionysian ship cart, see Wachsmann (2013: 120-132), and there additional bibliography.

² For a recent summary of the Tantura shipwrecks (A-G), see Wachsmann (2011), and there additional bibliography.

Conclusions

The methods described above are truly only a few of the digital possibilities available to nautical archaeologists today. Each of us must determine which, if any, of the ever-increasing possibilities is within their «comfort zone» in regard to digital and virtual publication. What is absolutely clear, however, is that these innovations are set to revolutionize nautical archaeology.

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Delimiting the area for prospecting and identification of the remains of the *Fougueux* through hydrodynamic modelling and historic logbooks of weather observations

La delimitación de la zona de prospección e identificación de los restos del *Fougueux* a través de modelos hidrodinámicos y observaciones meteorológicas de diarios históricos de navegación

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Abstract: A shipwreck site located in Camposoto beach (Cadiz, Spain) was identified as *Fougueux*, a French ship (Battle of Trafalgar, 1805). The site contains hull remains, 32 iron guns and a large anchor, but two-thirds of the ship are missing. Available information (including ships' logbooks of weather observations and other historic documents) establishes that *Fougueux* ran aground on 22nd October 1805, and broke up into pieces on 25th due to tempestuous weather. Making use of this information and of a set of numerical models (hydrodynamic, wave, meteorological and transport) we have simulated different scenarios in order to establish the most probable areas for finding the remains of the *Fougueux* accounting for the uncertainty of the available information. Those areas were surveyed later, resulting in the discovery of four additional sites containing 35 guns and a large anchor whose characteristics and dating are similar to those of the previously known site.

Key words: Shipwreck, dispersion model, numerical modeling, prospection, site formation process.

Resumen: el pecio localizado frente a la playa de Camposoto (Cádiz, España), está relacionado con el navío francés *Fougueux* (Batalla de Trafalgar, 1805). El yacimiento está formado por restos del casco, 32 cañones y una gran ancla, faltando dos tercios del barco. La información histórica disponible (cuadernos de a bordo con observaciones climatológicas y otros documentos históricos) establece que el *Fougueux* naufragó el 22 de octubre de 1805 y se rompió en pedazos el día 25 por un fuerte temporal. Haciendo uso de esta información y de un conjunto de modelos numéricos (hidrodinámico, oleaje, meteorológico y de transporte) hemos simulado diferentes escenarios para delimitar el área más probable donde se encuentran los restos, considerando el rango de incertidumbre de la información disponible. Dichas áreas fueron prospectadas mediante geofísica, descubriéndose cuatro yacimientos adicionales que suman 35 cañones y un ancla, con características similares a los encontrados en el yacimiento previamente conocido.

Palabras clave: pecio, modelo de dispersión, modelado numérico, prospección, formación de sitio arqueológico.



Delimiting the area for prospecting and identification the remains of the "Fougueux" through hydrodynamic modeling and historic logbooks of weather observations.

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1. Introduction and background

Scattered shipwrecks are the most common shipwreck sites typology in exposed coastal areas, where physical factors have a crucial role in the first stages of the site formation (Ward et al., 1999). Tidal currents, meteorological forcing, waves and hydrodynamic conditions produce the scattering of artefacts and pieces from the original sinking site. Survey techniques and seafloor mapping, with high-resolution acoustic imaging allow the identification of remains of different sizes and materials, and are now routinely used in archaeological studies. However, specially in shallow costal zones, survey techniques show technical limitations that result in higher costs of operation when intensive surveys are applied in larges areas. In the present work we use documentary sources of weather observations and a lagrangian dispersion model (LDM) to estimate and delimitate the survey area around the Fougueux site.

Fougueux, a 74-gun Temeraire-class French ship of the line took part in the Battle of Trafalgar (1805). She was sunk in front of the Sanctipetri sand spit (Cadiz), during the violent storm that struck the coast of Cadiz after the battle (Fig. 1). 32 guns, a large anchor and the central part of the hull are preserved at the site (Rodríguez Mariscal et al, 2010), conversely bow and stern section along with the rest of artillery are not at the site. This fact leads us to hypothesize that breaking and scattering of Fougueux remains took place during the storm following the battle.

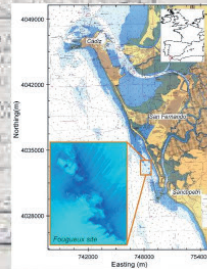


Figure 1. Location of study area

2. Material and Methods

2.1 Historical and documentary research

- Documentary research in order to investigate the historical sources information about the wreckage of Fougueux after the battle.
- Documentary research in historical sources, logbooks, *corpus documental* of the battle and previous works to know the characteristics of the storm and the oceanographic conditions prevailing after the battle of Trafalgar off the coast of Cádiz.
- Search within atmospheric reanalysis datasets in order to select a storm with similar characteristics to the Trafalgar battle storm.

2.2 Dispersion model

- Simulation of meteorological, and oceanographic conditions during the selected storm. Numerical models, MMS for wind, and Delft3d-flow for waves and current, were employed to obtain, wind, current and wind-wave fields in the area during the storm. These fields were later used to force a LDM.

- Implementation a LDM in the study area in order to know the potential trajectories followed by Fougueux remains, as a result of ocean currents, wind stress, wave motion and turbulent diffusion during the storm.

- A sensitivity analysis in the LDM was performed in order to identify the most important processes and to evaluate the model response to parameters value variation, as well as to ensure a suitable performance of the model.

- Finally, to consider the uncertainty associated to the problem (lack of knowledge of drag coefficients, size of pieces of the vessel, shape and emerged submerged/ratio, and initial time to wreckage and breaking), a pool of 1200 simulations were carried out. In these simulations, the uncertainty of the factors mentioned above was randomly generated. In this way, a likelihood distribution map of scattered archaeological remains belonging to the original Fougueux site was achieved.

2.3 Geophysical survey.

- Geophysical prospecting: in the Archaeological Easement Zone a geophysical survey was conducted using a side scan sonar (Klein®) and a high resolution magnetometer (Explorer model, Marine Magnetics®). Positioning of the geophysical survey was performed with a submetric differential GPS (Trimble®, model DMS132). Different graphic representations were produced with the obtained data including thematic maps of geomagnetic and sonar data.

- Visual inspection: inspection diving was made systematically in the very shallow areas where no geophysical survey was possible, while in the surveyed zone it was focused on the anomalies detected. Four divers swimming in parallel, 3 m apart from each other, covered the zone until a maximum depth of 12 m.

3. Results and discussion

3.1 Historical and documentary research

- Documentary research had reveal that Fougueux ran aground off Camposoto on the night of 22nd October or during the early hours of 23th
- During the storm after the Trafalgar battle dominant winds were from S to WSW direction with velocities of 10-20 ms⁻¹ and wave heights 2-5. 5 m.
- This result along with previous works (Wheeler, 1985, 1987) was used to select a similar recent storm that happened on 20th-25th December 2009. This storm had similar characteristics: S and WSW wind direction and 10-18 ms⁻¹ along with waves height 2-5 m (Fig.3)

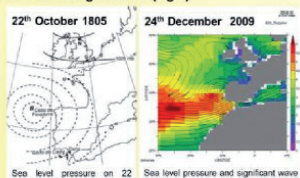


Figure 3. Meteorological condition during the storm after Trafalgar Battle. Selected storm for simulation occurred on 20th-25th December 2009.

3.2 Dispersion model

- Figure 4 shows a likelihood distribution map of scattered archaeological remains belonging to the original Fougueux site.
- The dispersion region extends from the original Fougueux site to the northwest. The most probable area is 4 km long and 2 km wide, with its longitudinal axis aligned parallel to the current coastline. The area is bounded by the coastline and the shoaling bedrock that crops out off-shore. The higher probability area is located in the onshore direction, with probability decreasing gradually with distance to the northwest.

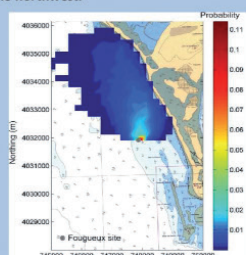


Figure 4. Likelihood distribution map

3.3 Geophysical survey

- The use of side scan sonar and gravimetric survey allowed the detection of several anomalies in the area (Fig.4).
- Visual inspection reveals that some anomalies correspond with groups of cannons.
- Correspondence between the remains identified as Fx-ucca I to IV, and the French vessel Fougueux was established after analyzing the cannons, which exactly follow the old French Ordinances between 1778 and 1786.

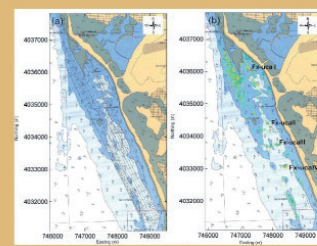


Figure 5. (a) Survey lines (b) Map of geomagnetic anomalies

4. Conclusions

The dispersion of Fougueux remains from the original Fougueux site was successfully modelled, as revealed by the good agreement between the likelihood distribution map and the anomalies identified as Fougueux remains showed in Fig. 5.

Due to the historical significance of the Battle of Trafalgar, the wide historical record allowed us to characterize the storm from a meteorological point of view, making it easy the characterization of the meteorological and oceanographic conditions prevailing during the wreckage.

The methodology proposed in the present work may be applied to other cases. But a limitation should be considered: the methodology works in regions where the climate pattern did not change between the wreckage period and present.

Results from this study have direct applications in underwater archaeology. During archaeological survey it may be used to establish potential search areas around previously located shipwrecks. In addition, results may be useful for remains identification, specially in areas with a high density of archaeological remains. During the management phase, the methodology can be applied when safety measures have to be taken to assess precautionary areas to exclude activities which may endanger underwater cultural heritage

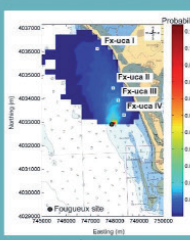


Figure 5. Verified Fougueux remains stamp on likelihood distribution map

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The Underwater Archaeological Map of the Southern Apulia: the GIS (Geographic Information System)

El mapa arqueológico subacuático de la Apulia meridional: el SIG (Sistema de Información Geográfica)

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Abstract: The project allowed us to upgrade the computerized archive of Underwater Archaeological Map of southern Apulia published in 2004 (Auriemma, 2004) in the current Geographic Information System (WebGIS) shared on the network (Cossa, 2013: 3-4 http://www.arcgis.com/apps/OnePane/storytelling_basic/index.html?appid=edb2b5022b3a4d4abb1b6f4abc95a2c7). Developed on the platform ArcGIS-online (www.arcgis.com), thanks to the support of the company Esri, the contribution of CUIS-Consortio Universitario Interprovinciale Salentino, the partner (city of Racale-Lecce, ITALY) and in concert [accordance] with the Superintendence of Ar-

chaeological Heritage of Apulia region, this networked version of Forma Maris Antiqui consists of approximately 650 archaeological underwater contexts or artefacts assemblages along the coast of southern Apulia (Cossa *et alii*, 2010; Cossa *et alii*, 2012; Zaccarelli *et alii*, 2011). The cataloguing is in agreement with the ministerial ICCD (Istituto Centrale per il Catalogo e la Documentazione) standard. The next step, aims to include this GIS inside the larger information system of the Carta dei Beni Culturali della Puglia.

Key words: GIS (geographic information system), underwater archaeology, archaeological map, Apulia region (Italy).

Resumen: el proyecto permitió la actualización del mapa computarizado de arqueología subacuática del sur de Apulia (region de Italia), publicado en 2004 (Auriemma, 2004) y el SIG (sistema de información geográfica – Cossa, 2013: 3-4 http://www.arcgis.com/apps/OnePane/storytelling_basic/index.html?appid=edb2b5022b3a4d4abb1b6f4abc95a2c7). Desarrollado sobre la plataforma online de ArcGIS (www.arcgis.com), con el apoyo de ESRI, la contribución de CUIS (Consorzio Universitario Interprovinciale Salentino), el socio (Municipio de Racale-Lecce, Italia), en coordinación con la Superintendencia arqueológica de Apulia, esta versión online de la Forma Maris Antiqui, consta de 650 contextos arqueológicos submarinos (Cossa *et alii*, 2010; Cossa *et alii*, 2012; Zaccarelli *et alii*, 2011). La catalogación está de acuerdo con los estándares del documento ministerial ICCD (Istituto Central de Catalogación y Documentación). En el siguiente paso, se propone incluir este SIG dentro del sistema más amplio de la Carta dei Beni Culturali della Puglia (Italia).

Palabras clave: SIG (sistema de información geográfica), arqueología subacuática, mapa arqueológico, región de Apulia (Italia).



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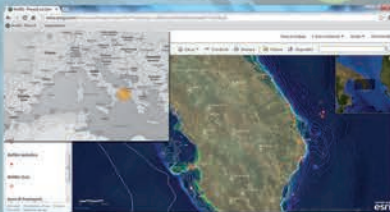
The Underwater Archeological Map of the Southern Apulia: the GIS (Geographic Information System)

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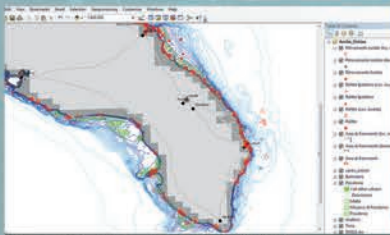
The project allowed us to upgrade the computerized archive of Underwater Archaeological Map of southern Apulia published in 2004 (Auriemma 2004) in the current Geographic Information System (WebGIS) shared on the network (Cossa 2013, http://www.arcgis.com/apps/OnePane/storytelling_basic/index.html?appid=edb2b5022b3a4d4abb1b6f4abc95a2c7). Developed on the platform ArcGIS (ArcGIS online - www.arcgis.com), thanks to the support of the Italian company Esri, the contribution of Consorzio Universitario Inter-provinciale Salentino - CUIS, the Lead Partner (City of Racale - Lecce, ITALY) and in concert with the Superintendence of Archaeological Heritage of Apulia region, this networked version of *Forma Maris Antiqui* consists of approximately 650 archaeological underwater contexts or artefacts assemblages along the coast of southern Apulia. It is the only experience in Italy of information system related to the submerged heritage. The researches carried out by the Department of Cultural Heritage - Underwater Archaeology, University of Salento, have increased the database with new evidences and helped revise some earlier data by encouraging new elements of reflection and an integration of the contexts already known.



The Underwater Archaeological Map of southern Apulia. The webGIS on line (www.arcgis.com)



Torre Santa Sabina (Brindisi, ITALY). Late Imperial shipwreck



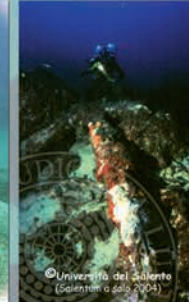
The geographic information system consists of 650 archaeological evidence



Sature (Taranto, ITALY). Late Republican cargo of tiles



Scalo di Furno (Lecce, ITALY). Nave lapidaria shipwreck (cargo of marble columns)



Porto Badoglio (Lecce, ITALY). Roman anchor



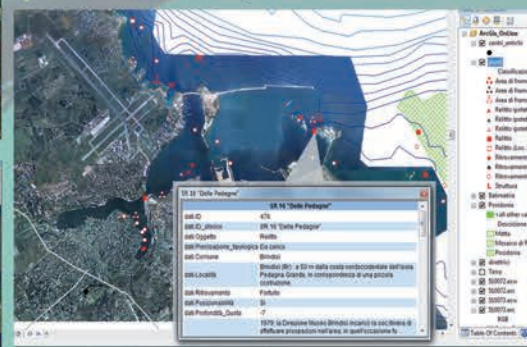
The data classification (standard ICCD)



The find is "blacked out" over the scale of 1 to 20,000

A lot of research areas have been taken into consideration, related to the archeology of coastal landscapes, where the archaeological elements, in close connection with the geomorphological and environmental indicators, become markers of changes of the landscape and contribute to the reconstruction of the coastal profile for a global reading of the territory. Moreover, the project promoted VIARCH (archaeological impact assessments) activities. In this way, the information system on the network, through the sharing of data between users, guarantees the visibility of submerged heritage, facilitates the work of archaeologists and the contribution of the divers, offers alternative solutions to the problems of environmental protection and, finally, promotes new forms of cultural tourism.

A new classification of contexts has been developed, based on specific elements of identity: the wreck, hypothetical wreck, area of fragments, finding isolated, structures. The cataloguing is in agreement with the ministerial ICCD (Istituto Centrale per il Catalogo e la Documentazione) standard. The model is a ICCD+ form, with integration and/or adaptation of some fields. Based on a detailed analysis of the ICCD form, it was decided to supplement it by the addition of dictionaries and the inclusion of descriptive fields specific to make it functional to "water" landscapes and to submerged contexts. Furthermore, parameters related to the type of discovery, to the positioning in respect of the current sea level, as well as related fields of the principles, methods and techniques of shipbuilding, the size of the vessel, tonnage, state conservation of hull and cargo, armament and equipment on board, to the supposed route, etc. have been identified and added. Similar operations have been carried out for the other categories of contexts.



The various archaeological evidences (positioning and associated form)

Furthermore, the development of this database saw the reorganization of the symbols and legends, with the adoption of a scale of values of approximation. Some parameters such as knowledge of metric data related to the distance from the coast or depth have become highly essential for correct positioning of the geographical contexts. A distinction between specific findings, of which you know the distance from the coast and the depth / bathymetry, and findings not georeferenced but derived from literature or other documentation, has been carried out. In this sense, quantitative and qualitative data about evidences out of context have been achieved. They are indicative of the dispersion of the findings, now in museums or private collections, but whose site of origin is unknown. Administrative and environmental data - including the trend of bathymetric and the distribution of "Posidonia", and the following degree of visibility of the sea bottom - contribute to enrich the information system.

The next step, now in progress, aims to include this GIS inside the larger information system of the Carta dei Beni Culturali della Puglia, carried out by the Apulia Region and the Universities of Foggia, Bari, Salento and Politecnico di Bari.



ESRI Italia

IKUWA V October 15 - 19, 2014 Museo Nacional de Arqueología Subacuática, ARQNA, (Cartagena, Spain).



New approaches to maritime visibility: a comparative study of traditional mathematical methods, GIS application and experimental archaeology

Visibilidad marítima, nuevos enfoques: un estudio comparativo de los métodos matemáticos tradicionales, la aplicación de SIG y arqueología experimental

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Abstract: Despite the ability of ancient seafarers to sail directly across open water, the visible shoreline has been always an important factor in navigation. Schüle (1968), applied arithmetic principles to study maritime visibility, but in recent times, the spatial analysis with GIS has been shown as a successful approach to study the archaeological landscape, for example «fuzzy visibility». We will apply these techniques to study the maritime visibility. Through this poster we study maritime visibility using three complementary approaches: mathematical methods, visibility analysis with GIS and visibility tested by ethnology and experimental archaeology. The study case is «Cabo de Palos» area, and it allows us to analyse different kinds of visibility using as control points archaeological sites. The dialogue between the results of these three analyses will allow us to adjust and improve the initial models and to obtain quantifiable data which will be used to interpret more precisely the maritime landscape.

Key words: Maritime archaeology, maritime spatial analysis, ancient navigation, visibility and viewshed.

Resumen: a pesar de la capacidad de los antiguos marinos para navegar en mar abierto, la línea de costa ha sido siempre un factor importante en la navegación. Schüle (1968), aplicó cálculos aritméticos para estudiar la visibilidad, pero el análisis espacial con SIG se ha mostrado, últimamente, como un enfoque exitoso para el estudio del paisaje arqueológico. A través de este póster analizamos la visibilidad marina utilizando tres enfoques complementarios: los métodos matemáticos, análisis de visibilidad con SIG y la información etnológica y la arqueología experimental. El caso de estudio seleccionado es «Cabo de Palos», ya que nos permite analizar diferentes tipos de visibilidad utilizando como puntos de control algunos yacimientos arqueológicos. El diálogo entre los resultados de estos tres análisis nos permitirá ajustar y mejorar los modelos iniciales y obtener datos cuantificables que se utilizarán para interpretar con mayor precisión el paisaje marítimo.

Palabras clave: arqueología marítima, análisis espacial marino, navegación en la Antigüedad, visibilidad.

CONSERVACIÓN Y TÉCNICAS ANALÍTICAS

CONSERVATION AND ANALYTICAL

The restoration *in situ* of a pavement in *opus sectile* in the Underwater Archaeological Park of Baiae (Naples, Italy)

La restauración *in situ* del pavimento en *opus sectile* en el Parque Arqueológico Subacuático de Baia (Nápoles, Italia)

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Abstract: Baiae was a famous seaside town very appreciated in antiquity for its temperate climate, beautiful setting and the properties of its thermal waters. At the end of the fourth century AD a bradyseism phenomenon caused the submersion of the city. In 2002 an Underwater Park, Marine Protected Area was created covering 176.6 hectares. The paper will show the *in situ* restoration work of the *opus sectile* pavement in the *thermae* of Punta Epitaffio, in the project «Restoring Underwater», defining the conservation strategies and most effective methods for the conservation *in situ* of this kind of Underwater Archaeological Heritage.

Key words: Baiae, *opus sectile* floor, restoration *in situ*, 3D documentation.

Resumen: Baia fue una famosa ciudad costera, muy apreciada en la antigüedad por su clima templado, su maravillosa localización y las propiedades de su agua mineral. Al final del cuarto siglo d. C. un fenómeno de bradiseísmo causó la sumersión de la ciudad. En 2002 fue creado un Parque Subacuático, un Área Marina Protegida que cubre 176.6 hectáreas. El artículo ilustrará la restauración del pavimento de *opus sectile* en las *termas* de Punta Epitaffio, en el

ámbito del proyecto «Restoring underwater», definiendo las estrategias de conservación y los métodos más eficaces por la conservación *in situ* de este tipo de Patrimonio Arqueológico Sumergido.

Palabras clave: Baia, pavimento en *opus sectile*, restauración *in situ*, documentación 3D.

Introduction

Baiae was a famous seaside town very appreciated in antiquity for its temperate climate, beautiful setting and the properties of its mineral waters that have been exploited since the second century BC. It was the most popular resort among the Roman aristocracy and the Imperial family until the end of the fourth century AD, when the bradyseism phenomena caused the submersion of the city. The submerged area includes part of the landscape of the ancient city of *Baiae* with its luxurious maritime villas, imperial buildings, more modest houses, private *thermae*, and *Portus Iulius*, the Roman harbour, warehouses and other infrastructures.

The interaction between natural processes and anthropic activity has modified the marine environment favouring the formation of new habitats. For this reason in 2002 an Underwater Park, Marine Protected Area (MPA) was created covering 176.6 hectares (Miniero, 2001).

In 2003, the ISCR started a project called «Restoring underwater» to test methods and materials for restoration and conservation of Underwater Archaeological Heritage of the Underwater Park of Baiae (<http://www.icr.beniculturali.it/pagina.cfm?usz=1&uid=69&idpro=4>, Petriaggi, 2005; Petriaggi/Davidde, 2012; Petriaggi/Davidde Petriaggi, 2015).

The aim of this paper is to present the *in situ* restoration work of the *opus sectile* floor in the *thermae* of Punta Epitaffio. The different phases of the restoration work including the 3D documentation and the archaeological study of the site, the identification of lithotypes, the characterization of the bioerosion processes and the conservation methods adopted.

Archaeological Overview

The study area is located near Plinth 39 of Zone A of the Marine Protected Area, Submerged Park of Baiae, alongside the Punta dell'Epitaffio Roman baths, and where, as we will see below, could appear a part of them. It was discovered in 2009 after being exposed as a result of rough seas. The area was covered in a substantial layer of sediment¹ and the debris of collapsed walls, and was not detected during the documentation of the baths at the end of the 1980s and the beginning of the 1990s, nor during the 2008 restoration of the Nymphaeum of Punta dell'Epitaffio by the *Soprintendenza* and the Via Herculanea excavation.

The *opus sectile* flooring is at a depth of 3.7 metres below sea level and, to the east, lies alongside the vestibule of the Baths of Punta dell'Epitaffio. It seems reasonable to assume, however, that it could be a part of the complex. The Punta dell'Epitaffio complex has been dated between the early part of the first century AD and the third century AD. It comprises two distinct nuclei: the baths complex and a nymphaeum (Di Fraia *et alii*, 1985-1986; Lombardo, 1993, 2009).

¹ The sediment is mainly coarse sand of volcanic origin (stone fragments, scoria, pumice and crystals). There are also larger rocks, presumably also of volcanic origin, and decorative marble in varying stages of fragmentation either from this area or the nearby baths.

The room in question is rectangular in shape with an internal surface area of about 3.35 m × 2.78 m. The entrance is on the southeast side, as evidenced by a Pentelic marble threshold (90 cm × 22 cm). There is some terracotta piping in the southeast corner. There is another piece of white marble halfway along the south wall, at the point where there is a wide gap of some 90 cm which opens onto another area where the walls are barely discernible as only a few centimetres have survived. The slab is not aligned with the flooring and, without excavating further, it is difficult to determine whether this constitutes a second entrance, possibly one added at a later date. The mostly poorly preserved walls are in brick and *opera reticulata*. In particular, only the two or three courses of bricks have survived in the west wall, and the south wall rises only to a height 10 cm to 20 cm. The brickwork of the southwest corner contains a second terracotta pipe, sealed off with mortar. The north wall consists of four different sections. Starting at the northwest corner, there is a short stretch of wall in good condition, preserved up to a height of 40 cm. This abuts onto a wall with a maximum height of 60 cm. between this and the brick wall that forms the northeast corner there is a stretch of wall with *cubilia*, but only the first 1.45-metre course of bricks has survived. Finally, the west side includes a stretch of surface decoration, albeit only up to the first two or three courses of bricks, and a semicircular wall abuts externally, part of another area. Near the northwest corner there is a triangular hole in the exterior at the level of a small adjacent room. All four walls have marble panelling, principally Pavonazzetto.

The room is paved in *opus sectile*, with the marble preserved only in the southwest corner, while for the remainder of the floor only the substrate of marble and brick fragments remains. The *opus sectile* reveals two forms of *modulo semplice*: one with large rectangular slabs and one of *modulo a quadrato* Q3. The former appears in the north section and at the edges while the central section has Q3 (Guidobaldi, 1985; Guidobaldi/Angelelli, 2008).

The *modulo a quadrato* is characterized by a 40 cm square (40.4 cm to be precise) containing two smaller squares, one oblique and the other in line with the main square. The latter consists of edging tiles some 20 cm long (20.2 cm), while the oblique square is some 29 cm long, equivalent to one Roman foot.

The mapping of the stone materials used in the *modulo quadrato* Q3 section, albeit somewhat fragmentary, reveals the use of a *modulo* resembling Q3B2. The central section has

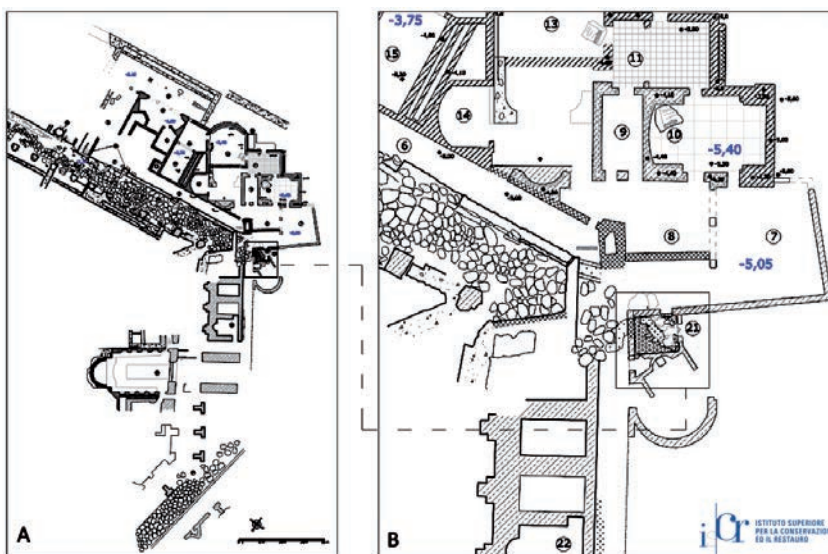


Figure 1. Punta Epitaffio area. A – Nymphaeum of Emperor Claudius and Thermae; B – Detail of the Thermae with the *opus sectile* pavement. 6 – Corridor; 7 – Palaestra; 8 – Vestibule; 9 – Disengagement; 10 – Calidarium; 11 – Tepidarium; 12 – Laconicum; 13 – Frigidarium; 14 – Apsed; 15 – Natatio; 21 – Opus sectile pavement; 22 – Rooms. (Relief by Filomena Lucci, Archive ISCR).

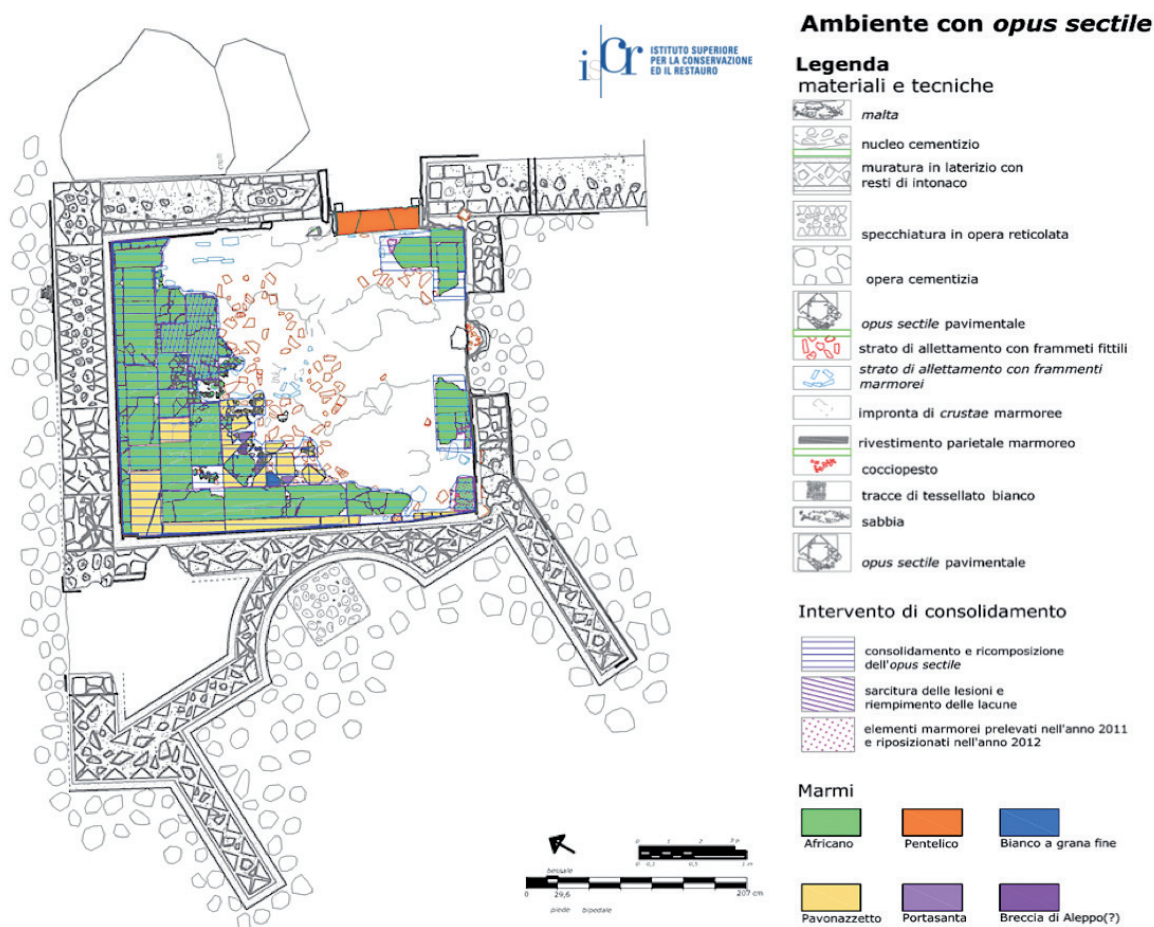


Figure 2. Thermae of Punta Epitaffio, map of the floor made of *opus sectile*. Construction techniques, conservation works and lithotypes are shown (Relief by Filomena Lucci, Archive ISCR).

alternating light and dark tiles (Pavonazzetto and African marble, respectively), with less regularity observed in the larger square of the same *modulo*. While the external square appears to have been almost exclusively executed in Pavonazzetto, the oblique squares use triangles of African marble, Porta Santa marble and, in one instance probably Breccia di Aleppo marble. We can therefore specify the modulo Q3 *opus sectile* in Guidobaldi's words: «...a due marmi prevalenti ('Africano' e 'Pavonazzetto'), alternati con inversione cromatica, alquanto 'spurio' per frequenti sostituzioni del litotipo colorato con 'Portasanta' e forse altri marmi (Breccia di Aleppo?)». We might surmise that uniform lithotypes could not be used to provide the geometrical uniformity required, or that some of the tiles are replacements. Nevertheless, it is clear that careful attention has been given to the chromatic distribution of the marble. The edges of the area have been straightened using thin rectangular, triangular or stretched trapezoidal slabs and slats. The west edge and north section of the room exhibit a rectangular *modulo*. The slabs have a width of approximately one Roman foot (29 cm) and are about double this in length (58 cm). The smaller rectangular slabs that alternate with the larger ones in the floor of the north section of the area are also one Roman foot in length. Pavonazzetto marble has been used, with beautiful violet to blood-red veining, especially in the edging that straightens the west section of the baths. Only the large rectangular slab used in the northwest part of the room uses Docimio marble, with minimal veining and a thickness varying between several millimetres and several centimetres. The perimeter of the northeast sector use standard African marble. The large slabs along the perimeter are of Lucullan marble with high calcare-

ous content and range from pale pink to deep red in colour. They are embedded into a grey-black core. This spreads into the large calcareous clasts through extensive veining and striation, to the point that there is no clear distinction between clast and core. The exception to this rule are the strips and slabs in the southwest sector, which are of green African marble. The rectangular slabs on the north side are all Lucullan marble, in particular the dark variety. Two of the triangles are of a pink variety very similar to the various Chios marble facies. Most of the remaining *modulo* 8 and 11 tiles are Pavonazzetto apart from two triangular tiles of Porta Santa marble and a white fine-grained macroscopically unidentifiable marble (possibly a white variety of Docimio marble). To summarise, while the edges and the north sector have a prevalence of dark flooring, the central sector has pale squares mainly of Pavonazzetto alongside dark squares of African marble.

This floor bears a strong resemblance to some of the floors of the Mount Vesuvius area (Guidobaldi/Olevano, 1998), in particular the geometrically identical *opus sectile* of Room 42 of Pompeii's House of the Golden Bracelet with marble *scutulae* that produce a similar chromatic pattern (room n. 42; Guidobaldi/Olevano, 1998: tav. 12).

There are also strong similarities with *tablinum* 15 of the *Casa di Lucrezio a Stabia* (Guidobaldi/Olevano, 1998: tav. 10). A floor with a similar geometrical pattern and, to some extent, a similar chromatic alternation in the marble (including Porta Santa marble) can be found in the *Casa dei Cervi* of Herculaneum (Bruno, 2002). Another example of square Q3, albeit using three pieces to form the triangles of the external square, is that housed in the *Antiquarium Comunale* in Rome, which exhibits a central alternation of light and dark tiles similar in colour to the triangles of the external square. The yellow triangles of the intervening square are of Giallo Antico and Porta Santa marble, with the external ones of Pavonazzetto and yellow Numidian marble (Salveti, 2002).

Condition

Extensive conservation measures were undertaken between 31 May and 30 June 2011. The floor lay under a layer of sediment, rubble and sundry material some 50 cm thick. What could be seen of the marble was cracked and flimsily attached to the substrate, and therefore liable to detach.

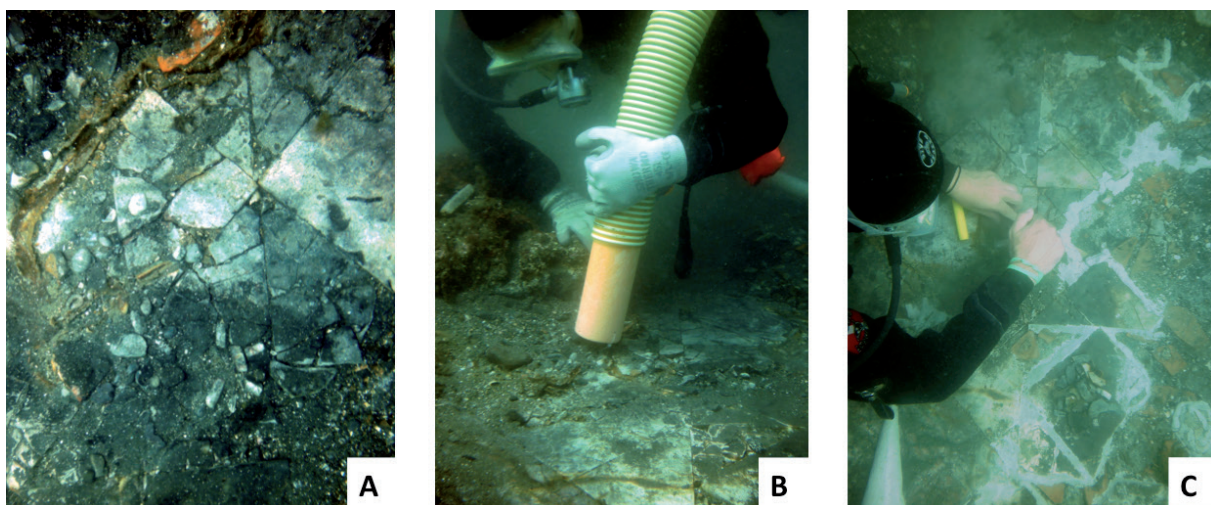


Figure 3. Phases of the restoration works. A - detail of the state of preservation of the floor after its discovery. B - cleaning of the floor with water dredge. C - consolidation through hydraulic mortar (Archive ISCR).

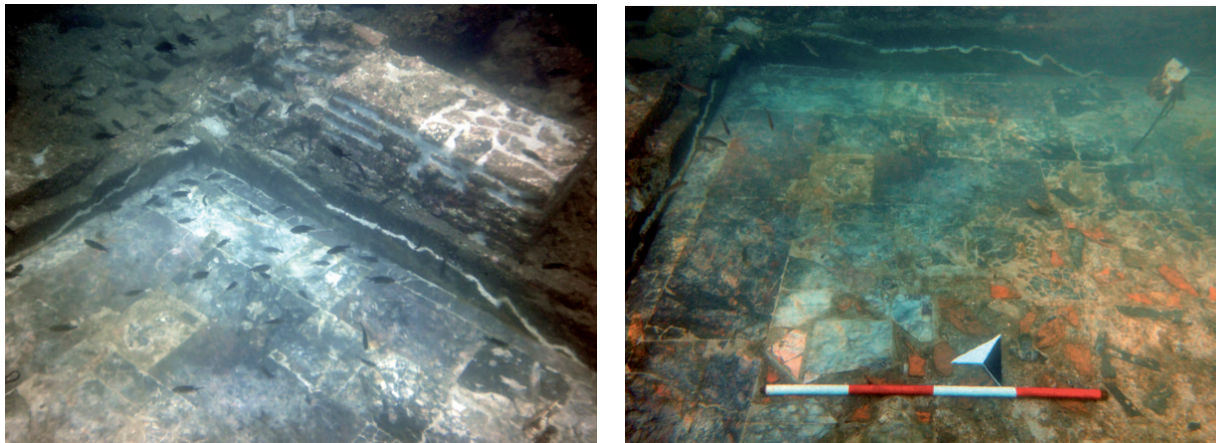


Figure 4. *Opus sectile* after restoration (Archive ISCR).

Beneath the rubble, some 50% of the surface of the floor had holes in it, with widespread cracking of the central areas. The marble surface of the central area was in addition covered with a widespread film-like blackish-brown incrustation. The material below this film was sometimes in good condition and regained its original colour after cleaning.

The walls showed widespread biological colonization across all of the surfaces. This had resulted in a weakening of the mortar and consequent collapse of the brick or tuff of the walls. At 30 cm above floor level, the north wall had a hole some 35 cm deep caused by marine erosion.

Conservation

The area was initially freed of sediment using a water dredge (Figure 3B) and the collapsed wall debris was removed, documented and relocated. Dredging was interleaved with preliminary reinforcement of the *opus sectile* marble fragments. Parts firmly secured to the substrate were pointed along the perimeter, with the addition of a kerb to protect from further marine erosion. Loose sections were removed to have their upper and lower surfaces cleaned, after which they were replaced in their original locations. Sediment and traces of biological encrustations were found beneath the individual fragments in most of the damaged areas. The presence of Polychaetes worms was also observed, as they frequently dislodged elements or fragments which had been replaced only the previous day, overcoming the bonding strength of the still-hardening grouting. The original substrate and all the brick and marble used to level out the slabs was reinforced by pointing the cracks and creating mortar edging along the perimeter of the damaged areas as well as within them. The widespread film of blackish-brown incrustation was removed using a scraper with replaceable blades. The same technique was used to eliminate traces left by encrusting epilithic organisms, which had affected the marble's colour in some cases. The marble pieces recovered at the moment of the discovery were replaced in their original positions, that had been determined at that time. The walls were reinforced, after which the removal of biological infestation was effected using scalpels and scrapers. Reinforcement was undertaken first in order to permit subsequent more thorough cleaning. Mortar was applied using plastic bags similar to those using in baking. The north wall was reinforced by filling the hole with ashlar bedded in Volteco «Microlime Gel»® mortar. To produce the correct chromatic effect, a Bayer pigment was added to the mortar (Figs. 3C and 4).

Documentation

The whole area and the phases of its restoration were documented manually by Filomena Lucici. In addition, ISCR tested, for the first time in the Baiae area, the Naumacos L1 underwater scanner designed by Gabriele Gomez De Ayala for documenting underwater architectural sites and planning conservation work. This light and compact instrument (15 × 16 × 10 cm - 4 kg) proved particularly valuable in producing an extremely precise and faithful 3D model of the original. This was invaluable in the production of archaeological documentation and the planning of conservation and maintenance tasks. This underwater scanner is an open system, well-suited to the unpredictably changeable conditions of underwater archaeological sites. To capture the level of detail required, the system was configured to give an accuracy of 0.05 mm at a resolution of 1 200 000 pixels. Many of the areas scanned were spatially aligned in post-production using reference points, shooting angles, solid forms and scanner metadata. The underwater scanner also captures textures which are subsequently rendered in the 3D model. These textures are acquired together with associated spatial coordinates, ensuring a perfectly faithful 3D model. Two different texture capture technologies are used, RGB point sampling and high-resolution spatially-annotated digital photography, which allows optimal results to be obtained in the variably turbid waters. For detailed scanning of larger areas, the system is configured to capture several square metres at a time, with an accuracy of 0.5/1/2 mm (Davide Petriaggi/Petriaggi/Gomez de Ayala, 2013). A given area can be scanned from different angles with the results merged into a single 3D model later. ISCR and Gomez de Ayala continued their collaborative work in subsequent years and for the documentation and restoration tasks undertaken in 2012, 2013 and 2014 at the *Villa con Ingresso a Protiro* complex using the Naumacos L3, an upgraded version of the scanner that offers a number of innovative advantages such as being able to capture surface detail in motion rather than from a fixed point as was the case with the Naumacos L1.

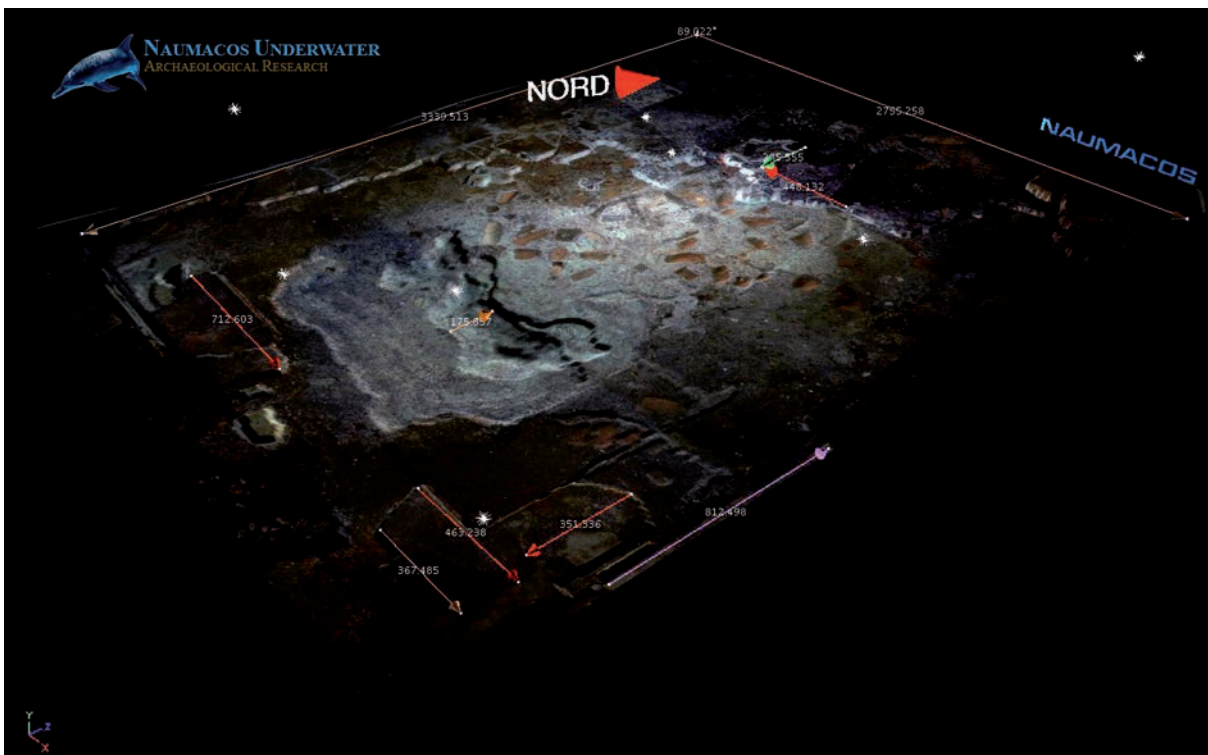


Figure 5. 3D laser scan relief (by Gabriele Gomez de Ayala, Archive ISCR).



Figure 6. The square opening created in the geotextile (Archive ISCR).

In situ protection

Once restoration work had been completed, a layer of Terram 2000 geofabric, generously provided by Officine Maccaferri, was placed over the floor and held in place with gravel-filled bags. To allow access, in agreement with Dr. Paolo Caputo, director of the Marine Protected Area, a square opening was created where the floor was covered only by the sand of the sea bed (Fig. 6). All the archaeological, biological and conservation data has been deposited with the analytical data card of underwater archaeological finds (SAMAS - Scheda Analitica manufatti Archeologici Sommersi) for diagnosing the deterioration (Petriaggi/Davidde, 2005) and added to the *Baia Sommersa* GIS, managed by ISCR (Davidde/Petriaggi/Gomez de Ayala, 2011).

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Recovery of super-fragile materials in underwater sites with silicone elastomers

Recuperación de materiales súper frágiles en yacimientos sumergidos con elastómeros de silicona

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Abstract: Super-fragile materials existing in underwater archaeological sites are an invaluable source of historical information which are rarely documented due to their poor condition. Natural fiber ropes used for rigging historic vessels are a key to understanding the evolution of nautical architecture in antiquity. A new method of molding adapted to super-fragile materials is being developed with trials on artificially aged hemp ropes. A system of laboratory scale molding designed for experimentation has been developed with three parameters in play; degradation of sample, viscosity of elastomer and pressure of molding. Preliminary results show the expected advantage of using low viscosity and high pressure for increasing accuracy of the impression in the mold. Whereas, it's necessary to progress in the affection of these factors on the integrity of degraded cordage. Optical evaluation with 3D microscopy allows to relate the factors of pressure and viscosity with the damage in the super-fragile object during underwater molding technique.

Key words: Conservation, silicone, molding, cordage, super-fragile.

Resumen: Los materiales superfrágiles hallados en yacimientos arqueológicos subacuáticos son una valiosa fuente de información raramente documentada por su degradación. Las cuerdas del aparejo en las embarcaciones históricas constituyen una clave para entender la evolución de la arquitectura náutica. Un nuevo método de moldeo para materiales superfrágiles ha sido ensayado sobre cuerdas de cáñamo artificialmente envejecidas con un sistema de moldeo a escala de laboratorio diseñado para experimentación a partir de tres parámetros: la degradación de la muestra, la viscosidad del elastómero y la presión de moldeo. Los resultados preliminares muestran la previsible ventaja de usar baja viscosidad y alta presión para aumentar la exactitud de la impresión. No obstante, es necesario avanzar en los efectos de estos factores sobre la integridad de la cuerda degradada. La evaluación óptica con microscopía 3D permite relacionar los factores de presión y viscosidad con el daño en el objeto súper frágil durante la ejecución de la técnica del moldeo subacuático.

Palabras clave: conservación, silicona, moldeo, cuerdas, superfrágil.

Introduction

A variety of materials made with plant fibers are included in ancient ships such as: cordage, sails, baskets and cloths. Consequently all are candidates to be found during excavations. The probability that they could be reported is the result of an equation with several factors: the object fabric and nature, the object-ambient conditions, the length of burial and the success of excavation. We only are responsible of the fourth one and this is the focus of the present work.

Scientific knowledge predicts a low percentage of survival for cellulosic materials as a consequence of their particular fabric which consists of small fibers. The feature that imparts its special qualities of resistance and flexibility are also the main reasons for early decay. Cordage in particular, is a functional tool designed and made with plant fibers with incomparable applications related to the development of humanity. Evidences of the use of ropes in archaeological sites from prehistory are valuable documents that can only be reported when exceptional circumstances of conservation occur. On these occasions, materials may appear in unreal good conditions hiding a very fragile object with a poor level of physical resistance.

In the underwater environment it is not uncommon to find such types of degraded objects. As we said, although they appear to be in good condition, they crumble when touched. They are characterized by having undergone a severe degradation of the original chemical compounds (Florian, 1988) which affects their consistency but not their physical aspect. Although degraded, their shape makes these well-preserved objects a source of invaluable archaeological documentation.

The main component of plant fiber is cellulose which in underwater environments undergoes a hydrolysis process filling the cellular structure with water thus reducing the original resistance. Once hydrolyzed the object cannot resist erosion unless it becomes protected under a stable cover of sand or mud.

If this happens we can find a type of object with a well conserved shape but with an unhandleable consistency and therefore difficult to study. We call these super-fragile materials and the experience shows that they invariably disappear during archaeological excavations. This work is aimed for the scientific interest and the principles of conservation.

Both questions converge in the scarcity of archaeological evidences –cordage in particular– for seafaring in ancient periods. All the fragments of cordage recovered from underwater archaeological sites in ancient periods, when joined together, hardly come to a set of ten linear

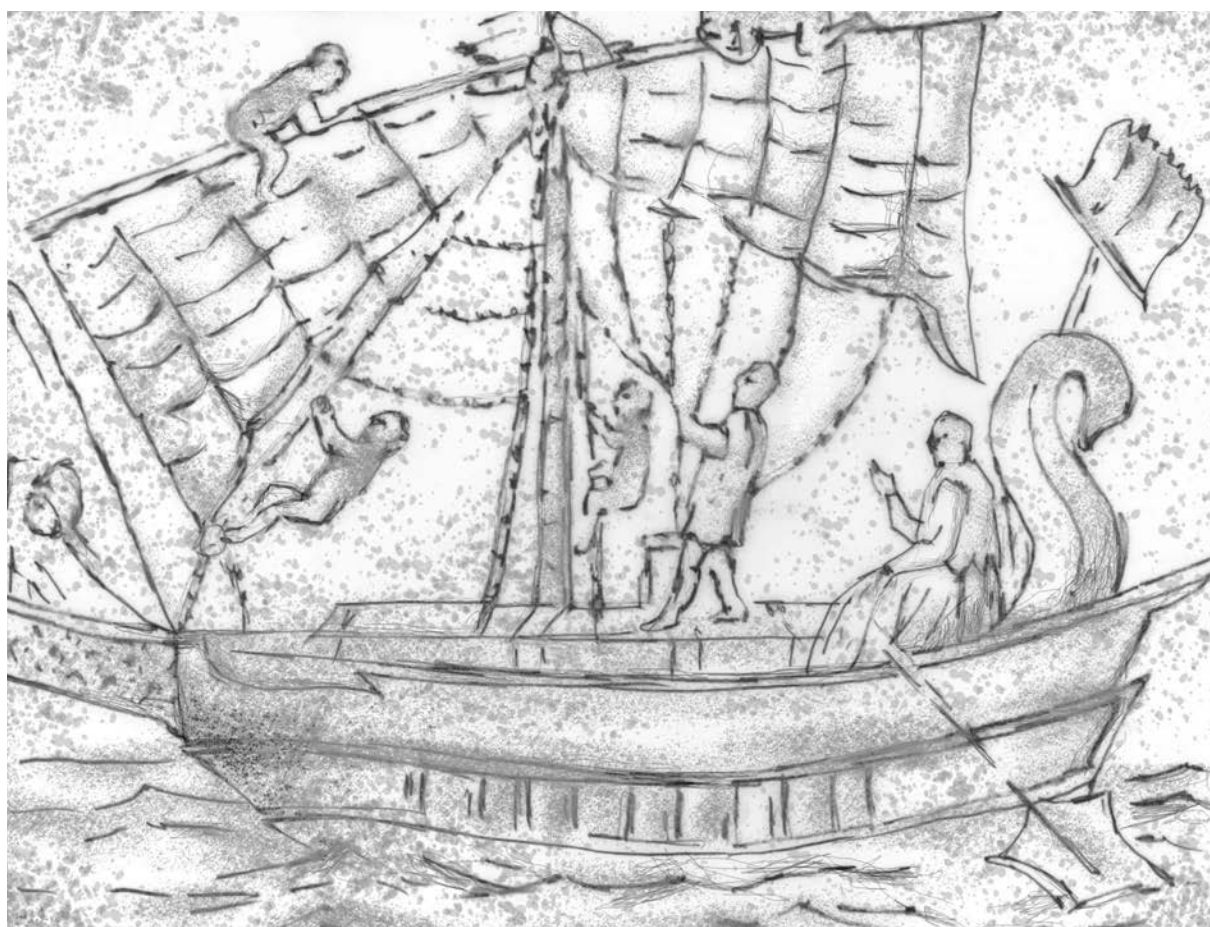


Figure 1. Rigging works with cordage and sails in a roman ship. Draw from a Pompeian painting (L.C. Zambrano).

meters (Charlton, 1996). For these reasons our purpose is to develop an effective methodology to recover the super-fragile materials using silicone elastomer.

Our premise is that the manufacture of molds with elastomer avoids collapse during excavation. The underwater molding technique has been developed during the last century as an alternative to the removal of bulky objects. There are references to these molds as in the medieval whaling ship in Red Bay (Murdock/Daley, 1984) and the cyclopean sculptures in Alexandria (Empereur, 2000). But in these and others cases molding has been used as a tool to record the archaeological remains.

Underwater molding technique for super-fragile objects

Molding, as an *in situ* conservation technique for fragile objects, is an alternative, though not a well known, application. It was first applied in Mazarrón 1; a nautical structure of 2700 year old timbers, extracted from the seabed with a silicone mold and polyester counter-mold (Negueruela *et alli*, 2000).

An area of 9 m² consisting of assembled fragile timber which repletes precisely joints and marks of carpentry, was covered with 400 kg of silicone elastomer and 600 kg of polyester resin in order to remove, without damage, a valuable example of Phoenician nautical architecture.

During the excavation of Mazarrón 1 (1994-1996), the first experiments of super-fragile material recovery were conducted on ropes, dunnage and mats (Zambrano, 2003). This work forms the basis of our experience in the treatment of these types of materials in underwater sites. Silicone elastomer RTV with thixotropic additive was the product used to make molding supports under different circumstances and with differing results. Sometimes the molding system does not work properly causing damage to the object due to excessive pressure during the application or lack of adaptation producing inadequate efforts. Viscosity of elastomer and handling pressure are determinant factors in the success of underwater molding technique.

Success in the process of underwater molding technique for super-fragile materials is equivalent to the preservation of its physical and chemical integrity. Main hazards in the process are the risk of deformation, erosion and breaking due to the poor physical condition of material. Physical characterization of these uncommon materials is necessary for improving results in the whole treatment of these materials from recovery to final restoration.

In the process of recovery, handling super-fragile material with confidence needs a support structure for evenly distributing stress. A mold is a support tailored to the object topography. The more contact there is between the silicone on the object, the better the result. The process of molding requires manual dexterity for guaranteeing success. But this factor is beyond the scope of this work. Our aim is to find a suitable protocol testing the product formulation and the handling process of underwater molding considering the most relevant factors in the success of this.

Following from our experience, further investigations on the method of underwater molding with super fragile materials will need to resolve two determinant questions: the viscosity of silicone elastomer and the handed pressure in molding. Both are directly associated with the



Figure 2. Recovering small fragments of cordage with silicone mold during the excavation of Mazarrón 1 (Photo P. Ortiz).

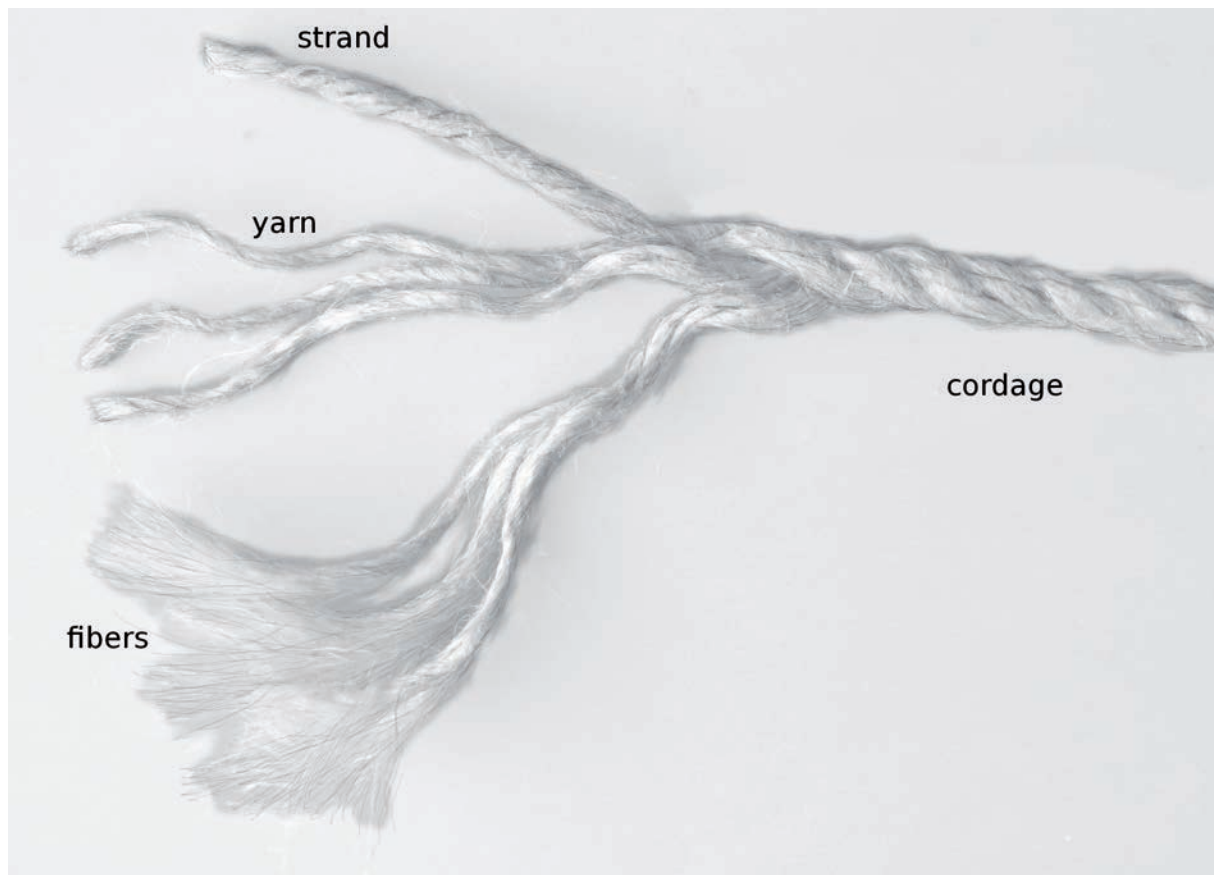


Figure 3. Hemp (*Cannabis sativa*) cordage, 3 strands in «Z» employed in experimentation. Four levels of control in affection on the sample are monitored: 1/ cordage, 2/ strand, 3/ yarn and 4/ fibers.

physical resistance of the archaeological material. Based on these premises an experimental methodology has been designed for resolving several obstacles with, two principals: 1) provide sufficient samples of super-fragile material in quantity and quality for testing the molding system creating a characterization model of samples according to the typical levels of deterioration in underwater sites; 2) develop a laboratory scale system for underwater molding that allows to compare variations in pressure and viscosity over very fragile samples.

Sampling and characterization model

The limited availability of super-fragile materials for experimentation has made it necessary to manufacture test tubes with artificially aged materials. For reasons of archaeological interest and suitability for experimentation, the object selected has been the hemp (*Cannabis sativa*) cord.

Samples are treated with a system of aging to obtain similar degradation to that of the original material in the archaeological context. The system of aging used has been the static immersion of fragments in a concentrated sulfuric acid solution at 70° C in an oven with a time increment for obtaining each level of degradation: 1) discharge; 2) average and 3) low. Acid hydrolysis of cellulose causes a swelling of the fibers. The cellulose dissolution results in a loss of consistency of the entangled fibers along the rope. This is an obstacle in handling test tubes. Therefore, it is necessary to devise a system for supporting the aged rope during and after aging.

Physical characterization of super fragile materials is necessary in order to evaluate the underwater molding technique. Therefore a characterization models was developed based on two measurable parameters adapted to our goals: 1) pressure resistance index (PRI %) and 2) maximum moisture content (MMC %).

Pressure resistance index (PRI %) is a physical parameter to measure the resistance to deformation. In practice, the method consists in measuring the penetration of a cylinder with a rounded end which exerts a force of 0.98 N. Operating with an info-graphic application we are able to know the relative resistance to penetration of any kind of cordage naturally or artificially aged.

This method is an adaptation of the system proposed by Christensen (1971) to evaluate degradation of underwater archaeological wood. The innovation of the present method is its application to extremely soft objects and its standardization using a controlled pressure system enabling quantification of the traces of deformation produced in the material.

Maximum moisture content (%) is a physical parameter to measure the proportional content of water. This value is directly related with the dissolution of cellulose and with sample degradation. In practice the method consists of weighing the aged sample in two stages; before drying at 100° C in oven during 1 hour –Wet Weight–, and post drying –Dry Weight–. The difference of both weights obtained from the formula (1) is the value of maximum moisture content of the sample in percent. The method is based on the work of archaeological wood characterization of saturated humidity (De Jong, 1977).

$$\text{Maximum Moisture Content} = [\text{Wet Weight} - \text{Dry Weight} / \text{Dry Weight}] \times 100$$

Combining the values obtained in test of MMC % and PRI % allows to establish reliable and sufficiently broad margins to characterize degraded hemp ropes. The combination of these margins is proposed as a general model for the characterization of hemp ropes from underwater archaeological sites. This model of characterization could be implemented in the recovery of materials by *in situ* super-fragile tactile examination of archaeological objects in order to establish their resistance to manipulation.

Degradation	Moisture Content (%)	Pressure Resistance (%)
High	155-170 %	5-20 %
PM1 B	90-120 %	30-45 %
PM6-B	55-70 %	65-80 %

Figure 4. Purposing model for physical characterization of underwater archaeological hemp ropes.

Laboratory molding scale system

An instrumental substructure was developed to reproduce conditions of underwater molding in the laboratory for monitoring the parameters of silicone viscosity and handling pressure. This equipment allows controlling the parameters of viscosity and molding pressure in aquatic conditions with special care to the handling of super-fragile samples.

Silicon elastomer used for molding purpose is a commercial formulation of polydimetil siloxane (PDMS) with reactive groups and condensation catalysis. Special applications in under-

water environment required changing the typical combination of components (catalyzer, thixotropic additive and silicone oil) in order to improve results. Time of polymerization, gravity weight, viscosity, shrinkage and viscosity experiment changes in the aquatic application of silicone. The chemical and physical characterization of silicone elastomer, which is currently in progress, will form part of the final doctoral thesis.

As we have already stated, the inference of silicone with the super-fragile material during the molding process is a physical risk that depends of two main factors: 1) silicone viscosity and 2) molding handling pressure.

The low viscosity of silicone makes it more adaptable for object relief. The viscosity of silicone elastomer can be modified by addition of silicone oil –50 cts– until a 10% limit. This formulation increases the accuracy of the replica and avoids the physical risks from the pressure of silicone on the fragile material.

The Silicone elastomer used in our experiment is Silastic 3481®. As we have proved in previous experiences this polymer is suitable for underwater molding applications. A fine characterization of the commercial product has been carried out in order to know the exact chemical composition as well as the physical performance under both dry and underwater conditions.

The method of silicone adaptation needs to exert some pressure on the object surface that is transmitted to the whole. Achieving the best fit with the minimum pressure is an objective of this project. Three calibrated weight of 0.981 Newtons (100 g/cm²), 0.735 Newtons (75 g/cm²) and 0.49 Newtons (50 g/cm²) for the three levels of pressure; P1, P2 and P3 are provided.

Experimental Method in practice consists in:

1. Drop silicone mixture into the molding box that has been placed over the cordage.
2. Apply pressure with the tare weight (0.98-0.73 or 0.49 N) to adapt the silicone.
3. Leave silicone to mold for 24 hours.
4. Release weight tare, molding box pieces and silicone molding.

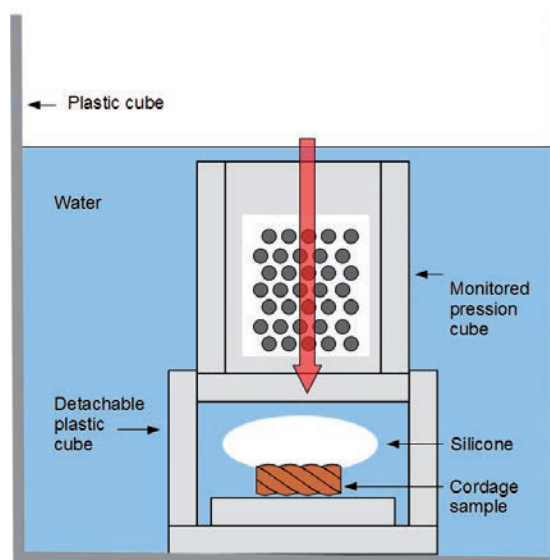


Figure 5. Schema of laboratory molding system for super-fragile samples of cordage. Applying silicone phase with controlled pressure.

To put in relation viscosity and pressure with resistance a test plan was made to find the best relation between the three factors in three levels High, Medium and Low. Combining the 9 values described (viscosity 1-2-3, resistance 1-2-3 and pressure 1-2-3) we obtained 27 molding test shown in the table and designated D1/P1/V1, D1/P1/V2, D1/P1/V3, ... and so on.

To check the effectiveness of the underwater molds both in the fidelity of copy as in impact over the original sample we have used the optical comparison with info-graphics tools of 27 pair samples of silicone-mold and plaster-positive in order to find the best relation of pressure and viscosity for each degree of degradation. The optical resources allow to compare incidence of molding in samples with different conditions analyzing numerical values in different levels of accuracy; whole cordage, strands, yarns and fibers.

The focus of study is the superficial relief of the cordage taking into consideration that rugosity in resulting copy decreases with the increase of degradation rate. While the high level of pressure and low viscosity provide better results in terms of accuracy, it is also true that excessive pressure increases the risk of deformation. Under such conditions viscosity plays an important role in increasing the fluidity of the silicone allowing for reducing the necessary pressure for obtaining results with the same level of accuracy. By relating between all the values tested we will be able to predict the best conditions for molding as related to the state of preservation of the object.

Discussion of results in progress

Physical characterization by tactile examination and objective measurements allows us to classify different degrees of coherence in fragile materials.

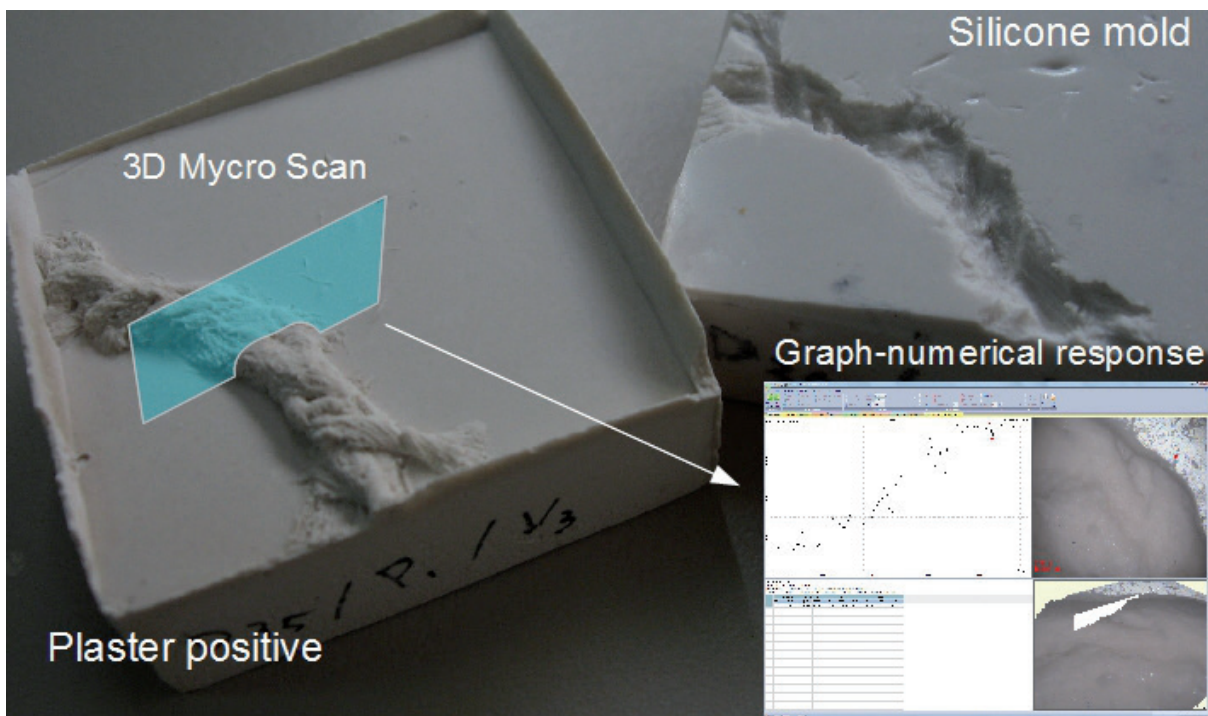


Figure 6. Example of microanalysis with 3D scanner on the mold of a sample highly degraded (D1), maximum pressure (P1) and low viscosity (V3).

Underwater molding techniques allow recovery of super fragile samples of fiber plant cordage, however, different levels of fidelity were observed in the mold impacting original material and were dependent on interplay of factors related to handling pressure, silicone viscosity and material resistance.

Initial results show the expected advantage of using low viscosity formulations to obtain better fidelity in recordings. This preliminary result is in agreement with a low pressure of handling to get similar results of fidelity that preserve the integrity of the original material.

Moreover, handling of low viscosity formulations is more difficult and implies risks for the integrity of materials during the molding process. The low resistance of samples shows clearly the breaking effect of pressure under the weight of silicone applied by hand.

In the absence of complete results we anticipate that the technique of underwater molding will be optimized by applying new tools aimed at the studying and the conservation of materials. These are the physical characterization of super fragile archaeological objects in order to establish their resistance to manipulation and the specific formulations of silicone elastomer in combination with the handling pressure adapted to the resistance of the original material.

Acknowledgements

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Binary drying method: One solution for the preservation of large waterlogged wood

Método de secado binario: una solución para la preservación de maderas de gran tamaño saturadas de agua

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Abstract: The drying of waterlogged archaeological woods, particularly the larger, presents, from the point of view of conservation and restoration enormous problems and difficulties. The necessity to find better alternatives, more economical and easy to implement is very important in this context. The development of binary drying technique brings new possibilities in the conservation of this heritage, as well as solves the difficult task of drying well preserved woods. This method allows the drying of the woods in good condition without adding consolidants, enabling the natural drying, keeping the essence of the timber. Moreover, this method also revealed an alternative treatment to combine others types of treatments especially with sucrose at low concentrations. In this sense, the binary drying method has showed himself to be effective in the treatment of well preserved wood, levels 1 and 2 according to the diagnostic method PRT (Penetration resistance test).

Key words: Wood, Conservation, Underwater Archaeology, Wood Drying, Heritage.

Resumen: el secado de maderas arqueológicas empapadas, especialmente las más grandes, presenta desde el punto de vista de la conservación y restauración enormes problemas y dificultades. La necesidad de encontrar mejores alternativas, más económicas y fáciles de implementar es muy importante en este contexto. El desarrollo de la técnica de secado binario trae nuevas posibilidades en la conservación de este patrimonio, así como a la hora de resolver la difícil tarea con maderas bien conservadas secas. Este método permite el secado de las maderas en buen estado sin añadir consolidantes, permitiendo el secado natural, manteniendo la esencia de la madera. Además, este método también reveló un tratamiento alternativo para combinar otros tipos de tratamientos, especialmente con sacarosa en concentraciones bajas. En este sentido, el método de secado binario demostró ser eficaz en el tratamiento de la madera bien conservada, de los niveles 1 y 2 de acuerdo con el método de diagnóstico PRT (prueba de resistencia a la penetración).

Palabras clave: madera, conservación, arqueología subacuática, secado de la madera, patrimonio.

Research aims

The need to develop new treatment techniques applicable to waterlogged archaeological wood, especially with regard to large objects, is urgent. The scientific community, specialized laboratories have had great difficulty in bridging this problem, there are many cases of objects that are stored in tanks and pools waiting for a viable solution for their treatment.

In this sense the objective of this project is to develop a drying treatment for the large woods that is physically and economically practicable.

Although treatment by binary drying can be combined with other treatments, our main goal focuses on the treatment of well preserved woods, with the main objective is the elimination of the necessity of the impregnation with consolidants in the woods, allowing a safe drying and without deformation of shapes, returning to the object its unique features.

Introduction

The preservation of archaeological wood from a humid environment, it is today, an area that presents a major challenge with regard to their conservation. Ironically this problem increases as better preserved these woods are. The dense woods in good condition have pores of very small diameters and clogged with natural materials of wood. This complicates the permeation of the consolidants inside, preventing the strengthening of the degraded woody tissue and that enter into cells in order to control the shrinkage and deformation of these timbers during the drying treatment.

Moreover, the size of the objects is also a problem, as the best treatment techniques are difficult to apply on large objects.

In this way, the necessity to find other solutions and methods to make these mixed dryings with the least possible damage have a great importance.

The development of binary drying methodology are making an important contribution to solving this problem, since it allows treating and dry the archaeological woods well preserved without the need for impregnation and consolidation treatments, allowing a natural drying without defects and distortions of forms and preventing a number of side effects present in the current treatments.

Material and methodology

The research was conducted on a set of 8 samples of archaeological wood of different species from various locations and in different conservation status (table 1).

The samples PM2, PM3, PM4 and PM5 are divided into two resulting in two test samples and subjected to two different dryings – normal air drying and binary drying, in order to compare the actual results and see effects of binary drying in the woods. The samples of PM1 and PM6 groups were not divided but belong to the same species and wood objects group with similar levels of degradation.

Ref.	T.H.	Species	Origin	Degree of deterioration of the woody tissue
PM 1 A	98.1%	Ulmus Minor (hardwood)	Tróia I	1
PM1 B	192.4%	Ulmus-Minor (hardwood)	Tróia I	1
PM2 A/B	107.6%	hardwood	Ria de Aveiro F (14)	1
PM3 A/B	118.2%	hardwood	Museu da levada	2
PM4 A/B	670%	hardwood	Ria de Aveiro F	10
PM5 A/B	360%	Pinus (softwood)	Ria de Aveiro A	1
PM6 A	617.4%	hardwood	Museu da levada	5
PM6-B	362%	hardwood	Museu da levada	5

Table 1. Test sample (Adapted Monteiro, 2014).

The samples were measured and weighed before and after drying. The moisture content of the sample was calculated using the test method of drying in an oven at 102° C and calculated by the following formula:

$$M_c = \frac{M_1 - M_2}{M_2} \times 100$$

M_c = moisture content

M_1 = mass of the wet sample

M_2 = dry mass of the specimen in an oven at 102° C

The diagnostic process of the woody tissue preservation condition was performed according to the new analysis method PRT, since the method proposed by De Jong (1977) is not correct and is not applicable due to the fact that the relationship between the content humidity and the actual state of degradation of the woods is not relatable or proportional (Monteiro, 2014).

During investigations it was realized that the three classification levels commonly used in the literature to diagnose woods conservation status did not correspond to reality. This is evidenced by the observation of some samples where its moisture content were above 350%, and yet, the timber had a very good conservation state, and that when diagnosed by De Jong method are considered in very bad condition. This situation posed a big problem, because there was no method of diagnosis that would allow us to diagnose accurately the woods conservation status.

Thus it was necessary to develop a new diagnostic system that allows us to calculate the tissue conservation status of wood and relate it to the treatments, in order to understand what woods and what conservation levels are best suited to binary drying.

The development of the diagnostic system designated Penetration Resistance Test, short for PRT, allows to calculate with scientific accuracy the current state of conservation of archaeological wood.

This method consists in sticking a probe with two millimeters of diameter in the tangential or radial section of wood with an accurate pressure of 3 121 kgf / m² which was calculated by testing on the wooden *Ochroma pyramidal*. This wood was chosen because it is the most fragile wood and with less resistance penetration in the market. So the pressure of 3 121 kgf / m² is the zero point of the timber resistance and provides the basis for all woods.

The data collected from the test are converted into degradation levels by the following formula:

$$\text{Conversion of level of degradation} = \frac{Pd}{\frac{b}{2}} \times 100$$

The result is expressed in percentage and converted into a level of degradation as we can see in Table 2.

Percentage estimates between	Conversion level of degradation	Condition of the woody tissue	From the viewpoint of treatment
0%-10%	1	Very good	No need for consolidants
11%-20%	2	Good	
21%-30%	3	Reasonable	Needs assessment
31%-40%	4	Severe 1	Partial deformation
41%-50%	5	Severe 2	
51%-60%	6	Severe 3	
61%-70%	7	Destroyed 1	Total strain
71%-80%	8	Destroyed 2	
81%-90%	9	Destroyed 3	
91%-100%	10	Destroyed 4	

Table 2. Conversion table (Monteiro, 2014).

As already mentioned each sample was divided into two and subjected to different drying.

The first group of samples (Acronyme A) was placed in air dry in the shade without any special care or treatment.

The second group (Acronyme B) was treated by binary drying method. This method involves subjecting the wood to an artificial environment which develops in two different drying stages (Fig. 1). The two phases were named absolute drying –which promotes an effective drying of the wood through the release of water into the environment by exposure to infrared radiation, which promotes heating and consequent evaporation of water– and calibration drying –where there is no release of water into the environment, but instead, we have a drying of the more humid areas of wood and the consequently humidification of the driest areas–. This «smart» dry-

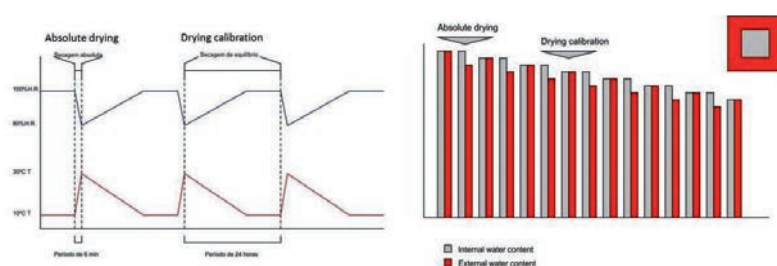


Figure 1. Theoretical model of the artificial environment produced by binary drying (Adapted Monteiro, 2014) and theoretical graphic the evolution of moisture content in the wood during drying.

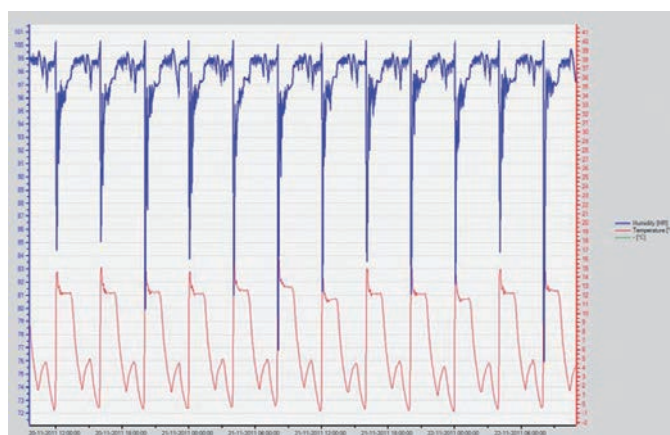


Figure 2. Environmental standard graph produced by climate chamber (Monteiro, 2014).

ing liberates the timber from natural stresses caused by unevenness of moisture, allowing the wood to dry naturally without distortion or warping (Fig. 1).

For the second group have been developed two models with different drying parameters.

The sample PM 4B was subjected to a more gentle drying model (Fig. 1), combining a very short absolute drying phase with a longer drying calibration phase, due to the high degradation of the sample. The purpose of this differentiation is to examine any behavioral changes in the timber on different binary drying parameters.

The other samples in this group were subjected to a more aggressive binary drying model, different from the previous model by increasing the drying time of the absolute drying phase.

Results and discussion

The results obtained by the treatment of binary drying, compared with the results of air-dried specimens, allowed to observe a great physical improvement of the treated wood.

The woods were evaluated according to a number of parameters, obtaining positive results in all of them.

The PM4 sample attests the ability of the binary drying method to reduce dramatically the damage normally caused by conventional drying. It is perfectly visible an accentuated decrease of the deformation of wood. However the observed results also support the conclusion that this treatment is not indicated for very degraded woods, always requiring a combination with a process of consolidation.

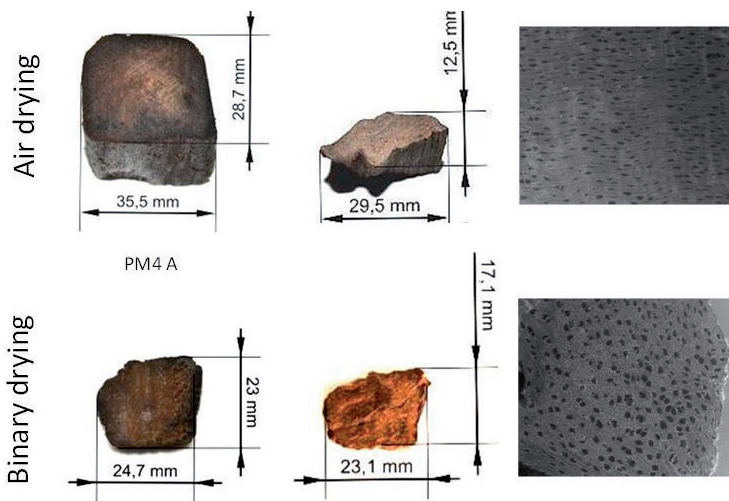


Figure 3. PM4 samples A and B. On the left the wet samples, in the center the samples after drying and right the images of the respective samples taken by electronic microscopy.

In the case of the woods with level of degradation 1 and 2 obtained by the method PRT, the results are very promising. In these cases the binary drying method may even dispense with the use of consolidants and allows a secure drying by canceling the distortion factors, providing a natural drying without deformation, keeping all the morphological characteristics of the treated wood.

These conclusions are reflected in the results obtained in the PM 2 (Fig. 4) test pieces where we can even observe an improvement in the wood look.

In sample PM 5 (Fig. 4) there was a marked decrease in fissures and crevices, and the PM 3B sample kept intact their morphological features.

The ability of the binary drying method to reduce the deformation is attested by the samples PM 1A and B and the PM 2A and B, in which were observed some warping and deformation in the dry air samples, however, these situations did not occur in the samples dried by the binary drying method.

In this regard the binary drying method has proved to be an important alternative for preserved wood, being an ecological method, relatively simple to apply in small scale or in large scale.



Figure 4. PM2 samples A and B. On the left the wet sample and right the sample after drying. And PM5 samples A and B. On the left the wet sample and right the sample after drying.

Conclusions

The aim of the research presented here was to improve the methodologies used for the preservation of wooden artifacts recovered from wet environments.

The development of models for controlled drying which minimise the damages caused by the drying process are of crucial importance to the conservation of this type of material. These models can help to improve our ability to remove water from wood, and may also help to decrease the amount of chemical consolidants used in the drying process – which will lessen the likelihood of side effects that can harm the material.

Furthermore, in the case of well-preserved pieces of wood this process can be simply used as a dehydration process, thus avoiding the use of consolidants which stabilises wood and prevents degradation during storage. The absence of water in wood inhibits chemical reactions with contaminants as well as the development of biological activity, favouring its preservation for much longer time.

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Neutron tomography: a new lecture of ancient lead artifact

Tomografía de neutrones: una nueva visión de objetos de plomo antiguos

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Abstract: The investigations here presented show the results of an epigraphic analysis, by means of Neutron Tomography (NT), on ancient roman lead ingots rescued from wreck ships along the coast of Sicily (Italy). The findings, including also a lead horn, can be dated back between 3rd and 1st century B.C. The three dimensional NT reconstructions helped the decipherment of hidden signs and partially visible details on the severely damaged object. The non destructive procedure allowed also to reach plausible conclusions in the context of the known commercial routes.

Key words: Roman lead, neutron, lead horn, no destructive analysis.

Resumen: las investigaciones presentadas aquí muestran los resultados de un análisis epigráfico, por medio de tomografía de neutrones (NT), en antiguos lingotes de plomo romanos rescatados de pecios a lo largo de la costa de Sicilia. Los hallazgos, incluido un cuerno de plomo, pueden ser datados entre los siglos III y I a.C. Las reconstrucciones tridimensionales NT ayudaron a descifrar los signos ocultos y los detalles parcialmente visibles en objetos severamente dañados. El procedimiento no destructivo permitió también llegar a conclusiones plausibles en el contexto de las rutas comerciales conocidas.

Palabras clave: plomo romano, neutrones, cuerno de plomo, análisis no destructivo.

In memoriam Prof. Roberto Triolo †

Introduction

In 2008, Roberto Triolo introduced me to a new type of nuclear analysis for cultural heritage objects, which we decided to use on some Roman lead ingots. Roberto was really excited about this new research. After the positive results of the study, carried out with Nicola Kardijloff and his staff at the Helmholtz Centre in Berlin, he called me and was clearly very upset about the news of some

destructive research carried out with the ingots of Mal di Ventre (Sardinia), used as shields (and destroyed) in research activities of the INFN at the Gran Sasso laboratory¹. Roberto asked for my help and we then wrote to the INFN, but received no answer. In 2013, a few ingots from the Bou Ferrer wreck (Spain) were also requested by physicists to be used as shields, and thus destined to be destroyed, not without the strong disapproval of Spanish archaeologists² who are opposed to this «bad practice», which destroys not only the ancient artefacts themselves, but other scientific data as yet unstudied, and not only on the upper surface of the ingots.

Here we wish only to observe that neutron tomography allows us to obtain new data from and new interpretations of materials that appear to be burnt, illegible or «useless» to History. P.T.

Neutron tomography is a universal non-destructive method for investigation of the inner structure of bulky samples (Kardjilov *et alii*, 2011c; Kardjilov *et alii*, 2009; Kardjilov *et alii*, 2008a; Kardjilov *et alii*, 2006; Lehmann *et alii*, 2007; Lehmann *et alii*, 2010; Schillinger *et alii*, 2000; Strobl *et alii*, 2009). The reconstruction of the volume is based on the collection of 2D transmission projections of the sample over an angular interval of 180° or 360° (Banhart, 2008). The transmission through the sample depends on its thickness (d) and local attenuation coefficient (m) which are connected in an exponential function as shown in eq. 1, the Lambert-Beer law:

$$T = I/I_0 = e^{-md} \quad (1)$$

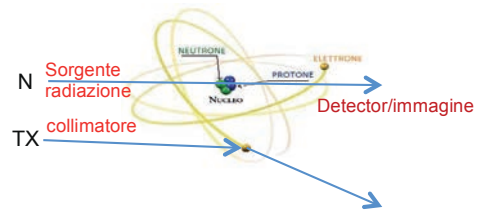
where T is the transmission i.e the ratio between I_0 and I the intensity of the incident and transmitted light respectively. The attenuation coefficient depends on the interaction process between the radiation and the matter. For low energetic neutrons (thermal or cold) the attenuation coefficients of the elements don't depend on their atomic number as it is in case of X-rays due to the fact that the neutrons interact with the nuclei and the X-rays with the electrons of the atom. In contrary to the X-rays the neutron beam is attenuated strongly by light elements like Hydrogen, Lithium and Boron and transmitted easily for metals like Iron and Nickel (Banhart *et alii*, 2010). Even for heavy elements like lead (Pb) very high transmission is observed. These properties of neutron radiation are used in number of experiments for determination of water (hydrogenous substance) in different devices like fuel cells (Manke *et alii*, 2007; Hartnig *et alii*, 2008) and visualization of mass transport in Lithium batteries (Siegel *et alii*, 2011; Lanz *et alii*, 2001). Many other applications related to the unique properties of the neutron were reported recently in the field of neutron imaging (Kardjilov *et alii*, 2008b; Manke *et alii*, 2010; Strobl *et alii*, 2008). The use of neutron imaging for investigation of samples of cultural heritage interest is very well suited due to the high penetration depth of neutron radiation in comparison to X-rays (Kardjilov *et alii*, 2008a; Kardjilov *et alii*, 2006; Lehmann *et alii*, 2007). This property of neutron beam allows for investigation of real samples with dimensions of 100 cm³. The sensitivity to hydrogenous substances helps to visualize organic materials like leather, wood and textile in metal environment (Lehmann *et alii*, 2005; Jacobson *et alii*, 2011). Lead is almost transparent for neutrons therefore the investigation of bulky lead samples by neutron imaging is non replaceable. The attenuation coefficient for lead is 0.37 cm⁻¹ which means that a thickness of ca. 2 cm reduces the beam intensity by a half. If we assume that the largest thickness of a lead sample investigated by neutrons should transmit at least 10% of the initial beam, in order to have acceptable signal to noise ratio in the image (see eq. 1) one can get $T_{max} = (\ln 10)/\mu = 6.2$ cm. A comparison of attenuation coefficients and T10% for different materials with cultural heritage meaning is shown in table 1.

¹ <http://physicsworld.com/cws/article/news/2010/apr/23/ancient-romans-join-neutrino-hunt>

² <http://www.gizmag.com/relics-physics-archaeology-roman-lead/30032/>

Material	Au	Ag	Cu	Sn	Bronze	Pb	Zn	Fe
[cm-1]	6.28	3.99	0.99	0.20	0.87	0.37	0.34	1.20
T10%, cm	0.4	0.6	2.3	11.5	2.6	6.2	6.8	1.9

Table 1. Linear attenuation coefficients of some metals for thermal neutrons.



As a conclusion it could be stated that lead is the metal with one of the highest neutron transmission among the cultural heritage relevant metals. This allows for investigation of large samples by neutron tomography which seems to be the most successful method for non-destructive study of the inner structure of bulky archeological lead samples.

Experimental parameters

The experiments presented in this work were performed at the neutron tomography facility CONRAD (Cold Neutron RADiography) at the Helmholtz Zentrum Berlin (HZB) (Kardjilov *et alii*, 2011b). It is situated at the end of a curved neutron guide facing the cold source of the BER-II reactor. The neutron guide provides a cold neutron flux in the order of app. 2×10^8 n/cm²s directly at the end of the guide with a negligible background of γ -radiation and fast neutrons. A pinhole geometry with L/D of 170 (L=500 cm, D=3 cm) is used for achieving of better spatial resolution reflecting in a beam field of 10 cm $\times$ 10 cm with a neutron flux of $\sim 10^7$ n/cm²s. The used detector system is based on a 16-bit CCD camera (Andor) with 2048 $\times$ 2048 pixels. The images obtained from the LiZnS scintillator are projected via a mirror and a lens system onto the CCD chip (Kardjilov *et alii*, 2011a).

The lead ingots had approximate dimensions of 10 cm $\times$ 10 cm $\times$ 40 cm and weight of ~ 33 kg. The surface of the samples was covered by thick corrosion layer which was very crispy. Therefore a special sample holder was used where the contact with sample surface was as less as possible (Fig. 1). The tomography experiment was performed by taking of 300 equidistant angular projections over 360° rotation. The exposure time per projection was 10 s which reflects in a total time of 1.5 hours. Due to the limited field of view of 10 cm $\times$ 10 cm the sample was tomographed only at 3 heights where the stamps were presented. For samples without visible signs on the surface the whole sample length with vertical steps of 10 cm was scanned (4 tomographies in total). The data were reconstructed by a backprojection algorithm implemented in the software Octopus (Octopus). The visualization and the 3D rendering were performed by the VGStudioMax software (Graphics). After the illumination of the samples by neutron beam the irradiated positions become radioactive and some decay time is necessary until the samples were approved to be non-radioactive again. In our case the decay time was 3 weeks after the experiment.

Results

Here we present the epigraphic analysis, in a totally non invasive way, of two kinds of lead ingots coming from loads belonging to sunken roman ships near Sicily's coast (Siracusa and Messina). Tomographic reconstructions of a lead artifact will be here also shown; a small ornamental horn rescued in shallow waters along western Sicily shoreline (Trapani).

It is well established that the mining and use of lead grew very fast in the period between the 2nd century B.C and the 1st century A.C., due to the high demand for ship construction, both

military and commercial, as well as in pipe systems for water and wastewater management. Therefore there was a heavy traffic of commercial ships that were involved in the lead trading (the ingots were used also as ballast), along the Mediterranean sea. A first group of 4 similar lead ingots, which were found under water in the same location (Siracusa, Italy ca. 1 BC), were characterized for having same shape, size and weight as well as rectangular mold mark on the top side. In figure 1 it is shown one of these ingots which is about 40 cm long, has a troncopyramidal shape, it is about 10 cm high, with a rectangular base and weight of ca. 33 kg (the maximum weight a slave could carry by law).

It clearly shows signs of heavy damage due to deposits of salts, algae and probably carbonaceous material very likely coming from a fire occurred on the ship. It is characterized by the presence of three regular indented rectangular areas (cartouches), on the same side, in which mold marks can be found; both characters and images are usually found in these cartouches. In this sample these areas of interest are covered by deposit and in middle section, one could see a hint of an image (zoomed region in figure 1). The neutron tomography investigation provides a 3D matrix of the attenuation coefficients in the sample which can be considered as a digitalized volume. This volume can be processed by 3D volume rendering software. In the case of the lead

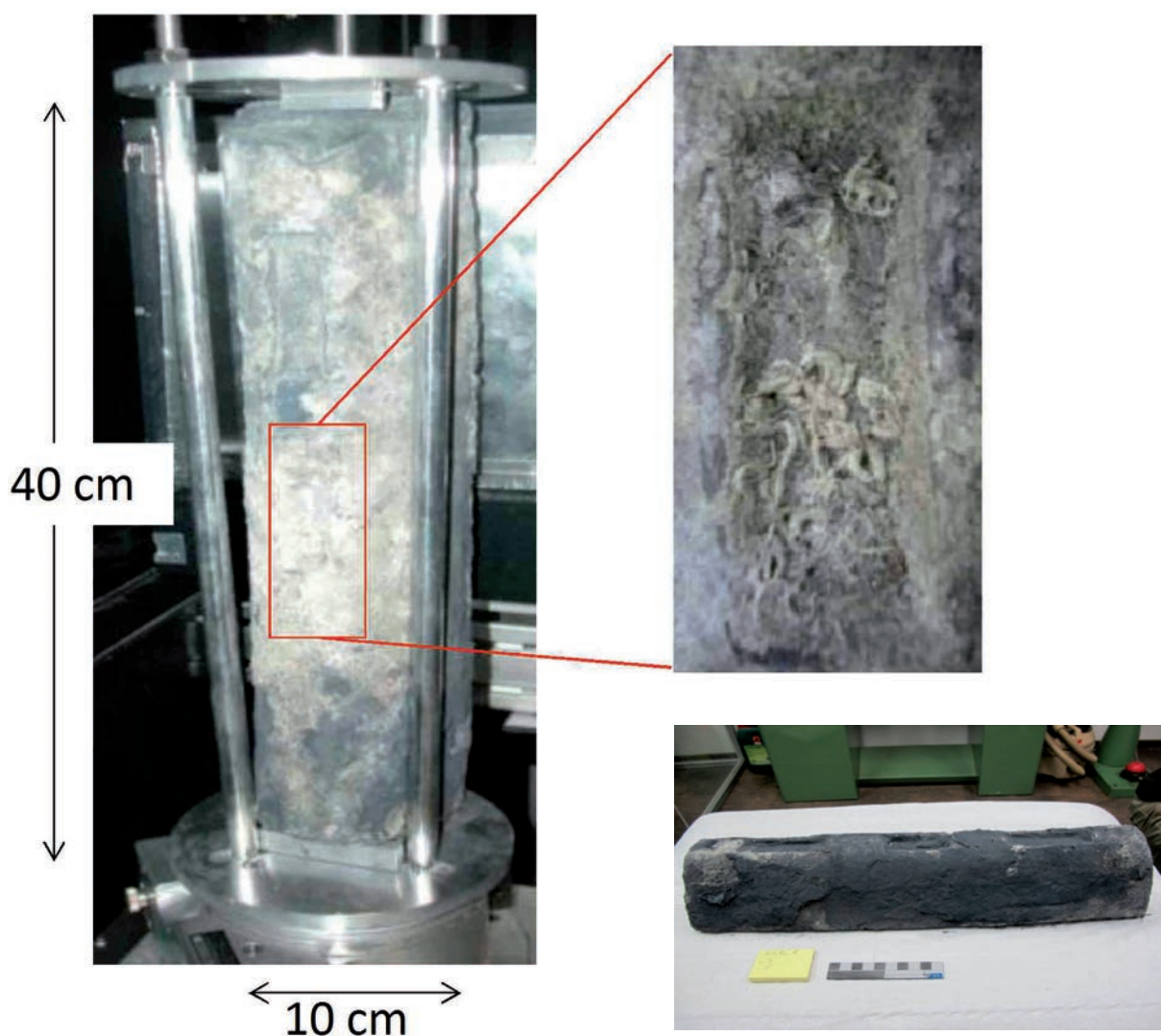


Figure 1. Lead ingot from Siracusa in the experimental sample holder. The zoomed region refers to the middle cartouche.

ingots the corrosion layer can be removed digitally and the original surface of the sample can be visualized non-destructively. The NT reconstruction shows that the latter represents a dolphin as shown in figure 2 (middle).

This fact is indeed consistent with the finding, in the cartouches adjacent to the dolphin figure, of two different inscriptions in relief as shown in figure 2 (top and bottom part). They read as MPLANILF, i.e. M(arcii) PLANI(i) L(ucii) F(ili)i, and RVSSINI (Russini) (Domergue, 1965; Antolinos/Noguera/Soler, 2010) respectively according to *tria nomina* standard used mainly by Roman citizen. Indeed they were identified by a personal name, i.e. the *praenomen* (Marcius in its genitive form), followed by the family name, i.e. *nomen* (Planius in its genitive form) and then a third name, i.e. *cognomen* (Russini), which basically indicates a specific branch of the family. This epigraphic analysis refers therefore to the producer of the lead ingots and possibly also the mine owner in *Carthago Nova* in Spain (Trincherini *et alii*, 2010; Tisseyre *et alii*, 2008; Tisseyre, 2010) which dates back to 1st century B.C., when in fact the Planius family (either Marcius or Lucius, probably brothers and sons of Lucius, as the L(ucii) F(ili)i inscription suggests) was active in lead ingots trading. In fact the latter were found in ship wrecks in many location along the coast of Italy and France. Similar characteristics were found in the other three ingots which at naked eye also appear to have partially erased mold marks.

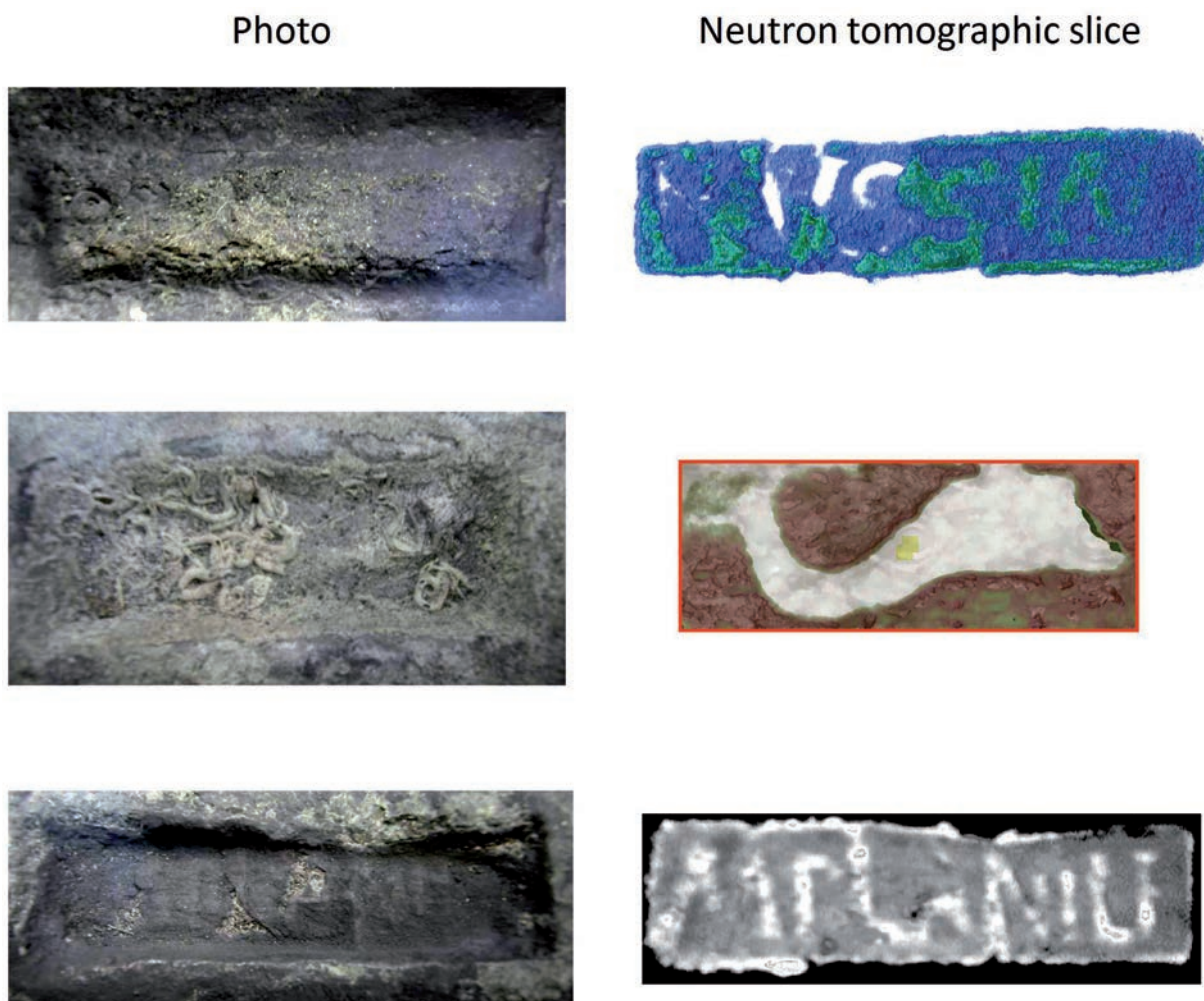


Figure 2. Comparison between the three cartouche of lead ingot of fig. 1; on the left the naked eye view, on the right the corresponding digitally reconstructed images.

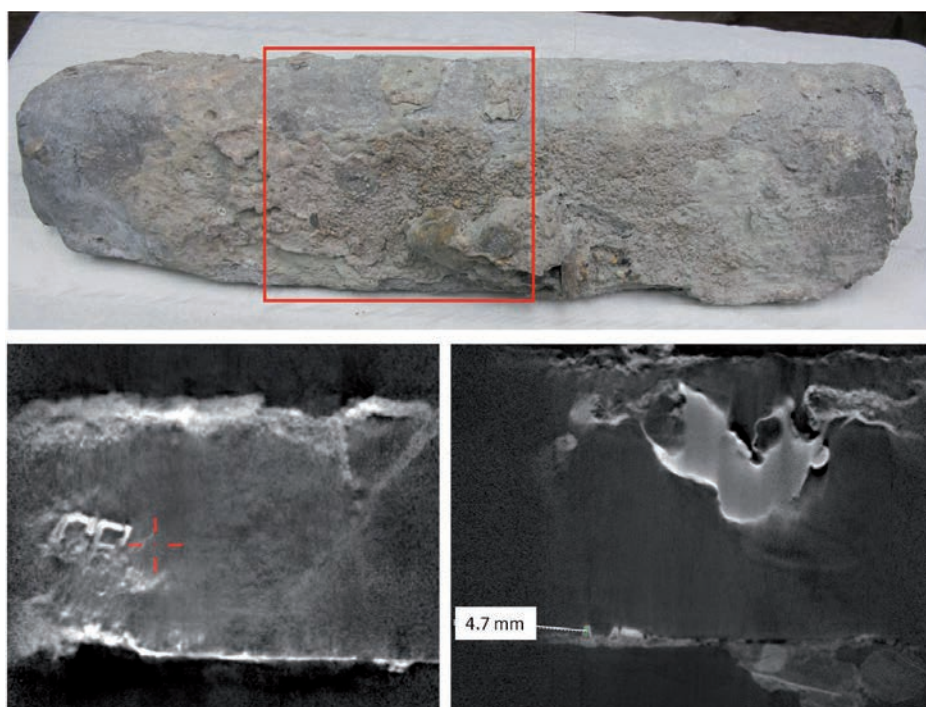


Figure 3. a) Picture of the whole lead ingot depicting its highly damaged state, concretions are clearly observable. It is also marked (red square) the area in one of the slanted sides where signs were found after the digital reconstruction; b) from the digital reconstruction a group of two letters as well as a big cross sign (not visible at naked eye) were found. The red mark on the image is showing the position of the cutting plane for the cross section shown in subsection c c) top view of the slanted side where the letters were found showing the shape and the depth of stamping marks.

The second lead ingot, as shown in figure 3a has different shape in the cross section compared to the one described in figure 1, different length and weight (semi cylindrical, 20 kg), the sample was a part of a load rescued in Capo Rasocolmo Messina (Italy) that could be probably date back to the 3-2nd century BC. It is possible to see that it has slanted sides and a rounded top while the base is still rectangular. The sample is heavily covered by calcareous concretions which in some parts include small spherical shaped stones (see the protrusion in the lower right part of figure 3c).

There are two regions of interest, beneath the calcareous concretion in one the slanted sides. It is possible to see, in figure 3b, a big X shaped sign running across the whole width of the ingot, while about 10 cm away there is a group of characters which could lead to a possible identification of the maker. The group of characters can be read as CP which can be probably traced back to one of the firsts Cartagena's producers C(aius) P(ontileieni) which is contemporary to the Planius family. Indeed it has been found around 3rd century BC (Laubenheimer, 1973) that some of the ingots produced by the Planius family has been stamped as well with Marcus Caius Pontilieni inscription³. The big X shaped sign is probably a mark for the production or trade control. In figure 3c it is also shown in the vertical projection that the letters have been stamped, the depth of the stamp is 4.7 mm and it is triangularly shaped.

Furthermore here we report the NT reconstruction of a small lead ornament horn which was found along the seashore in western Sicily (Petrosino, Trapani). Figure 4a shows a picture of the lead horn. It is approximately 25 cm long and its section is elliptical (at its base it is 5.7 cm × 7.6 cm, minor and major axes respectively). An identical piece was recently found at Filicudi (Eolian) in summer 2013.

³ A new lead cargo was found in 2010 at Messina, with the name of this entrepreneur.

It is characterized along its length by 4 rows of nearly regularly spaced holes (18 in totals) with a 7 mm square section. This horn was probably placed on the ship holding decorations or being decorated itself or being part of a more elaborate decoration. It could be also that this lead object was a filling part of a real bovine horn, indeed not only sizes are comparable but in some cases remaining of real horn were found (Lamboglia, 1964; Mouchot,



Figure 4. a) Lead horn rescued near the western Sicily shoreline (Petrosino, Trapani); b) A zoomed region (bottom part) of the lead horn of previous figure.

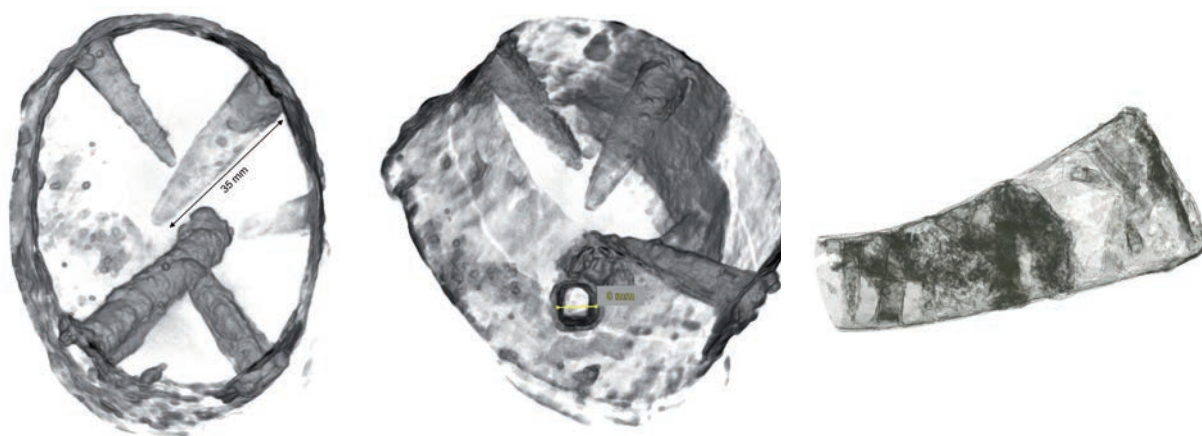


Figure 5. a,b and c) NT reconstruction of the lead horn of figure 4a.

1970). The choice of lead was probably due to the fact that it has a lower melting point in respect to Copper or bronze and furthermore scientific evidences show that pouring molten lead into a horn cavity does not produced damages to the horn itself (Mouchot, 1970). The holes are due to the presence of the nails that were put in place immediately after the pouring of molten lead, while it was still malleable. Indeed driving a nail trough solid lead is not only very difficult but it would have caused heavy deformation in the lead body. Furthermore the nails have left imprints of their head on the exterior curved part of the horn meaning that they were applied from the convex part. It is also possible to see in the bottom part of the horn two parallels protruding lines that were caused by the fact that it needed to be mounted to another structure of the ship. In figure 4b it is possible to see the detail of some holes and some stripes in lead body that are due to production process. Figure 5 shows the NT digital reconstruction from different angles and zooming level. It is interesting to see the oblique orientation of the holes (i.e. the space occupied by the dissolved nails) respect to the main axis of the horn mostly pointing towards its base, as well as their length (approx. 3.5 cm) and density along the horn. A detail from the bottom part section of the horn is shown both in figure 5b and c, where it is possible to clearly see the shape of the nails (quadratic cross section) as well as the size of their heads (approx. 8 mm.). The manufacture of this lead horn, analogous to other similar findings may suggest that it could belong to Hellenistic or Roman ships could date back in a wide time frame between 3rd century BC and 3rd century AC.

Conclusions

The work presented here gives a full perspective on the possibilities offered by the Neutron Tomography in the field of archeological investigations. The techniques has been applied on severely damaged lead ingots rescued from underwater shipwrecks, and it has given final answers both on the provenance and the historical frame time in which the ingots were traded. A lead horn coming as well from a ship wreck was also investigated giving thus evidences to its manufacture and therefore to its time window of production. It is very important to underline that NT technique has allowed not only to examine rather bulky samples, but thanks to their selectivity to different elements has made possible to digitally retrieve precious information in a non destructive way.

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Biological damage and methods for *in situ* conservation of the underwater mosaic pavement of the Villa dei Pisoni (Baiae, Naples, Italy)

Daños biológicos y métodos de conservación *in situ* del pavimento de mosaico sumergido de la Villa de los Pisones (Baia, Nápoles, Italia)

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Abstract: The Underwater Archaeological Park of Baiae (Naples) preserves the remains of the submerged Roman city of Baiae. In this work the restoration, prevention procedures and biological studies conducted on the white mosaic pavement situated in the Villa dei Pisoni, restored in 2004 and monitored until 2014 are described. Specific protection methods have been implemented: in particular mosaic pavements were covered with geotextile sheets in order to prevent bioerosion phenomena and to allow an easy fruition for scuba divers. The results highlight the efficacy of geotextile covers and the need to perform periodic monitoring to assess the state of conservation of these structures of great value.

Key words: Conservation, underwater pavement, Baiae, Villa dei Pisoni, bioerosion.

Resumen: el Parque Arqueológico Subacuático de Baia (Nápoles) preserva las ruinas de la ciudad Romana sumergida de Baia. En este trabajo están descritos la restauración, las intervenciones de prevención y los estudios biológicos realizados sobre el mosaico blanco situado en la Villa de los Pisones, restaurado en 2004 y controlado hasta 2014. Métodos específicos de protección fueron implementados: en particular los mosaicos fueron cubiertos con geotextil para prevenir fenómenos de bioerosión y para permitir la fruición de parte de los buzos. Los resultados resaltan la eficacia del geotextil y la necesidad de monitorizaciones periódicas para evaluar el estado de conservación de estas estructuras tan importantes.

Palabras clave: conservación, mosaico sumergido, Baia, Villa de los Pisones, bioerosión.

Biological damage and methods for *-in situ* conservation of the underwater mosaic pavement of the Villa dei Pisoni (Baiae, Naples, Italy)

Sandra Ricci, Roberto Petriaggi, Barbara Davidde Petriaggi



Study area

Baiae, Naples

The mosaic floor is a part of the architectural complex called Villa dei Pisoni, named after the family who owned it until 65 AD. In fact, a failed conspiracy against Nero forced to commit suicide Gaius Calpurnius Piso, the most prominent figure among the conspirators. Then the house passed to the imperial property and, after Nero, the most important architectural changes that have altered and expanded its general characteristics are due to the Emperor Hadrian.

The villa is located about 150 meters SE of the promontory called Punta dell'Epitaffio and it occupies approximately 295 x 270 m on a seabed from 5 to 8 m deep.

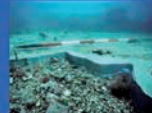


Around a central rectangular area, that we can define the *Viridarium* of the villa (about 95 x 65 m), are distributed several rooms for residential purposes, hallways and baths.



The mosaic, with white tesserae, very damaged and fragmented in some portions, was the floor of a room, perhaps part of a thermal area along the southwest side of the *Viridarium*.

R. Petriaggi, Nuove esperienze di restauro conservativo nel Parco sommerso di Baia. *Archaeologia Maritima Mediterranea*, 2, 2005, pp. 135 - 147.

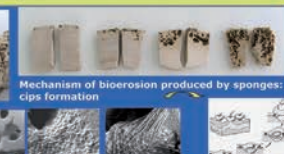


Bioerosion of mosaic floors

The mosaic, consisting of calcareous tesserae, is highly damaged by bioerosion phenomena due to endolithic microphytobenthos, microzoobenthos and macroborers. The analysis focused on bioerosion levels, allowing the identification of biodeteriogens.

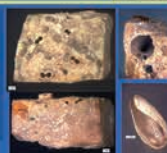
BORING SPONGES Fam. Clionaidae

Cliona celata and *Cliona viridis* are boring sponge species found in the mosaic tesserae. They produce cavities and tunnels inside the stone eroding the calcareous material by acids. The cavities show the typical bioerosion traces. The species identification is based on the presence of the skeletal elements (spicules) revealed by SEM observation.



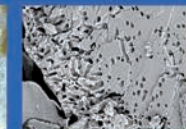
BORING BIVALVES

Rocellaria dubia is a boring species responsible for bioerosion phenomena. The aperture of its perforations is 8 shaped. The species secretes aragonitic deposition on the walls of the eroded chamber. Its growth is very dangerous for underwater archaeological remains.



MICROBORERS

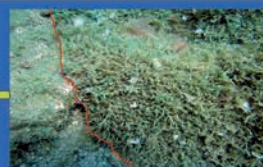
Some microorganisms are able to penetrate into the stone by acid secretions. Cyanobacteria, microalgae and fungi have been found inside the lapideous tesserae. The damage is located in the outer layer of the stone (2-3 mm) because many of these are photosynthetic. Their presence is revealed by embedding - casting technique.



Methods for *in situ* conservation

Use of GEOTEXTILE Terram® 2000

The floor has been covered with geotextile; this protection has been useful to create a physical barrier against erosion and to prevent biological growth.



After two years →

Mosaic protected against biological damage by the geotextile sheet

Biological growth on geotextile

Davidde B., Ricci S., Poggi D., Bartolini M., 2010. Marine bioerosion of stone artefacts preserved in the museo Archeologico dei Campi Flegrei in the Castle of Baia (Naples). *Archaeologia Maritima Mediterranea* 7: 75-115.

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Estado de conservación de los restos encontrados en la ensenada de Cariño (Ferrol)

Condition of the remains found in the cove of Cariño (Ferrol)

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Resumen: el proyecto de prospección arqueológica subacuática en la ensenada de Cariño (Ferrol) deseaba localizar los restos de la nave veneciana *Ragazzona*, hundida en la ría de Ferrol el 8 de diciembre de 1588. Durante una semana el G.I Arqueopat de la USC en colaboración con la Unidad de Buceo de la Armada y la empresa Argos S.A.S. S.L. localizaron varias piezas de artillería. El estado de conservación de estas es el que cabe esperar dentro del medio en el que se encuentra (concrecionados, biocolonización, etc.). Es de destacar la gran ausencia de restos cerámicos. Mediante análisis organoléptico y un amplio registro de documentación gráfica, se observa que este proceso de alteración natural, el cual en ocasiones funciona de capa de protección, ha sido modificado antrópicamente. También se deben subrayar los vestigios de pérdida de sedimentación trascurrida en un corto periodo de tiempo. Finalmente se recomienda encarecidamente que los restos encontrados, aunque escasos, sean conservados *in situ*.

Palabras clave: *Ragazzona*, concreción de hierro, biocolonización marina, conservación *in situ*.

Abstract: The underwater archaeological survey project at Cariño cove (Ferrol) was founded with the interest to locate and identify the remains of the Venetian *Ragazzona* ship, sunk in the Ria de Ferrol on December 8, 1588. During a week the USC GI Arqueopat in collaboration with the Diving Unit of the Navy and the company Argos SAS S.L. located several pieces of artillery. The condition of the remains found, is expected within the medium in which it is located (concretionary, biocolonialism, etc.). Note the absence of ceramic remains. The organoleptic analysis and the extensive record of photo material, shows that this process of natural disturbance, which sometimes works as a protective layer, has been modified by human activities. It should also be emphasized a vestige elapsed sedimentation loss in a short period of time. Finally it's strongly recommended to preserve the remains found *in situ*.

Key words: *Ragazzona*, iron concretion, marina biocolonialism, *in situ* conservation.



ESTADO DE CONSERVACIÓN DE LOS RESTOS ENCONTRADOS EN LA ENSENADA DE CARIÑO (FERROL).



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INTRODUCCIÓN

El proyecto de prospección arqueológica subacuática en la ensenada de Cariño (Ferrol) nace con el interés de localizar e identificar los restos de la nave veneciana Ragaz-zona, hundida en la ría de Ferrol el 8 de Diciembre de 1588. Durante una semana el G.I. Arqueopat de la USC en colaboración con la Unidad de Buceo de la Armada y la empresa Argos S.A.S. S.L. ejecutaron un trabajo de campo que localizó un pecio de época moderna, compuesto fundamentalmente de varias piezas de artillería de hierro y un ancla.

OBJETIVO

El objetivo en este proyecto desde el punto de vista de la conservación – restauración del patrimonio cultural subacuático ha sido, en todo momento, la **conservación in situ** de los restos, tal y como recomienda el artículo 2.5 y en la Norma I del Anexo de la convención UNESCO del 2001.

METODOLOGÍA

1. Trabajos de documentación gráfica, bibliográfica, archivista y sobre todo estudios de los expedientes de la infraestructura del Puerto Exterior de Ferrol.

Debido al alto riesgo de expolio se barajó la posibilidad de la recuperación de las piezas cerámicas. Finalmente se tomó la decisión de la conservación in situ de todos los restos.

2. Una vez en la zona de trabajo se comenzó por el desbroce de la biocolonización de la familia de las *Laminariaceae*, genero *laminaria* denominada comúnmente *laminaria*, *algaza* o *carrumeiro*.
3. Teniendo ya los objetos despejados, se pudo continuar con la observación detallada de los mismos, recabando toda la información.
4. La diagnosis utilizada mediante análisis no destructivo, viendo y anotando los daños del objeto y su hábitat colindante.

La recopilación de datos bajo el agua se tomó mediante fotografías concretas del deterioro y audiovisual.

5. En gabinete se seleccionó la documentación (fichas, fotos y videos) recogida en la zona de trabajo y se estudió toda la información obtenida.



Actualmente se ve la relevancia de realizar más estudios para la conservación preventiva de los restos. Proponiendo estudios hidrográficos y oceanográficos específico.

RESULTADOS

Lo más relevante que debe de ser subrayado es la ausencia de restos cerámicos.

Los restos encontrados han sufrido un proceso de alteración natural debido al medio marino en que se encuentran. Este medio provoca en las piezas de hierro un gran número de reacciones químicas. Lo que se va formando una concreción que crece encima de la superficie original por toda la pieza de forma uniforme. Trascurriendo el tiempo, la concreción aumenta de volumen e induce que las reacciones químicas se ralenticen, de esta manera se consigue que la pieza esté en equilibrio con el medioambiente. Esta concreción resultante realizada la función de capa de protección.

C4, un cañón que tiene una gran pérdida de concreción en una grandísima parte del objeto.



Ancla A. El increíble deterioro que ha sufrido esta pieza es muy preocupante, quedando escasamente la cruz del ancla. Por si esto no fuera poco, esta movida de su origen (rompiendo su concreción inicial). La uña que le queda es prácticamente inexistente esta totalmente deformada y sin concreción que funcione como capa protectora.

Los cañones denominados C5, C6 y C7 están dañados en su concreción puntualmente, observando que se forma nueva corrosión.



CONCLUSIÓN

- Realización del proyecto según las directrices de la Convención del Patrimonio Cultural Subacuático de la UNESCO del 2001. A mayores hemos aportado un perfecto trabajo multidisciplinar.
- Es relevante destacar la manipulación antrópica constante de las piezas donde parece que se ha normalizado la actitud de "patrimonio souvenir".
- Se abre debate axiológico de los beneficios reales de la divulgación de los restos encontrado en campo.

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Una polémica alternativa de conservación: el reenterramiento del pecio de Zencity, Buenos Aires

A controversial alternative conservation case: reburial of the Zencity shipwreck, Buenos Aires

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Resumen: en el caso del pecio de Zencity, la estructura de la embarcación ha sido reenterrada ya que cuando no hay opciones técnicas para mantener expuesto el hallazgo, es mejor regresarlo a las condiciones en las que se conservó por tanto tiempo. Pensamos que era importante tener en cuenta el contexto de gestión del sitio, para plantear a largo plazo una estrategia de mantenimiento y seguimiento adecuados. La resolución tomada fue la de considerar una alternativa viable sin generar un costo elevado y sin tener la seguridad de que el presupuesto para otro tipo de conservación se mantuviera en el tiempo. Al no estar en «contacto» con el bien patrimonial se consideró que el ciudadano no estaba «disfrutando» del hallazgo. Esta situación ha costado ser revertida porque la propuesta original era la de construir una réplica pero los avatares de la gestión política no han previsto *aún* el presupuesto necesario.

Palabras clave: reenterramiento, bien patrimonial, prevención, conservación.

Abstract: In many cases, after an archaeological excavation is not possible to guarantee suitable conditions for the finding's proper conservation. This is more important in particular when working with waterlogged wood. Reburial is a very efficient and versatile conservation strategy. Due to this it was considered as the best for this case in particular. This Shipwreck was reburied under

the environmental conditions similar to the ones in which remained for so long. It was located in a place under strict control, where the public cannot access freely. A digital monitoring system was set on site in order to measure possible environmental variations. This reburial accomplishes the international standards recommended in the specific Unesco documents. To be able to satisfy the public's desires of access to the remains, a program to build a replica has been developed.

Key words: Reburial, heritage, preservation, conservation.

La polémica alternativa de conservación: el reenterramiento del Peco de Zencity, Buenos Aires

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Buenos Aires Ciudad



Luego de una excavación arqueológica no siempre es posible garantizar las adecuadas condiciones de conservación de los bienes culturales recuperados. Dejarlos en contacto con el medioambiente produce con rapidez deterioros irreparables, en particular tratándose de piezas de madera saturada en agua.



Izado y colocación del pecio en el acoplado del camión para su traslado.



Emplazamiento del pecio en su localización definitiva.

En el caso de los restos del Peco de Zencity, la estructura completa de la embarcación ha sido reenterrada cumpliendo con los estándares acordados internacionalmente. Los mismos plantean que cuando no se dispone de las condiciones técnicas para mantener el hallazgo, es mejor recrear las condiciones en las que se conservó durante tanto tiempo, antes de su hallazgo.

El reenterramiento controlado implicó la elección de un lugar en la ciudad que cumpliera con varias condiciones. Primero, la posibilidad de realizarse una excavación en un lote de propiedad de la Ciudad Autónoma de Buenos Aires. En segundo lugar que estuvieran las condiciones de humedad relativa adecuadas y similares a las del sitio del hallazgo. El sitio fue forrado con geotextil, al igual que el pecio, de modo de asegurar las mejores condiciones de protección y conservación posibles. El lugar del enterramiento es accesible y se lo tiene controlado.



El pecio se encuentra monitoreado con sensores fabricados por ingenieros del Instituto Valenciano de Conservación y Restauración de Bienes Culturales (Valencia, España). A su vez se realizan exploraciones directas con sondeos sistemáticos. El comportamiento del bien es el adecuado.



La conservación del marfil de procedencia subacuática: las defensas de elefante del yacimiento del Bajo de la Campana (San Javier, Murcia)

The conservation of ivory of underwater origin: elephant defenses of the site of Bajo de la Campana (San Javier, Murcia)

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Abstract: The archaeological excavation project in Bajo de la Campana's site (San Javier, Murcia), was developed under the agreement signed between the Ministry of Culture of Spain and the Institute of Nautical Archaeology of Texas, 2007-2011. Among the recovered materials, 50 Phoenician tusk and tusk fragments stand out, some of them with inscriptions. The research project for Bajo's elephant tusk conservation started with the study of composition and hierarchical organization of ivory components, underwater environment and deterioration processes. This aims to find a conservation procedure that fits special features of ivory and current conservation criteria, ensuring dimensional stability. Analysis and conservation tests are being developed in collaboration with Universidad Politécnica de Valencia, Universidad Politécnica de Cartagena, Universidad de Cádiz, Universidad de Murcia and the Western Australian Museum, among others.

Key words: Ivory, conservation, underwater cultural heritage, MEB-EDX, FTIR.

Resumen: el proyecto de excavación arqueológica en el yacimiento del Bajo de la Campana (San Javier, Murcia), se desarrolló en virtud del Convenio firmado entre el Ministerio de Cultura de España y el Institute of Nautical Archaeology de Texas, los años 2007-2011. Entre los materiales recuperados, destacan 50 ejemplares de defensas y fragmentos de defensa de elefante de época fenicia, algunas de ellas con inscripciones. El proyecto de investigación para la conservación de estas defensas parte del estudio de la composición y organización jerárquica del marfil, de los factores de alteración del medio subacuático y procesos de deterioro. Tiene como objeti-

vo el diseño de un/os procedimiento/s de conservación que se ajusten a las especiales características del marfil y a los criterios de conservación vigentes, garantizando la estabilidad dimensional. La caracterización y fase experimental se están desarrollando en colaboración con la Universidad Politécnica de Valencia, Universidad Politécnica de Cartagena, Universidad de Cádiz, Universidad de Murcia y el Western Australian Museum, entre otros.

Palabras clave: marfil, conservación, patrimonio cultural subacuático, MEB-EDS, IRTF.

LA CONSERVACIÓN DEL MARFIL DE PROCEDENCIA SUBACUÁTICA: LAS DEFENSAS DE ELEFANTE DEL BAJO DE LA CAMPANA (SAN JAVIER, MURCIA)

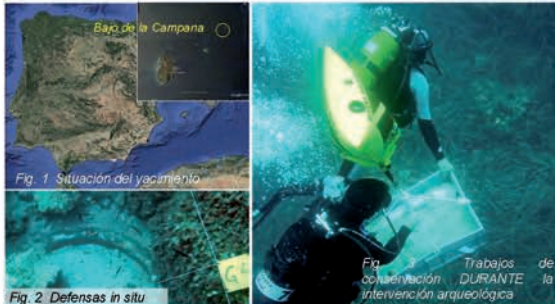
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INTRODUCCIÓN

El proyecto de intervención arqueológica sobre el yacimiento del Bajo de la Campana, San Javier (Murcia), se desarrolló en virtud del Convenio firmado entre el Ministerio de Cultura de España y el Institute of Nautical Archaeology - I.N.A. de Texas, entre los años 2007-2011.

Por su singularidad, destacan las 53 defensas de elefante de época fenicia, algunas de las cuales conservan inscripciones, que documentan el comercio ebanario en ese periodo.



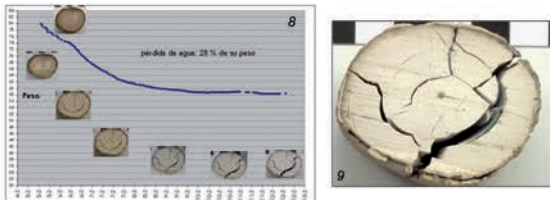
El laboratorio de conservación y restauración del Museo Nacional de Arqueología Subacuática de Cartagena, implementó un programa de conservación, ANTES, DURANTE y DESPUÉS de la intervención arqueológica, como uno de los pilares básicos en la investigación, estudio y difusión de este patrimonio.



Fig. 4 Laboratorio de conservación y restauración del Museo Nacional de Arqueología Subacuática
Figs. 5, 6, 7 y 8 Trabajos de conservación DESPUÉS de la intervención arqueológica

OBJETIVOS

El proyecto de investigación para la conservación de las defensas de elefante del Bajo de la Campana, comienza con el estudio de la composición y organización jerárquica del marfil, los factores de alteración del medio subacuático y los procesos de deterioro que generan. El objetivo es el diseño de un procedimiento de conservación que se ajuste a las especiales características del marfil de procedencia subacuática y a los criterios de conservación vigentes, garantizando la estabilidad dimensional.



Figs. 8 y 9 El secado SIN TRATAMIENTO del marfil arqueológico de procedencia subacuática produce una importante pérdida de peso. Detalle del colapso del material.

El marfil es un material de naturaleza compuesta (orgánica-inorgánica) cuya estructura jerárquica le confiere extraordinarias propiedades mecánicas. Durante el periodo de enterramiento en el medio subacuático, sufre importantes transformaciones que modifican estas propiedades. Como resultado, el secado sin la aplicación de un tratamiento de conservación causa daños irreversibles.

PRIMEROS RESULTADOS

Los factores de alteración del medio subacuático se están estudiando dentro del proyecto ARQUEOMONITOR de la Universidad de Cádiz, mediante el seguimiento del deterioro muestras de marfil moderno ubicadas en entornos de similares características que las de origen.

Por otro lado, se ha caracterizado marfil arqueológico y moderno, cuya comparación nos ha permitido conocer las alteraciones que ha sufrido el marfil arqueológico del Bajo de la Campana.



Figs. 10 Muestras de marfil moderno para el estudio de factores de alteración del medio subacuático dentro del proyecto ARQUEOMONITOR de la Universidad de Cádiz.
Fig. 11 Muestra de marfil arqueológico para su caracterización. Microscopio Electrónico de Barrido, Universidad Politécnica de Cartagena.

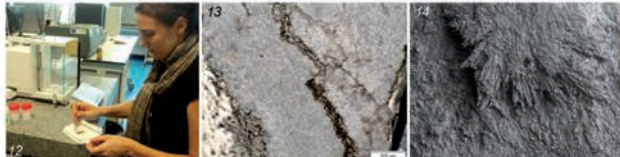


Fig. 12 Preparación de muestra para análisis termogravimétrico.
Figs. 13 y 14 Detalle de depósito neoformado entre anillos de dentina en marfil arqueológico, bajo Microscopio Óptico y Microscopio Electrónico de Barrido.

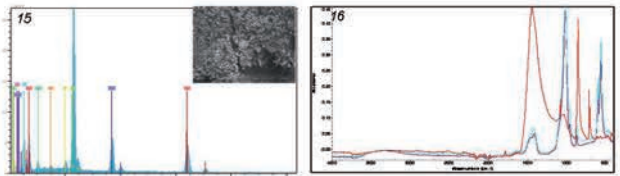


Fig. 15 Microanálisis por energías dispersivas de Rayos X del depósito neoformado entre anillos de dentina en marfil arqueológico. Destaca la presencia de FeS.
Fig. 16 La espectroscopia infrarroja por transformada de Fourier nos muestra un aumento en la cristalinidad de la muestra arqueológica.

Tras la caracterización se ha iniciado la fase experimental, con una revisión de los escasos tratamientos tradicionales conocidos, con desiguales resultados, y el estudio de otros nuevos, entre ellos, la plastinación (procedimientos BIODUR y Dow Corning), en colaboración con el Laboratorio de plastinación de la Facultad de Veterinaria de la Universidad de Murcia.

Posteriormente se prevé la experimentación con otros procedimientos, cuyos resultados nos servirán para valorar el método más adecuado.

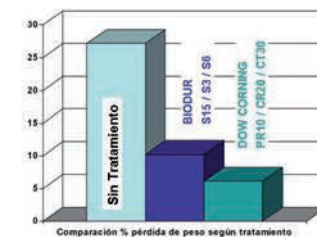
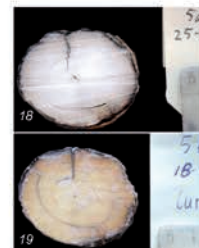


Fig. 17 Comparación del porcentaje de pérdida de peso de las muestras arqueológicas después de la aplicación del procedimiento de plastinación, procedimientos BIODUR y Dow Corning.



Figs. 18 y 19 Detalle de las muestras de marfil arqueológico plastinadas. La estabilidad dimensional conseguida es significativa.

CONCLUSIONES La conservación de las defensas del Bajo de la Campana requiere un conocimiento profundo del marfil y el impacto que el medio subacuático ha tenido sobre él, para entender las transformaciones que ha sufrido durante el periodo de enterramiento y alcanzar un tratamiento de conservación adecuado.

AGRADECIMIENTOS. Institute of Nautical Archaeology - I.N.A. de Texas A&M University, Autoridad administrativa CITES España, Dr. Ian Godfrey del Western Australian Museum, Fremantle, Dr. Rafael Latore y Dr. Octavio López, Laboratorio de Plastinación de la Facultad de Veterinaria de la Universidad de Murcia, Servicio de Instrumentación Tecnológica de la Universidad Politécnica de Cartagena, Dirección General de Bienes Culturales, Comunidad Autónoma de la Región de Murcia, Museo Nacional de Arqueología Subacuática, Cartagena.

Autenticidad y pátina en el patrimonio metálico subacuático

Authenticity and patina in the underwater metallic cultural heritage

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Resumen: el patrimonio metálico subacuático es auténtico en su forma y en su esencia. La manera en que lo concebimos está ligada a la que lo percibimos. Su imagen determina nuestra experiencia y opinión acerca de él. Por ello, conservar la huella del paso del tiempo en su materia –pátina– se convierte en la prueba inapelable de su autenticidad. Es un patrimonio que refleja su devenir acuático mediante su estado material, el cual testifica su inmersión veraz y creíblemente, creando su identidad subacuática. No obstante, su autenticidad no radica únicamente en el hecho de haber estado sumergido, sino en la totalidad de las etapas de su vida que fueron nutriendo esa autenticidad. En consecuencia, la conservación de la pátina del patrimonio metálico subacuático debe impulsarse, dentro y fuera del agua. Solo así se estará asegurando la preservación de su identidad. La estrategia dependerá del contexto actual y proyectado del patrimonio.

Palabras clave: autenticidad, pátina, patrimonio subacuático, conservación.

Abstract: Underwater metallic cultural heritage is authentic in its shape and essence. The way we conceive it lies in the way we perceive it. Its image guides our experience and opinion about it. Therefore, to conserve the trace of the time in its material, patina, became the definitive evidence of its authenticity. It is a heritage that shows its aqueous history through its material state, which testifies its underwater nature creating its underwater identity. However, its authenticity does not lie only in the underwater stage or period, but in the whole life of the heritage. This means that every life stage of the underwater cultural heritage builds up its authenticity. Consequently, the conservation of the patina of the metallic underwater cultural heritage should be ensured both inside and outside the aqueous context. Only by doing this, the identity of the heritage will be preserved. The conservation strategy will rely on the actual and intended future of the heritage.

Key words: Authenticity, patina, underwater heritage, conservation.



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Restauración y Museografía

Autenticidad y Pátina en el Patrimonio Metálico Subacuático

CAPTAGENA 2014
IKUWA V

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Instituto Nacional de Antropología e Historia

México

Patrimonio Metálico Subacuático

El patrimonio metálico subacuático es auténtico en su forma y en su esencia.

La manera en que lo concebimos está ligada a la que lo percibimos.

AUTENTICIDAD

Es un patrimonio auténtico porque en su historia de vida, ha sido afectado por diferentes factores: naturales y culturales, intrínsecos y extrínsecos. A partir del estudio de su línea del tiempo, es posible identificar el momento en que surge su autenticidad y comienza a conformarse su pátina.

Su imagen determina nuestra experiencia y opinión acerca de él.

Por ello, conservar la huella del paso del tiempo en su materia -pátina- se convierte en la prueba inapelable de su autenticidad.



HOLÍSTICA E INTEGRAL

En consecuencia, debe impulsarse la conservación de la pátina del patrimonio metálico, dentro y fuera del agua.

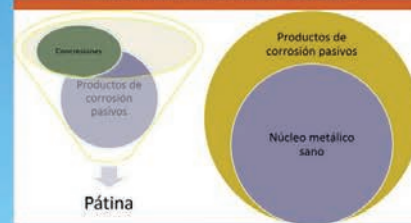
Sólo así se estará asegurando la preservación de su identidad.

PATINA SUBACUÁTICA: IN SITU



Pátina

PATINA SUBACUÁTICA: FUERA DEL CONTEXTO ACUÁTICO



Pátina

Fuera del agua, los productos de corrosión deberán ser evaluados y tratados.

La estrategia dependerá del contexto actual y proyectado del patrimonio.

Línea del tiempo...historia de vida del patrimonio

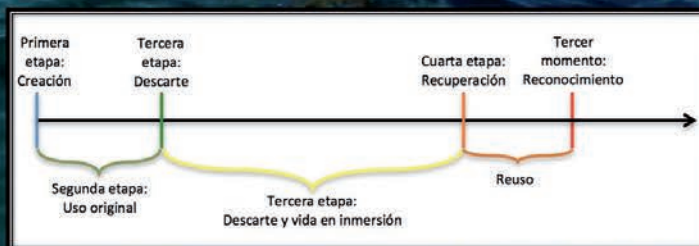
Esta vida excepcional, comenzó desde el momento de la creación, hasta quedar marcada por el hecho extraordinario de haberse sumergido en el agua.

Es un patrimonio que refleja su devenir acuático mediante su estado material, el cual testifica su inmersión veraz y creíblemente, creando su identidad subacuática.

Identidad subacuática

No obstante, su autenticidad no radica únicamente en el hecho de haber estado sumergido, sino en la totalidad.

Es decir, en cada una de las etapas o momentos de vida que fueron nutriendo esa autenticidad y le confirieron su identidad.



Línea del tiempo del Patrimonio Metálico Subacuático

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PAÍSAJES MARÍTIMOS

MARITIME LANDSCAPES

The evolution of the maritime cultural landscape at the south-southeast coast of Crete (Final Neolithic-Hellenistic period)

La evolución del paisaje cultural marítimo en la costa sur-sureste de Creta (Neolítico Final- período Helenístico)

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Abstract: In this paper I will discuss some preliminary results from my on-going PhD research on this lesser-known coastal area of the island of Crete. The concise presentation of the settlement patterns from the Final Neolithic to the Hellenistic period aims at bringing together all the relative archaeological data regarding the coastal sites of the south-southeastern Crete. The purpose is to better understand the evolution of the human occupation in the specific coastal environment from a macro-economic point of view, a task that becomes more challenging not only because of the often-limited archaeological evidence, but also due to the geographic peculiarities of this area. In addition, each settlement pattern analysis is placed into the wider context of the island of Crete, in order to compare the eventual differences and/or similarities between the two. Finally the maritime aspect of the single sites and of their wider patterns plays a primary role in this analysis.

Key words: Maritime cultural landscape, South Crete, Southeast Crete, settlement patterns, coastal occupation.

Resumen: este artículo presenta algunos resultados preliminares de mi investigación de doctorado en curso sobre la zona costera menos conocida de la isla de Creta. La presentación concisa de los patrones de asentamiento desde el Neolítico Final al periodo Helenístico tiene como objetivo reunir todos los datos arqueológicos relativos a los yacimientos costeros del sur-sudeste de Creta. El objetivo es la mejor comprensión de la evolución de la ocupación humana en este ambiente costero específico desde el punto de vista macroeconómico, una tarea que resulta aún más difícil tanto por la evidencia arqueológica (a menudo limitada) como por las peculiaridades geográficas de esta área. Además, cada análisis de patrón de asentamiento se sitúa en el contex-

to más amplio de la isla de Creta, a fin de comparar las eventuales diferencias y/o similitudes entre los dos. Por último el aspecto marítimo de cada yacimiento y de sus patrones más amplios desempeña un papel protagonista en este análisis.

Palabras clave: paisaje cultural marítimo, sur de Creta, Creta sudeste, patrones de asentamiento, ocupación costera.

Introduction¹

Although the coast is the meeting point between land and sea, it is the belief of the author that the human activity and occupation within such a landscape is far more influenced by the sea. For this reason the analysis of the evolution of the human occupation at the S-SE coast of Crete will lean towards the concept of the *Maritime Cultural Landscape* as Christer Westerdahl defined it (Westerdahl, 1992)², while it will be articulated as an attempt to detect and describe the occupational settlement patterns of the study area throughout the prehistoric and historical times (Final Neolithic to Hellenistic period).

A brief geographic presentation of the island of Crete

The core of the island of Crete are the five main great mountain groups that dominate its hinterland, limiting the communication between the north and the south coast to the numerous gorges (around a hundred) that carve the landscape, from the highest mountain peaks to the coast. Within those mountain ranges there are various plateaus (around twenty-five) that usually concentrate large quantities of water that spills from the nearby mountains. In addition, due to the small width of the island (that varies from sixty to twelve kilometers) and its elongated shape, there are no more than twenty-six rivers most of which are seasonal, while only six have water flow all year round (Rackham/Moody, 2004: 57). The Cretan coastline is characterized by a vast geomorphological diversity. However, while the northern coast presents wide coastal plains and various peninsulas that form deep gulfs, the southern one is less hospitable with cliffs and steep slopes descending directly to the sea (Nowicki, 2000: 21).

The central-eastern part of the island is characterized by three mountain ranges, six plateaus and three rivers. The S-SE coast is not only generally inhospitable, as mentioned above, but also geographically isolated from the northern part of the island (due to the mountain ranges) with the exception of the Isthmus of Ierapetra that connects the two coasts. It is important to note the absence of natural harbors at the S-SE coast, a «gap» that was filled in by the various small and relatively protected bays that were used as anchorages.

However, during the following analysis one should keep in mind the –yet not extensively studied– differences between the present coastline and the prehistoric and historical ones. This is due to: i. the rise of the Sea Level, ii. the high tectonic activity and the subsequent vertical movements of the earth, iii. the human impact (i.e. touristic development, extensive greenhouse cultivation). All these parameters have defined –and they still define– the variations of the under discussion coastal landscape from its past to its present form, and consequently the different options and possibilities that they could offer to its past inhabitants.

¹ We will use the abbreviations N, S, W, E = North, South, East, West, as well as the standard chronological abbreviations: FN, EM, MM, LM = Final Neolithic, Early, Middle and Late Minoan.

² That could be summed up as the holistic view of the multi-layered context of the coastal areas that should include any hermeneutic kind of human relationship to the sea.

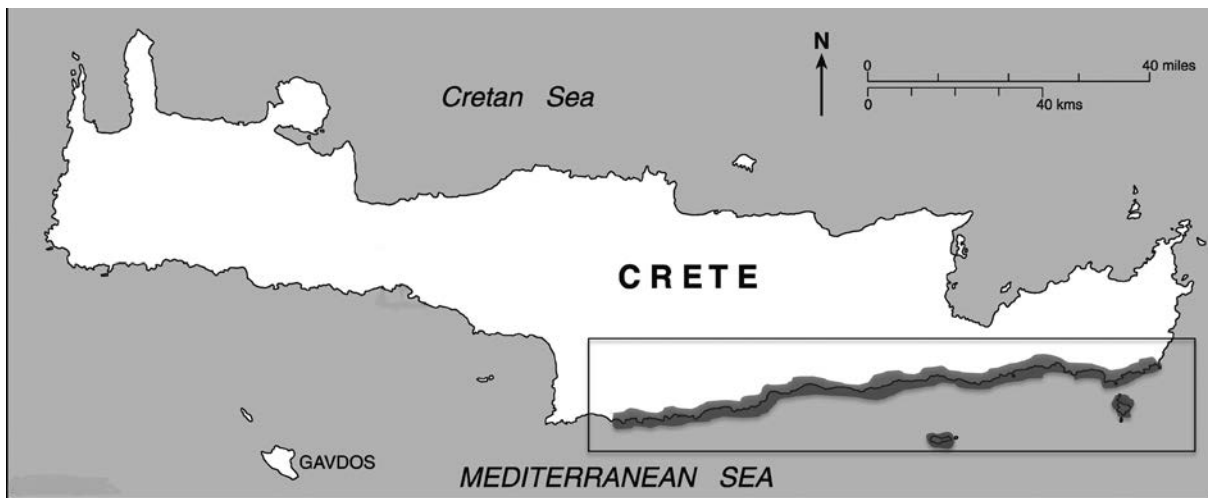


Figure 1. Map of Crete, research area.

This research concerns the area between Xerokambos bay (site 1)³ to the East and Lasea bay (site 30) to the West, as well as the islets of Chryssi and Lefki (sites 5 and 4), for a distance of 300 km on each side of the coastline (Fig. 1). However an exception was made in the case of the sites 10, 11 and 12, which, although out of the research area by ca. 500 m, they were considered of crucial influence to the latter, and therefore significant for the correct interpretation of the relative context.

Settlement patterns

Final Neolithic period

The (Late) Final Neolithic sites at S-SE Crete (3600-3000 BC) indicate a temporary colonization of coastal areas of limited accessibility by small groups of people. By summing up the characteristics of the sites we are able to deduce a pattern (Nowicki, 2011: 42) of newly founded sites located on ridges, rocky promontories and islets⁴, which present the typologies of small, often fortified, villages and isolated houses or hamlets (Nowicki, 2008: 209, 212). In order to interpret this sudden colonization of marginal sites with those curious topographic characteristics of habitation, which defines –mostly the second half of– the fourth millennium BC in the entire island, various theories have been proposed: i. the search for natural resources, ii. the human response to the climatic change (Vagnetti, 1972-1973: 132; Tomkins, 2010: 43), iii. the arrival of a pastoral economy (Tomkins *et alii*, 2014: 1), iv. the potential of defensibility, namely the inhabitants' response to the security threat that newcomers' groups represented to them (Nowicki, 2011: 202), v. the emergence of sea «trade», followed by the intensification of maritime activity and the consequent usage of geographically strategic coastal sites (Papadatos/Tomkins, 2014).

³ The numbers of the sites in the text are referred to the site catalogue (Fig. 1), as well as to the maps with the location of the sites (Fig. 3, 4).

⁴ However, in the case of the islets Nowicki (Nowicki, 2008: 220) detects a variation in the settlement pattern, defined as «undefended extensive sites on low coastal terraces», which in our opinion is debatable. Even if they do not share the exact same topographic characteristics, they present the element of defensibility since they are located at the isolated and of limited accessibility islets of Chryssi and Lefki.

The FN period is a transitional phase with deep socioeconomic changes the causes of which could be an issue of an endless controversy. The facts on which we should focus are the unprecedented expansion of settlements, the more developed social and territorial organization and the numerous new elements in the material culture with no antecedents in Neolithic Crete (Nowicki, 2009: 288). Concerning the latter, the inhabitants of Crete seem to acquire a more extrovert character towards the rest of the Aegean, as the attested import of pottery, raw materials and finished products at the site of Petras Kephala (NE Crete) (Papadatos/Tomkins, 2014: 331-336), as well as the stylistic affinities with the Dodecanese, present at various coastal FN sites (cheese pot vessels, new pottery wares) indicate (Nowicki, 2008: 225; Papadatos, 2008: 265, 270). Consequently, the evidence strongly suggests that the new material culture appears to be the result of cultural influence and interchange. In fact, in our case, namely the FN sites of the SE coast, a further element they also have in common is one of the abovementioned new pottery wares, the Red Ware (Nowicki, 2008: 225). Therefore our settlement pattern is enriched with the feature of the maritime-based cultural interchanges.

This temporary colonization of marginal coastal sites with no environmental potential to support long-lasting occupation seems to have been a conscious collective choice in the light of the emerging conditions and needs. For Siteia, a region of E Crete, where, as far as the coast is concerned, we can observe a similar pattern to those of the S-SE sites, there is a study on the macro-scale socio-economic relationships of FN settlements (Tomkins *et alii*, 2014) that, in the author's opinion, offers insight regarding the «bigger picture» of that new choice of settlement. According to the authors of the study «the dispersal of small sites seems to have been balanced by a form of visual integration that supported the formation of a type of dispersed community [...] certain sites appear to have been special sites where communities could gather [...] In this way dispersed inland and coastal clusters were inter-linked to form a single network of overlapping social fields» (Tomkins *et alii*, 2014). So we end up with a model of a multicellular settlement pattern constituted of smaller and bigger «cells», where every site location should be seen in the context of its surroundings in order to make sense. The validity of this model on the S-SE coastal sites is not certain but is worth considering. If that was the case, these coastal sites with the curious topographic characteristics would become the «satellites» of the larger defensible inland settlements, such as (from E to W) Xerokampos Kastri, Goudouras Kastri, Vainia Stayromenos and Dermatos Kastrokefala (Nowicki, 2008: 209, 213, 214; Nowicki, 2011: 42). Thus, in this context, the under discussion settlement pattern at the S-SE coast of Crete was functional to its wider socioeconomic network for a specific period of time and for a specific set of activities. The sites may have served as outposts of the larger settlements in terms of territorial control, exploitation of new natural resources and also as a gateway to sea-related activities.

Early Minoan period

A closer look at the Early Minoan sites (ca. 3000-2050 BC)⁵ can reverse the initial impression that could be summed up as a «simple, village-based/non-urban, conservative and lacking craft specialization» pattern (Cherry, 1983). Even though most of the sites are seasonal coastal villages and isolated tombs, the presence of settlements⁶ among them (sites 9, 10, 11) indicates a certain level of social complexity and of natural resources' management concerning that period. By that we do not imply anything more than a well-established settlement arrangement of a village consisting in several households (Nowicki, 2010: 223). Regarding the emergence of the social complexity it is important to point out the introduction of seal-stones, attested both at sites 11 and 10 (Rutter, 2011).

⁵ The chronology of Minoan Crete is based on the one used by Vasilakis, 2001.

⁶ The settlements bear close similarities between them as far as the arrangement and the site location are concerned.

In addition a new tomb type appears, namely the tholos tomb, which is attested at sites 8 (Schlager *et alii*, 1997), 4 (Papadakis, 1989: 304), 11 (Vasilakis, 1989: 56), 12 and 18 (Alexiou/Warren, 2004). The emergence of these formal burial customs (Vagnetti/Belli, 1978: 150-151) is a significant development that so far stimulated various interpretations such as: i. the possibility that they are indicative of primary burials of status or ii. the introduction of new burial customs as a consequence of population movements from other areas and specifically from North Africa into Crete (Branigan, 1988: 198-199). Finally other features worthy of mention are the higher density of sites and the continuity of the external relations as indicated by various findings such as obsidian at site 11 (Vasilakis, 1989: 56) or an Egyptian scarab at site 12 (Alexiou/Warren, 2004: 13). The settlements of the sites 10 and 9 were destroyed by fire during the Early Minoan IIB period. If something becomes evident from the observation of the evolution of this settlement pattern, that is undoubtedly the more permanent character that most sites acquire and the consequent sense of ownership of the territory. While there are still some settlements of probable seasonal function (such as sites 3 and 8), the life and death-related links to the territory now seem to be stronger, something that is attested both from the well-established settlements at the sites 9, 10 and 11 and from the tholos tombs, the first exemplar of a monumental burial practice in Crete.

Middle Minoan period

The elements that characterize the settlement pattern of the MM period (ca. 2050-1675 BC) at the S-SE coast are: i. the continuity of occupation that is attested at most of the sites (especially at the tholos tombs, which present diachronic usage) and ii. the establishment of new ones during the MMIIIA mainly at Keratokampos bay (sites 15, 19) (small villages, sanctuary and tombs), that increase the total site-density. The EM settlement of site 10 was abandoned for good after its destruction, while the neighboring site 9 was resettled after a probably short gap (Cadogan, 2000: 171). Interestingly though the buildings that represent its new MM phase were a tower, stout terrace walls and two cisterns (Cadogan, 1977-1978: 74), something that raises discussion regarding the security issues of that period. Some attempts to explain the abovementioned development were made (Cadogan, 1977-1978: 74; Nowicki, 2010: 233) but in our case we prefer not to reach conclusions about the settlement pattern based on a single site⁷. However it is fair to assume that this settlement pattern is characterized by continuity regarding the permanence at the sites (also those of seasonal character) and by a form of regional conservatism, since the passage to the Protopalatial (that begins at ca. 2000 BC, when the first palaces are founded) and to the Neopalatial period (ca. 1700 BC) cannot be retraced in the pottery of the sites of our study area until almost three centuries later (we are referring only to the MMIIIA sites of Keratokampos bay)⁸.

Late Minoan period

In relation to the previous periods the LM sites (ca. 1675-1200 BC)⁹ present a much higher density and a wider range of typologies. Some of the sites present continuous occupation, while several other small sites/villages (probably seasonal ones) are founded. However apart from the small sites a new typology emerges: the, popular during LM I, so-called «Minoan villa» at the site 21 (Davaras, 1997). The Minoan villas can be described as rural isolated centers for the collection

⁷ Unfortunately Myrtos Pyrgos is the only SE coast site, as far as the MM period is concerned, that has been excavated systematically (but only preliminarily published).

⁸ We keep, however, certain reservations regarding the last assumption, since it may be subject to the lack of excavations and consequently, of evidence.

⁹ The LM chronological frame here does not include the LMIIIC period (ca. 1200-1050 BC), which belongs to the Early Iron Age instead. For the «peculiarities» of the LM chronology see also Cadogan, 1983.

of agricultural surpluses in sparsely populated areas. In addition we have the LM I «country house» of site 9 (Cadogan, 1977-1978: 77) that bears some resemblances with to the «villa» type.

Other major sites are the LM III coastal settlements at sites 22 and 23 and the cemetery at site 19¹⁰. The archaeological evidence about the LM III relations between various central-eastern Cretan sites (mostly the coastal ones) with the palace of Knossos (Banou, 2004), along with the indications for the extensive exploitation of Chryssi islet (opposite to Ierapetra region) (Chalikias, 2013: 49), could indicate the existence of a certain coastal control by the Knossian authorities regarding also the remote sites (Banou, 2004: 187), or even of a wider economic strategy for the exploitation of the coastal territory.

To sum up, it seems that the LM I period is characterized by a rural-based economic system for the exploitation of the territory that is structured around the «villa» type, which later on, during the LM III, is abandoned and maybe replaced by a sea-based local «trade» and a production-orientated net of coastal settlements in the role of trading posts at S-SE Crete, that was organized by a higher (palatial?) authority.

Late Bronze and Early Iron Age

The chronological periods that follow, namely the LMIIIC (ca. 1200-1050 BC), the Sub-Minoan¹¹ (1050-970 BC) and the Proto-Geometric (970-810 BC), will be examined together since: i. they constitute the transition period to the Iron Age and the beginnings of the establishment of the new socio-political and economic system that succeeded the Minoan one, ii. the sites that represent them have a lot of features in common, including the continuity of occupation during all of these periods (with the exception of one site), due to which the chronological limits of the single phases are often hard to distinguish.

After the collapse of the Minoan state system there is a radical shift of the settlement pattern that is characterized by instability and the relocation of people from low-lying to upland sites (D'Agata, 2001: 346). The Early Iron Age emerging pattern could probably be better described as the sum of «clusters of interdependent nucleated hamlets and villages» (Nowicki, 2002: 153). The S-SE coast seems to follow the abovementioned new settlement-pattern features and despite the insufficiency of respective excavations and publications, we will attempt to «extract» any further characteristic elements from the existing yet limited data. What we can instantly notice is the considerable decrease regarding both the number of sites and the variety of their typologies. Sites 20 and 15 present continuity from the previous periods and they are cult-sites. That element seems to illustrate well the general tendency in Crete during the Protogeometric (and Geometric) period, where several cult places re-used Late Bronze Age settlement remains, a choice that could be interpreted as a legitimizing one (Wallace, 2003: 263). As far as the other sites are concerned, 5 and 8 seem to have been seasonally occupied since they preserve only pottery shreds concentrations, while site 26 is probably an Early Iron Age upland settlement (located on a high promontory) for which we lack any further information since it remains unexcavated. Given that our estimation could be biased by the lack of evidence, we have to admit that there is a difficulty in detecting the general pattern. However we could say that it is characterized by scarcity and maybe even randomness, since we cannot «see» the wider plan in terms

¹⁰ Unfortunately the excavations and publications are very limited, consisting only of the preliminary reports in *Archaiologiko Deltio* (ADelt).

¹¹ The Sub-Minoan period is the brief transition-phase that followed the end of the Minoan socio-political and economic system, that remains still a little bit foggy as far as its duration and its pottery style are concerned (see also Hallager, 2010: 141).

of site distribution and/or typology; a no-pattern. The absence of an occupation pattern in a macro-area as this one though, could indicate the emergence of more localized –thus invisible to us– socioeconomic and political microsystems. Interestingly that fits well the general occupation pattern in Crete, which, after the Minoan millennia, experiences for the first time the absence of a central authority, while the strong regionalism emerges, an element that has also defined the following centuries (D'Agata, 2001: 353-354).

Finally, the density of the sites at the S-SE coast indicates its –without precedent– abandonment and it seems that the coast and probably the sea in general, has a very limited role in this new socio-political and macroeconomic system of the island. In short, as far as the Sub Minoan and the Protogeometric periods are concerned, the huge economic and cultural value that the sea represented for the past millennia seems to be lost. According to a number of scholars this could be explained as the consequence of the general disturbances in the Mediterranean and the threat coming from the sea, related to the commonly known «Sea-Peoples» migration (Nowicki, 2002: 23, 24, 37).

Geometric period

The element of sea will be retraced again in the material evidence that comes from the S-SE coast only later on, during the Geometric period (810-700 BC), in the cult site 20; a diachronic cave-sanctuary (mentioned also above) that provided us with three boat clay figurines (Kanta/Davaras, 2011: 141, 135) as well as with numerous Egyptian and Syro-Palestinian votive offerings (scarabs, amulets) dated to the Orientalizing period (Kanta/Davaras, 2011: 168-187), that indicate external relations and maritime activity. In our study area the site density remains at a very low level. However, according to the broader picture, during the Geometric and the Orientalizing periods the island seems to regain its extrovert character and the sea its importance, something that is further attested by the participation of Cretans at the colonization of Gela in Sicily and of Cyrene in Libya in the 7th century BC (Scirpo, 2012: 92).

The brief mention of the Orientalizing period (700-600 BC), is due to its limited available evidence. The particular period is represented by only two sites at the S-SE coast, thus it is impossible to draw further conclusions about the wider settlement pattern. However, in order to maintain a general idea of the historical sequence, it is worth noting that during the Orientalizing period Crete served as a transshipment point in the Phoenician trade circuit (Ericksson, 2010: 279).

Archaic and Classical period

Archaic and Classical periods (600-330 BC) are represented by only four sites in our study area, which are unfortunately unexcavated (apart from site 20 that is partially excavated). Therefore it would be premature to attempt to detect and interpret the respective settlement pattern. The scarcity of evidence though should not be interpreted as the reflection of historical reality. These centuries are characterized by a low archaeological profile all across the island of Crete and the so-called «negative evidence» that initially gave the impression (which was maintained for a long time) of a recession due to a catastrophic decline in population and in cultural achievements, always in the context of a pre-assumed «Dark Age». However recent studies have shed light on what seems now to be «an emerging warrior culture, a prototype of the militaristic and austere culture of the Spartans» (Ericksson, 2010: x). Finally it should be mentioned that the –mostly ceramic– material traces of this new socio-economic pattern are difficult to distinguish and that, consequently, this could be one of the reasons for the scarcity of Archaic sites along the S-SE coast.

Hellenistic period

It becomes evident just by looking at the map of S-SE Crete and the site catalogue (Figs. 2, 3, 4) that the settlement pattern of our study area underwent a major change during the Hellenistic period (330-69 BC). Indeed the density and the variety of site typologies increased considerably. We notice the emergence of an important new cult site (29) along with the perpetuation of an old one (site 20), of a small coastal settlement (site 31), of harbor towns (sites 28, 30) one of which would actually become the most important city-state in East Crete, of fortified small settlements (sites 19, 27), of a cemetery (site 26) and of neighboring and probably interconnected minor sites on the islets of Chryssi and Lefki (sites 4, 5) that indicate an intensive territorial exploitation in terms of pastoralism and agriculture.

	Final neolithic	Early mi- noan	Middle minoan	Late minoan	Late bronze- early iron age	Geome- tric	Archa- ic-classical	Hellenis- tic
1: Xerokambos Kastri	✓							
2: Xerokampos Amatou	✓							
3: Aghia Eirini	✓	✓	✓					
4: Lefki islet	✓	✓	✓	✓				✓
5: Chryssi islet	✓(2 sites)	✓(4 sites)	✓(8 sites)	✓(16 sites)	✓			✓(20 sites)
6: Lendas, cape Liontas	✓							
7: Tsoutsouros, Mandalos	✓							
8: Livari		✓	✓	✓	✓	✓	✓	✓
9: Myrtos Pyrgos		✓	✓	✓				✓
10: Myrtos Fournou Korifi		✓						
11: Tripiti		✓						
12: Lendas, Papouras		✓	✓					
13: Ampelos			✓	✓				
14: Faflago			✓	✓				
15: Keratokampos, Komis			✓	✓	✓	✓	✓	
16: Keratokampos, Listis			✓	✓				
17: Ai Ghiannis, Dermatos			✓	✓				
18: Lendas, Gerokampos			✓	✓				
19: Keratokampos, Trapeza			✓	✓				✓
20: Tsoutsouros, Eileithyia cave			✓	✓	✓	✓	✓	✓
21: Makrygialos, Vigla				✓				
22: Diaskari				✓				
23: Koutsouras, Spiliaridia				✓				

	Final neolithic	Early mi- noan	Middle minoan	Late minoan	Late bronze- early iron age	Geome- tric	Archa- ic-classical	Hellenis- tic
24: Tertsia, Panoklissia				✓				
25: Tsoutsouros, Aliori				✓				
26: Keratokampos, Kastri					✓	✓	✓	✓
27: Ampelos, Farmakokefalo								✓
28: Ierapetra								✓
29: Lendas								✓
30: Lassea								✓
31: Tripiti, Fylakas								✓

Figure 2. Site catalogue.

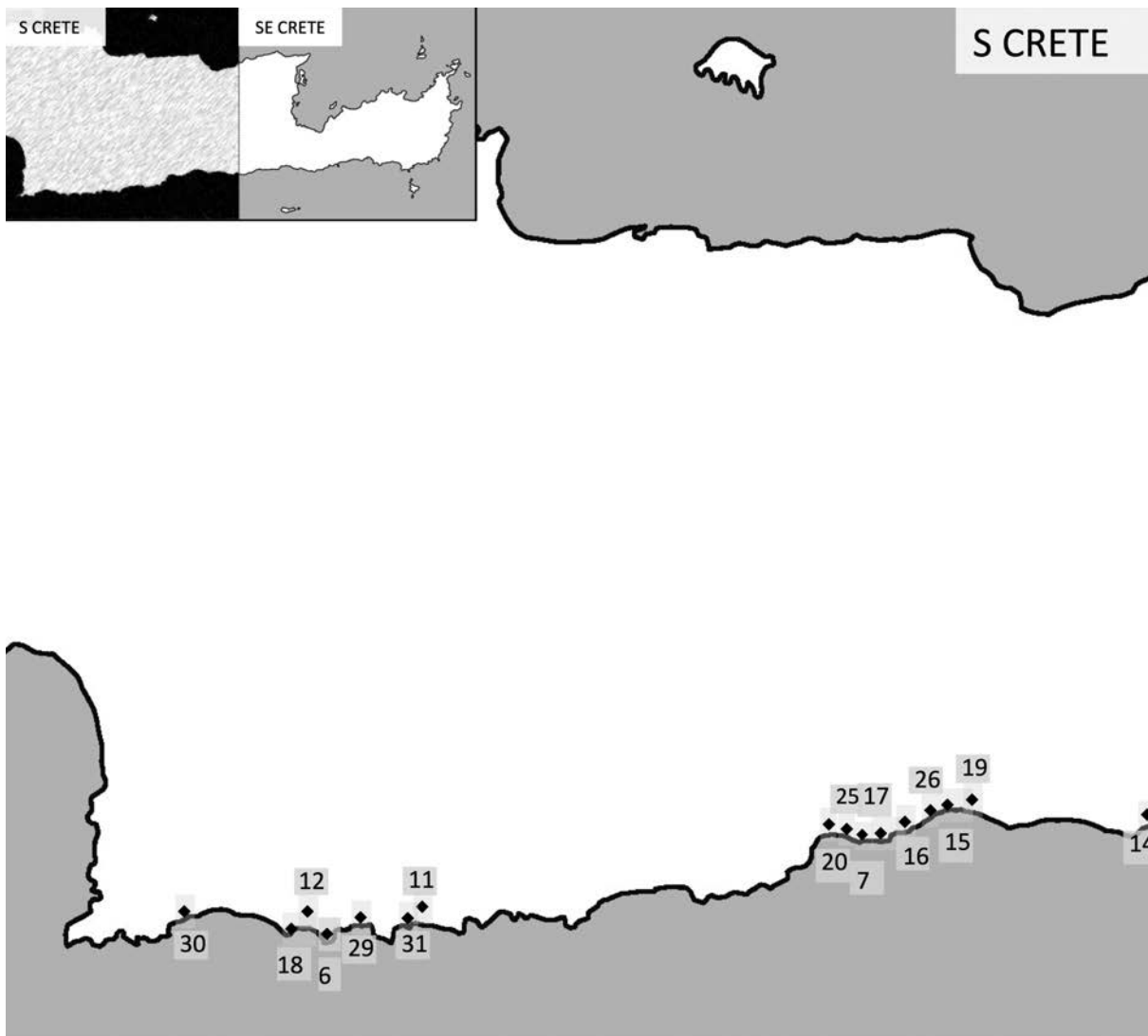


Figure 3. Map of S Crete with the location of the sites.

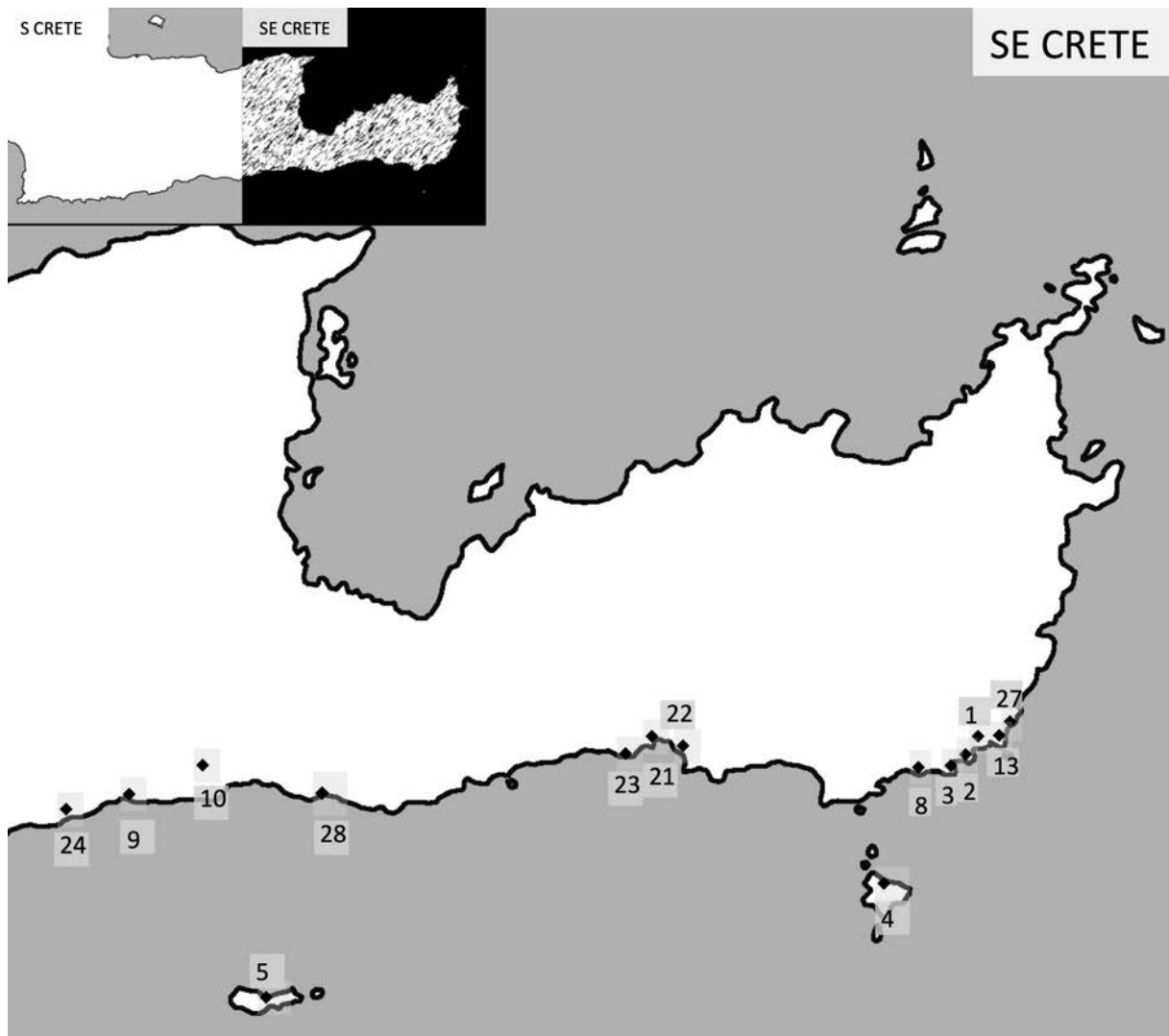


Figure 4. Map of SE Crete with the location of the sites.

The culture –and probably the economy too– of subsistence of the Archaic/Classical periods characterized the Hellenistic Crete as well. The new important features that emerge in the Cretan society, as we know from the literature sources and the epigraphic record (Chaniotis, 2000: 55), are the city-states and their almost continuous warfare for territorial –and subsequently economic– control, the agrarian economy, the intensive practice of piracy and the massive «production» of mercenaries that were recruited from the warring states all around the Eastern Mediterranean (Willems, 2013: 143-150). In such a context the «rediscovery» of the coast seems indeed inevitable, driven not only by the needs of the piracy-involved Cretan people, but also by the exploitation of maritime resources (sites 4, 5, 30, 28) and the necessity of the Cretans to be present in the sea networks –and consequently on the coasts– for economic (Viviers, 1999: 224) and political (Apostolakou, 2006: 198)¹² reasons. Two elements that are worthy of notice are the existence of fortifications in at least three cases (sites 5, 13, 19), a feature that probably depicts the general instability during that period, as well as the high density in cult sites (both at-

¹² An example of this is the alliance between Ierapytna and the Seleucids.

tested and probable)¹³. The latter could suggest an intensification of the cult practices due to a reason we are unfortunately unaware of, given also the lack of a fully excavated and published context.

Finally another matter that deserves an extensive mention concerns the sea trade in Hellenistic Crete. Given this «renewed interest» for the coast, one should expect to find evidence regarding the maritime trade. However the existence of the latter is still under debate (Chaniotis, 1996; Perlman, 1999) since the evidence for Cretan imports and exports exists, but at such a low number that implies something more similar to casual transports (regarding their connection to the mercenaries see Hadjissavas/Chaniotis, 2012: 168) and less to an organized form of exchange. Nonetheless, it is the author's opinion that the real debate should not concern the existence of this «maritime trade» but its nature. We cannot ignore either the evidence we have regarding the export of Hadra vases (Hadjissavas/Chaniotis, 2012: 168) or the strong indications about the export of cypress, wool (Viviers, 1999: 229) and purple dye (Papadakis, 1983: 59-60). All of the above presuppose the insertion of Cretans into the pre-established Mediterranean exchange networks, which they accessed probably due to the piracy activities. Therefore we should maybe consider the possibility of a minor scale and less organized maritime exchange network, which of course differs much from the type of the later Roman maritime trade, but complies with the extrovert character (also in relation to the previous periods) that the Hellenistic settlement pattern at the S-SE coast of Crete indicates. The density and the typology differentiation of the abovementioned sites reflect the interest for territorial and economic control of the coast that probably served –among other things– as the base for the various sea-related activities.

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¹³ Attested cult sites; 20, 29, probable sites; 27 (Papadakis, 1987: 306), 9 (Cadogan/Chaniotis, 2010: 296-297), 4 (Papadakis, 1997: 125).

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The maritime cultural landscapes of Cascais (Portugal): the model of research and coastal management

El paisaje cultural marítimo de Cascais (Portugal): el modelo de investigación y gestión costera

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Abstract: Underwater Archaeological Charter programs appear as a coastal management tool built from the Maritime Culture evidence. As a source and as a tool of knowledge, leaning on research such as the ability to define strategies and priorities in establishing a policy of sustained development and enjoyment of the underwater cultural heritage. The model that we have followed in the management of the Underwater Cultural Heritage on the municipality of Cascais, searches –through interdisciplinary analysis– of the Maritime Cultural landscape's use and space. Shipping zones accompany this multiplicity of man in the landscape. They are, in last regard, the harmony between the sea and the Earth

Key words: Maritime cultural landscape, coastal archaeology, coastal management, Portugal, Cascais.

Resumen: el proyecto de Carta Arqueológica Subacuática aparece como una herramienta de gestión costera construida a partir de las evidencias de la cultura marítima. Como fuente y como herramienta de conocimiento, se basa tanto en la investigación como en la capacidad de definir

estrategias y prioridades en el establecimiento de una política de desarrollo sostenible y el disfrute del patrimonio cultural subacuático. El modelo que hemos seguido en la gestión del patrimonio cultural subacuático en el municipio de Cascais, busca –a través de un análisis interdisciplinar– el paisaje marítimo cultural necesario para interpretar la costa como un espacio de uso y manipulación diacrónica. Las zonas de embarque acompañan esta multiplicidad del hombre en el paisaje. Son el último punto de la armonía entre el mar y la tierra.

Palabras clave: paisajes culturales marítimos, arqueología costera, gestión costera, Portugal, Cascais.

Introduction

The purpose of this article, inserted in a wide investigation, has a dual perspective: firstly, continue to provide the Underwater Cultural Heritage of Cascais Survey an epistemological substrate for coastal management, while a maritime cultural space; and, secondly, seeks to give wider scope to gather the data collected. It aims to enable a new approach to archaeological issues, but also to promote new areas of research. With this work we also contribute to the protection of underwater archaeological sites, particularly in the scope of their scientific and patrimonial value, giving particular emphasis to current issues of the territory (Freire, 2012: 12).

In fact, as coastal erosion and coastal urban development have become a real concern, this type of study contributes with a new scientific and technical base for coastal planning policies (Ford, 2011: 763). Objectively, a continual investigation oriented towards coastal ar-

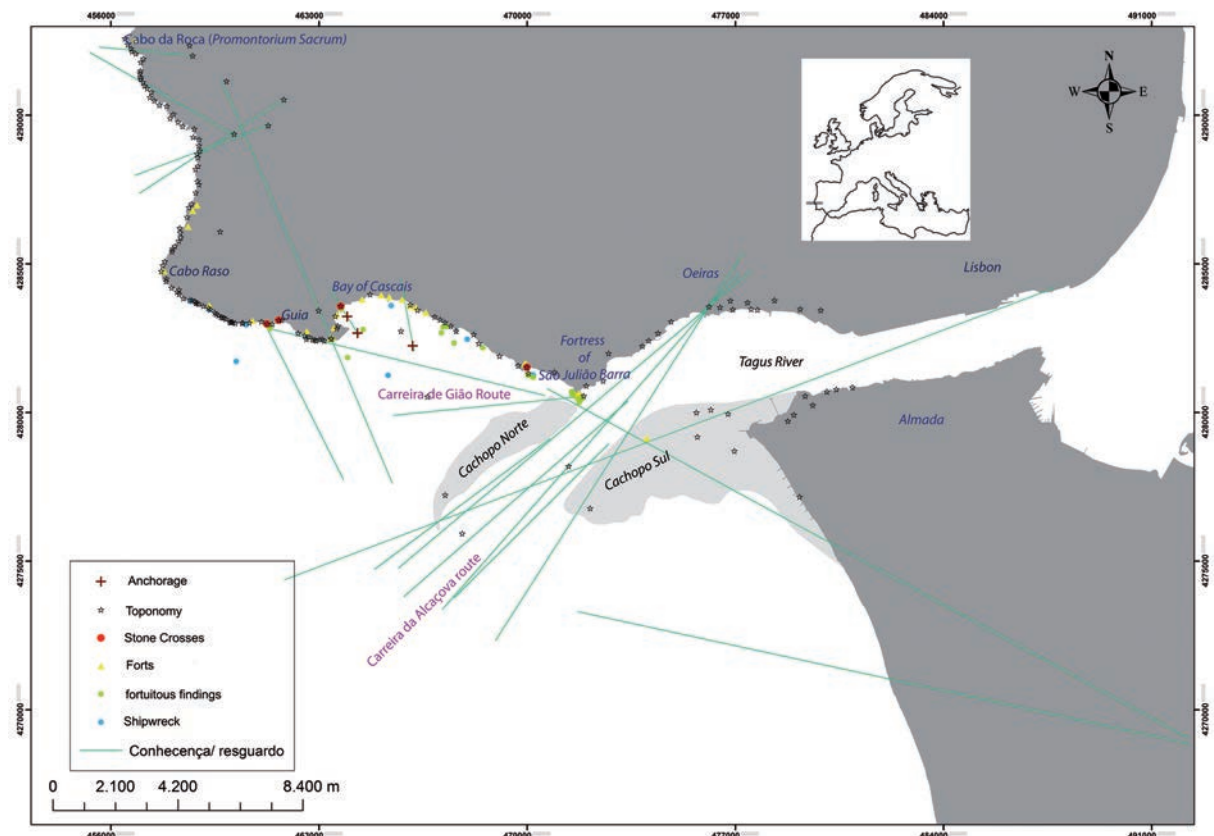


Figure 1. Portugal and Cascais (Map by authors and José Bettencourt).

chaeology (Paddenberg/Hession, 2008: 150), where the maritime landscape is not represented as a blue sterile area but filled with historic shipwrecks and a multitude of direct and indirect elements belonging to navigation aids and to human occupation of the coast: «the whole network of sailing routes, with ports, havens and harbours along the coast, and its related constructions and other remains of human activity, underwater as well as terrestrial» (Westerdahl, 2008: 212).

Maritime cultural landscapes cover multiple issues that focus on the continuities and dynamics, social aspects, cognitive and natural perceptions of a region that, in the case of the coast of Cascais, is of millenary usage (Freire, 2014). We propose in this small work the analysis of this region into the logic of a transport zone from the perspective of *longue durée* (Rönby, 2007: 65) and of transit points (Westerdahl, 2006: 339-341).

Cascais Transport zone

The current development of the Underwater Cultural Heritage of Cascais Survey (Fig. 1) comes from the understanding that the coast is an area of transport zones which limits the ability for navigation and the construction of ways of orientation (Westerdahl, 1999: 135-143)

The hypothesis of transport zones has a deeply cultural essence of transport corridors, routes and the organization, a better expression of the social practice, and of the ever changing habits and mental maps; in fact, a social field of study of those that utilize the space. We must understand this hypothesis as a maritime culture that, in good part, is also a gesture of response to nature (Freire, 2012).

In this perspective, the concept of transport area can very well be used in a dynamic manner, in order to cover some of the most complex interactions between nature and culture. The elements of nature are related to culture through the context and the hydrography of transit points. This reality of transport has obvious implications, in the images of the world and the space in which we are working and it is necessary to assign it to an anthropological and cognitive dimension (Freire, 2012: 73-89).

The manipulation of this zone is determined accordingly to a logic of interpretation in network, starting from the elements that best characterize the landscape and which best define this land-sea dichotomy.

The record of this zone is firstly established by its natural context. This is supported by the history of anthropization and by the proliferation of coastal underwater contexts. These areas are obviously mentally mitigated through cartography of maritime routes and popular practices (Ransley, 2011: 879-904). Some of these documents were used to illustrate the patterns of the transport zones (Westerdahl, 1999: 135-143), mainly, to confront them with archaeological and historical assets.

Geographically, the coast of Cascais, located on the Western façade of the Iberian Peninsula, is part of the Portuguese territory, which has suffered the submersion of post glacier deep valleys. This situation has led to the creation of a very jagged coastal topography, especially between the Bay of Cascais and the *Promontorium Magnum* (Dias/Rodrigues/Magalhães, 1997: 53-66), allowing an excellent seaworthiness. This happens due to a set of natural shelters (Blot, 2003: 56), reinforced by the orientation of the coast that provides protection from the prevailing winds of the Northern Quadrant, facilitating the entry and exit from the mouth of the estuary of the river Tagus (Carvalho/Freire, 2009: 855-856).

Integrated into the hinterland of Lisbon, this coastal region also benefits from a double hydrography that plays with both oceanic and fluvial influence, predominantly characterized by strong tidal currents, associated with the flow and ebb of the Tagus River estuary, introducing in this space a particular dynamic and diversity (Freire, 2014:146).

Estuary transport zone

The «Carcavelos» area (Fig. 2) is part of the entrance to the Tagus River. From a hydrodynamic point of view this area is strongly affected, especially in the ebb period. Unlike the local «Guia» or the underwater archaeological site *Thermopylae/Pedro Nunes*, which are solely influenced by the hydrography of the mouth of the Estuary, this area is not only influenced as also directly influences the Tagus estuary. The dives there carried out mainly at the Ponta da Rana suffer from this reality, which hampers archaeological record.

The Ponta da Rana is a small promontory with a seafloor consisting of a long rocky plateau. Situated in one of the vortices generated by the strangulation of the mouth of the Tagus, and the areas of Carcavelos and Parede, at certain times of the tide, an intense maritime current hinders any archaeological work. In addition to the intense maritime current caused by the proximity of the Tagus estuary, the fact that work is done in very shallow water exposes us directly to the force generated by surface wave actions. So, whatever intervention in these areas has to take into account this conjuncture: the influence of the Tagus estuary, currents and tidal range, as well as the direction and intensity of wind.

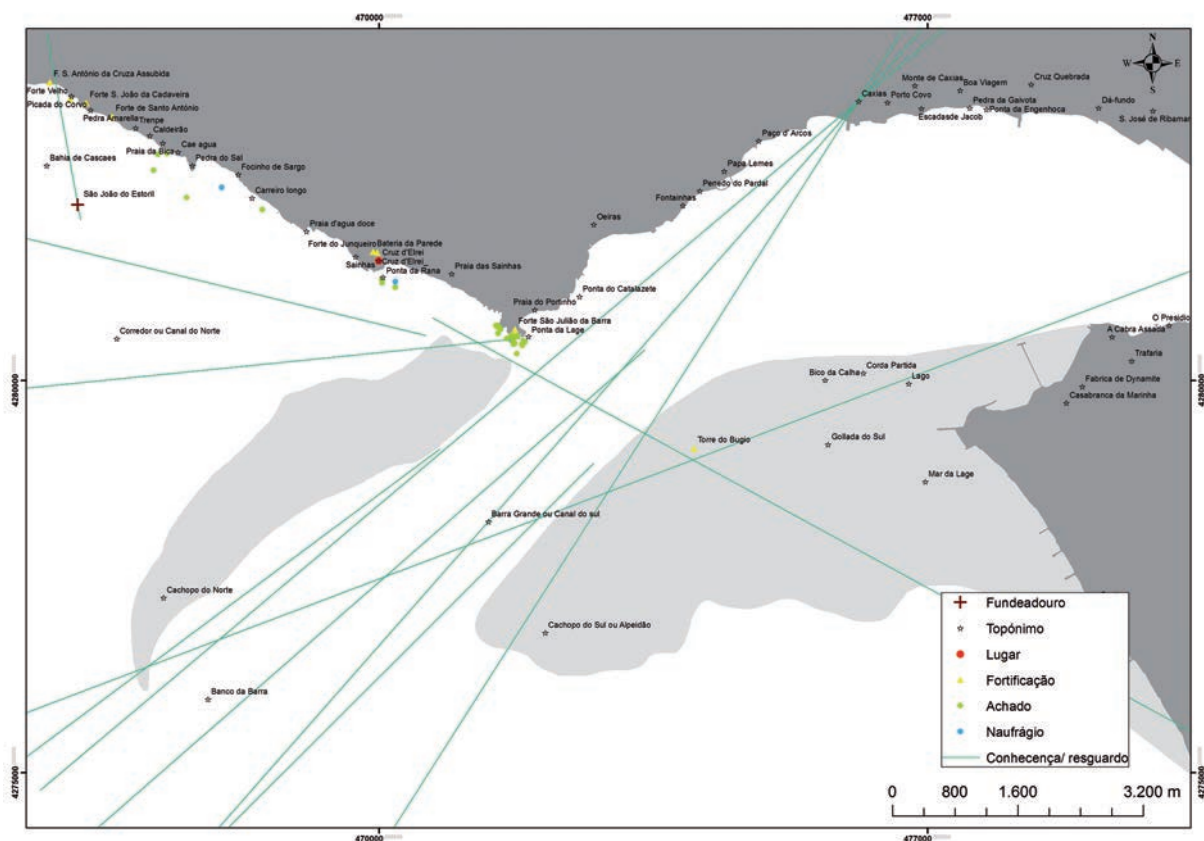


Figure 2. Estuary transport zone (Map by authors and José Bettencourt).

In this area, the number of historic shipwrecks amounts almost to a hundred. The greatest majority occurs in the vicinity of Cachopos, followed by Ponta da Rana and, finally, São Julião da Barra. The documentation reveals the frequent occurrence of shipwrecks, since at least the 16th century. Those same sources also indicate their cultural diversity, with Portuguese, Spanish, English, French and German ships.

Between 1976 and 2013, were collected near São Julião da Barra 2616 artifacts. The quantitative expression is divided in: 57% of metals, 23% of ceramics, 17% of organic material and 1% of other groups (rock, bone material and glass). Within the metals, silver (Ag) assumes the greatest relationship with 50%, followed by the lead (Pb), with 23% and copper (Cu), with 18%. Iron (Fe) has 1%, while the gold (Au) and the brass have a residual representativeness. Most collection types are, without doubt, the numismatic, with approximately 600 specimens collected. The bullets, in lead, represent close to 300 copies. Also important to highlight are the fastenings with 100 artefacts in copper and about 76 in bronze. Of the collected objects, the «suba», chest plates, astrolabes, compasses and the sets of measures are clearly the largest cultural asset valued objects. In the case of ceramics, the glazed is the more expressive (44%) followed by the common ceramic (23%), the porcelain (21%) and faience (12 percent). Finally, the overwhelming majority are organic materials: fruit pits (87 percent), pepper (4 percent), plus coconut and sugar choweverane (graph 3). The preliminary study of the site held in 2011 has enabled us to correlate some of the artifacts to the shipwrecks of the Royal Navy HMS *Kingfisher* and Portuguese ships from Brazil (Freire/Bettencourt/Fialho, 2012).

Recorded *in situ*, are 83 evidences, including cannons, anchors and shipwrecks distributed spatially, around the fortress to a depth of 10 meters (Freire/Bettencourt/Fialho, 2012).

The geography of shipwreck risk, at the entrance to the mouth of the Tagus, is indirectly referred to on written sources as in the speeches of Leonardo Turiano. Observed in the spectrum of this cartographic work and fueled by a cartography collection ranging from the 16th to the 20th century, we obtain data on the «conhecenças» to enter and exit the Tagus. The variation of this sample leads us to moments of sediment changes of the seabed, but also to the volatility of the loss traps. The Gião approximation route or the Santo Antonio da Barra approximation route to Lisbon harbor became known because of its immense difficulty to sail but, at the same time, was the best route for vessels of modern times. At first, circa 1590, we have four bearings Santa Marta with the Guia at West; Cabra Assada (Serra de Sintra) with Moinho to the North; the Baluarte de São Filipe with Oeiras beach northeastward.

To conclude, at the dawn of 17th century the navigation bearing beacons changed, especially to avoid newly formed sandbanks. The new route required the bearings of Marta-Guia with the Bugio, West-East direction; Cabra Assada with the Moinho to the North, and bastion of São Filipe with the Forno (Beach Tower) to the Northeast. This moment, recorded by Italian architect, stands out the practice continued, even today, to use the bearing of Santa Marta guide with the Bugio (West-East); «Boa Viagem com a Marca da Mama (*Nordeste*) para navegar dentro e fora do Tejo» (Freire, 2012:73-89).

Transition transport zone

Aligning the bearing of «Santa Marta-Guia» (Fig. 3) we arrive in another zone that has been subject to archaeological record. Geographically it is a cove oriented towards North/West, protected from prevailing winds, but exposed to the Southern winds. The hydrography considers it to be the limit of the Tagus estuary, however it is still influenced by it. The bottom morphology is variable, from the 5 meter bathymetric forward, with large sand areas to rocky bottoms. Directly in front of the coastline, the bottom is generally rocky, due to cliff erosion.

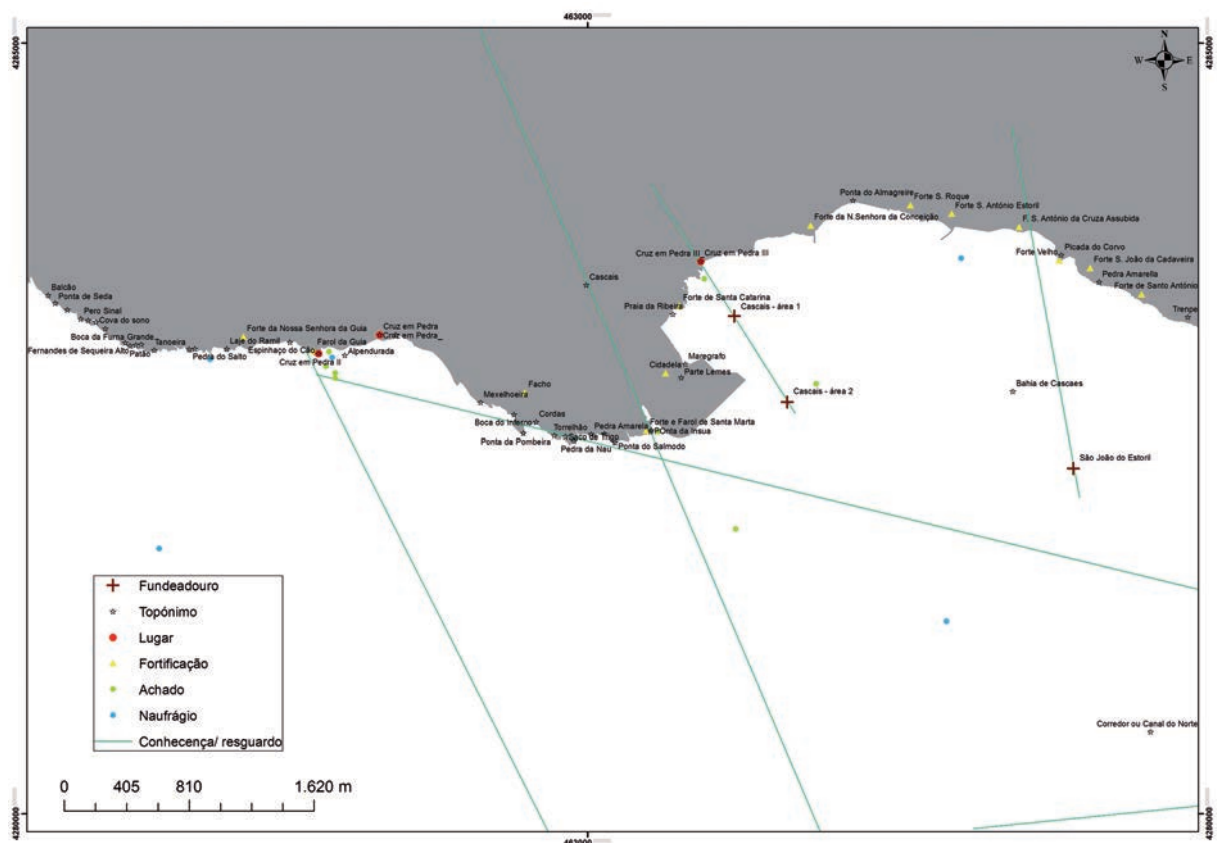


Figure 3. Transition Transport Zone (Map by authors and José Bettencourt).

Approaching from the cultural heritage point of view, we observe *in situ* the remains of two iron ships, anchors and two iron cannons of the modern era. From this area were retrieved several Roman anchors lead stocks and a stone anchor. This collection indicates a protohistoric European age.

The Cove da Maceira, is a fertile fish nursery, and is still today used as an important fishing spot. The toponymy «Pombeira», among others, witness a long practice of this activity. In the local toponymy there are also references to ships like the Carrack stone; or human actions, such as the «Lage of Ramil» or little eye booger. Also, connections to the previous parish, as «Pau Amarelo».

Again based on historical facts, the Guia has six shipwrecks recorded, going between the 16th and 20th centuries (Freire/Fialho, 2009: 10). Although we have several archeological materials dating of the modern era –cannons and anchors– we cannot, in the light of existing knowledge, risk a proposing of a cultural origin. With less uncertainties the iron ships of the wreckage, surely are, of English or Portuguese origin. In this case, the list of ships of the contemporary era is reduced to five: the yacht *Nova Esperança* (1879), SS *Earl of Dumphries* (1883), SS *Bemptom* (1889) and two fishing vessels. The news of the sinking and the subsequent accident reports (British archives from Southampton), are another contribution in the analysis of this space as a place of transition between the Atlantic Ocean and the Tagus River Estuary.

It is curious, however, that as a way to minimize or prevent maritime accidents, the oldest Portuguese lighthouse was built here, as a guide for the port of Cascais and/or at the mouth of the Tagus.

In this region, the danger is not always visible. In more recent times, the navigational aid was enhanced with a new lighthouse in Santa Marta. Both mark the entrance to the Cove, known as Bay of Cascais.

The cartography of the findings suggests an ancient navigation and a permanent or semi-permanent occupation of the port, situated on the Bay of Cascais. In this case, we have to regress to Roman times to analyze the importance of this area in the context of maritime culture. The amphorae of type Haltern 70, Dressel 1-A, Lusitania 2 and other unidentified forms typologically, preserved in the Direção Geral do Património Cultural (Cultural Heritage of the Portuguese Government-DGPC), collected by trawlers in the 50-metre bathymetric, were interpreted as evidence of the journey that was made by the Roman ships along the coast of Lusitania (Carvalho/Freire, 2009). However, we are left wondering if, during this period, the port of Cascais would be used as a port of call or as a port of refuge for large ships faced with foul weather. We have little doubt about the use of the Bay as a natural fishing harbour, in lieu of the presence in the west bank of the Ribeira das Vinhas of production of prepared fish roman industry, partially excavated in 1992, next to the preserved section of the medieval wall of the castle of Cascais, located at Rua Marques Leal Pancada; as well, the retrieval of seven lead anchor stocks: one next to the beach of the Duchess (2005), another off the coast of Santa Marta (1977) and finally five in the Guia (1976, 2003 and 2013) (Freire *et alii*, 2014: 36-43).

All these data allow us to assume that the Bay of Cascais was, already in Roman times, a point of interception of the two «navigation circuits», because it presents geomorphological conditions that show that has been used as a navigation «hormos» over long distances and, simultaneously, as a small fishing port. Of the situations mentioned by the Itinerarium Maritimum port (Namaciano, *De reditu suo*: Lt. Sea., 497-508) and the *Digesta* (*Digesta* XLIX, 15.2), the Bay of Cascais can be classified as a *statio* because its fits into in a small ports set category, more or less sheltered, where ships could anchor securely, and that corresponded to points of approach, already with some organization (Mantas, 2000).

In the following seasons this position has been reinforced by the fortified buildings that gave Cascais a significant importance as part of the Lisbon port complex. Indeed, the ancient route taken by ships to enter and exit the mouth of the Tagus is still today marked by a stop near the ancient Roman *Statio* of the Bay of Cascais (Carvalho/Freire, 2009: 859). It is commonly used as a safe haven, to develop commercial and fishing activities, or to give the inlet marine pilot entry («Piloto da Barra»). Other evidence of the location's antiquity is presently invisible, though the Bay's anchorage and the *silent evidence* of human activity is portrayed in contemporary cartography and preserved in the memories of coastal populations (Freire, 2014: 147).

The material evidence is given when we combine the archaeological data available – the identification of five isolated anchors between the zone of Santa Marta and Cascais (Freire/Fialho, 2009: 29-32; Freire/Fialho, 2012a: 26-28). In the same area of the findings, the *Plano Hidrográfico barra do porto de Lisboa* (1857) and the *Plano hidrográfico da baía de Cascais* (1926) mark the East/West approaches to the port, in a direction that follows the support points of the Ribeira das Vinhas and the chapel built on Monte Peninha. Another variation relates to the bearing that connects the Ribeira das Vinhas to the Luís Figueira house (Northeast).

It is curious, however, the existence of a map, dating from 1922, which also depicts the hydrographic survey of the Bay of Cascais, but with two distinctive nuances from the remaining cartography. The first is the position of two anchorage locations, near Cascais, a line oriented with Luís Figueira house (North West). Most peculiar is the second, a shelter in São João Estoril, also with a support point at the chalet Bruno dos Santos (North). Important for analysis is the underwater archaeological intervention developed in 2008, within the framework of an environ-

mental impact study for the placement of an artificial reef in S. Pedro Estoril. The systematic prospecting carried out in an area of 400 by 400 m, enabled the identification of a set of 5 iron anchors of different typologies and of varying sizes, in context of abandonment or fortuitous loss. Also relevant is the work of monitoring the portion West of this area, approximately 100 meters, done in 2011 and 2013 in the archaeological site Estoril 1, which allowed to register two cannons and to identify four iron anchors (Freire, 2012: 73-89).

Ocean Transport zone

In a first synthesis, the navigation memory of the eastern areas off the coast of Cascais is evidenced by the Historic shipwreck and the archaeological remains, supported with some terrestrial elements, forts and lighthouses, plus a lot of cartography (Fig. 4).

The cultural landscape of the Western zone differs from the above mentioned. Because this is an area of a much more rugged topography, much more of the Atlantic maritime coast, and by the cartography no longer focuses on the «conhecenças». Nevertheless, it preserves the record of a toponym hostile coast, dangerous and leading to shipwrecks. In several historical periods, it also appears the legendary narratives of piracy and the seafarer's religiosity. Popular economic contexts that exalt today fishing ethnography are reflected in the Museu do Mar (Sea Museum).

In our approach, this area of the coast hails towards mysticism which is profusely accepted and studied in surveys carried out by Tuddenham (2008) and for Nordic coast Westerdahl which are strongly influenced by metaphysical issues (Westerdahl, 2005: 8-54).

The archaeological remains of this area allow the validation of shipwrecks and economic contexts. Analyzing from closer the coast, whose anthropization is slower and more dispersed, we find where the language of the stones and the human dynamics are recorded.

The toponym «Nau de Prata», «Ponta do Melissa», «Margarida» or «Ponta do Navio», must refer to maritime tragedies. We believe that the «Ponta do Navio», name used in the map of the fisheries, concerns the memory of the wreck of the steamer *Alcor*; in 1954, and it was geo-referenced in the course of the work done in 2009. The «Nau de Prata» is a name that accompanies the cartography, at least since the 19th century, on a coast where the record of shipwrecks is marked between the 18th and 20th centuries (Freire/Fialho, 2009: 8).

The archaeological sites data is conditioned by information obtained from the Department of Culture and the Cascais Municipality databases and, residually, by project interventions. The natural conditions in this part of the coast less sheltered and with strong Atlantic characteristics, hinders access to sites with archaeological potential. Places like Praia do Abano or the Cabo Raso contain numerous evidence of wreckage whose contexts have not been well-studied yet. Among these are the Florentine ship remains of the *Great Princess of Tuscany*, in which the historian Patrick Lizé managed to locate, in 2003, a set of documents in Italian archives. The findings of the modern era extend throughout this track until *Promotorium Magnum*, as a result of intense regional, inter-regional and global navigations. In fact, if the bronze cannons from the Cabo da Roca identify the nature and the identity of the wreck, the remaining findings attest to trading and military movements, such as the naval battle of Cabo da Roca (1703), part of the Spanish Succession conflict.

The importance of contemporary navigation is also strongly registered by the occurrence of shipwrecks, with a high percentage of steamships. If we compare, quantitatively, the shipwrecks with the eastern zone, those are surely in a greater number. The interpretation of this fact

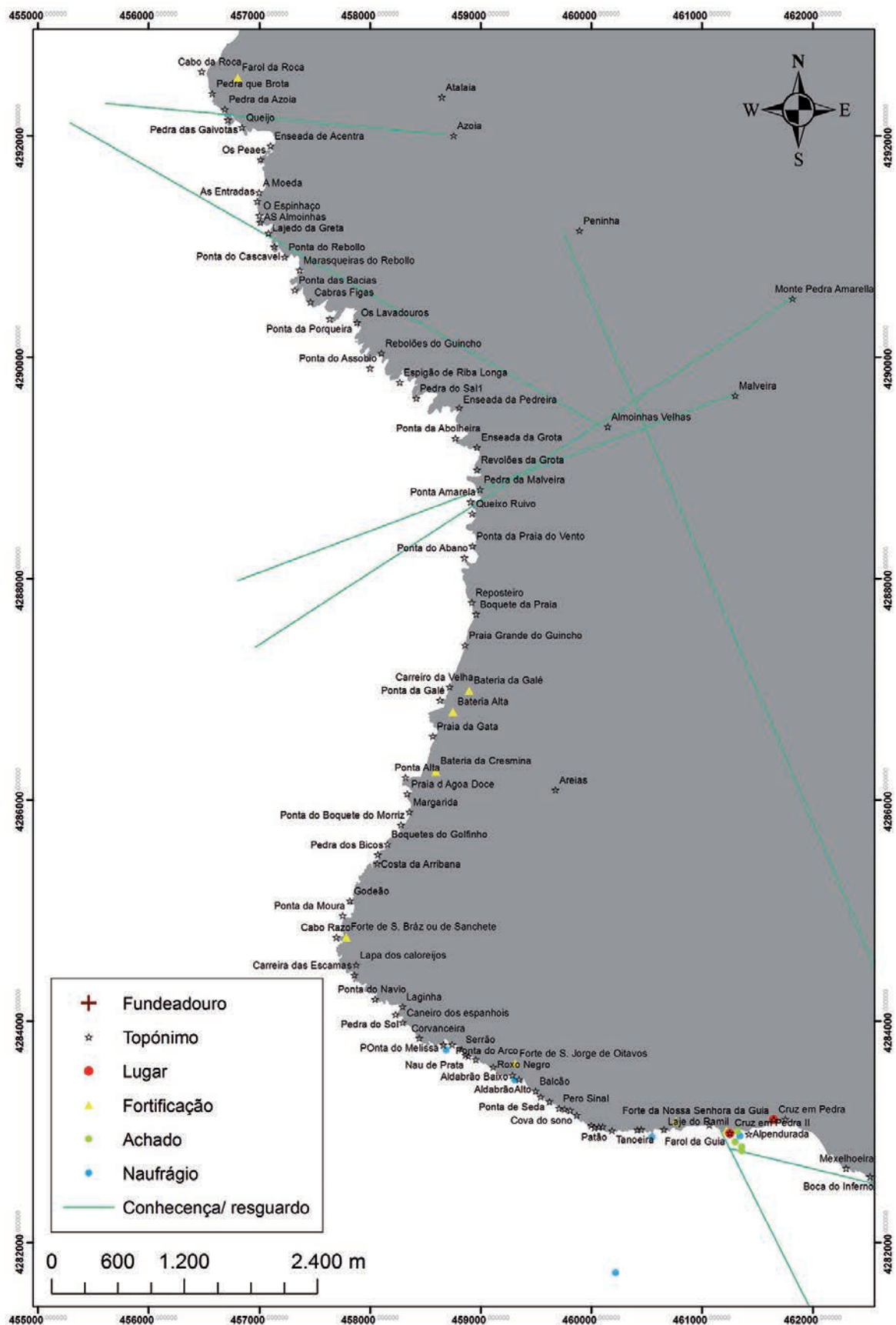


Figure 4. Ocean Transport Zone (Map by authors and José Bettencourt).

is not only due to the difficulty of the coast. Seen at a different analysis angle, the human elements of the coast supporting the navigation on this site are invisible. The lighthouse of Cabo Raso, was built in 1894, surely in response of the numerous tragedies that have occurred in previous centuries. If we are attentive to the percentage variation of occurrences, we note that in the Tagus entrance there is a comparative reduction of shipwrecks due to the *longue durée*, of *conhecenças* and of on shore features.

Nevertheless, today the toponymy allows us to measure on the coast, and its use prior to the modern era, by interpreting, for example, the toponymy «Pedra da Azoia» with the «Azoia» village in the countryside, «Almoinhas» with «Almoinhasvelhas»; «Pedra da Malveira» with «Malveira» and, for the second time, «Ponta Amarela» with the Mount in the countryside bearing the same name. These will be supplemented by other toponyms of the memory of human gestures, like «Ponta do Assobio», «Pêro-Sinal», or «Ponte dos Passantes» (Freire, 2012: 73-89).

Conclusion

The key element of this project has been looking at a coastline that is limited by two geographical points: Cabo da Roca and São Julião da Barra, and uncover it's the human and natural dynamics. The maritime space is manifested through the direct elements of human presence of the past, revisited in underwater archaeological materials, in the history of shipwrecks, and human thought constructions.

These relate to non-parties, but incubators of human gesture and attitude, through manipulation or use of the environment.

The network created between human and non-human elements has, in the case of Cascais, a relationship of continuity with ancient practices.

Exploited in the dynamics of *longue durée*, is a problematic analysis in which the geographical area is mainly twofold: influence of oceanic and estuarine. This influence, within our approach was examined in three micro-spaces, characterized by identifying points or transit marks.

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The maritime cultural landscape of the Ria de Aveiro lagoon (Portugal) in the Early Modern period: a first approach

El paisaje marítimo costero de la laguna de la ría de Aveiro (Portugal) en el periodo moderno temprano: una primera aproximación

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Abstract: The Ria de Aveiro lagoon influenced the human occupation of central Portugal; settlements were strongly related to maritime activities. The lagoon's natural features contributed to a diverse underwater archaeological record, with nearly a dozen archaeological sites, and to the formation of a landscape featuring several elements related to maritime activities. Aiming at the cultural integration of these underwater sites, the authors attempt to approach the evolution of the lagoon between the 15th and the 19th centuries. Natural and cultural changes in the lagoon will be taken into consideration, as well as the economic aspects related to human settlement, the use of natural resources and the development of Aveiro port in the early modern period.

Key words: Portugal, Aveiro, maritime cultural landscape.

Resumen: la ría de Aveiro influyó en la ocupación humana del centro de Portugal, y dio como resultado la presencia de comunidades fuertemente relacionadas con las actividades marítimas. Sus características naturales originaron un registro arqueológico subacuático variado, que cuenta una docena casi de yacimientos, y forma un paisaje que comprende varios elementos relacio-

nados con las actividades marítimas. Buscando la integración cultural de estos yacimientos subacuáticos, pretendemos acercarnos a la evolución de la laguna entre los siglos xv y xix, teniendo en cuenta los cambios naturales y culturales, y también los aspectos económicos relacionados con los asentamientos, la utilización de los recursos naturales y el desarrollo del puerto de Aveiro en la Edad Moderna.

Palabras clave: Portugal, Aveiro, paisaje cultural marítimo.

Archaeological research has demonstrated that the characteristics of the continental Portuguese coast, straight and very exposed to undulation, are adverse to the preservation of underwater contexts. The only exceptions are estuary and lagoon areas, which have revealed important underwater remains in the last decades, like the Arade River (Castro, 2005; Loureiro, 2011), or areas that have been covered by waterfront development, such as Cais do Sodré (Rodrigues *et alii*, 2001) or the Boavista ships (Bettencourt *et alii*, 2013), in Lisbon.

In this context, the Ria de Aveiro lagoon is a singular case, given the number and diversity of archaeological remains preserved therein. For centuries, this archaeological record has been protected by the silting that led to the development of this shallow coastal lagoon system. These transformations are marked in the archaeological record by wreck sites and artefacts from medieval times to Early Modern age, evidence for the intense maritime contacts between this region and several parts of Europe and the Atlantic. Besides the archaeological record, these transformations resulted in numerous written and cartographic documents that allow us to approach the changes that took place in the maritime cultural landscape until the 20th century.

This study has been carried out in the scope of a currently undergoing PhD thesis by the first author, on the subject of the Ria de Aveiro A shipwreck site, and as part of the project Maritime Archaeology of the Aveiro Lagoon, which has been developed by the Portuguese Centre for Global History (CHAM) in recent years. This project aims to study several archaeological sites from the Aveiro Lagoon, integrating them in the lagoon's broader historical context. This approach is based on the concept of maritime cultural landscape (Westerdahl, 1992) but, given the multiplicity of research subjects covered by it, the purpose of this paper is approaching the evidence related to navigation in the lagoon, considering its geomorphological evolution, the economic aspects of human settlement and the use of natural resources.

Geographic context

The Ria de Aveiro lagoon is located on the northern coast of Portugal, in the Aveiro region, between Porto and Coimbra. Its geomorphological evolution was one of the major constraints to navigation over the centuries. The formation of the lagoon was a rather quick process, which started around the 10th century, with the development of a sandbank, rooted in the Espinho area. Around the 10th century, the Aveiro region featured an open coast, with considerable exposure to the sea. By the 12th century, the sandbank was located north of Torreira and in the 15th century it reached the São Jacinto area. In the 18th century, the sand barrier arrived at Mira, completing the lagoon formation process (Corrochano *et alii*, 1999; 2000) (Fig. 1).

This whole process has conditioned not only navigation, but also the life of local populations, as coastal settlements became locations inside the lagoon. For example, new settlements areas were gradually added to Ovar, Ílhavo, Aveiro, Vagos and Mira, following the progressive silting of the coast (Amorim, 2008c). Some densely populated present-day areas like Gafanha, Costa Nova and São Jacinto only feature a few buildings in 17th century

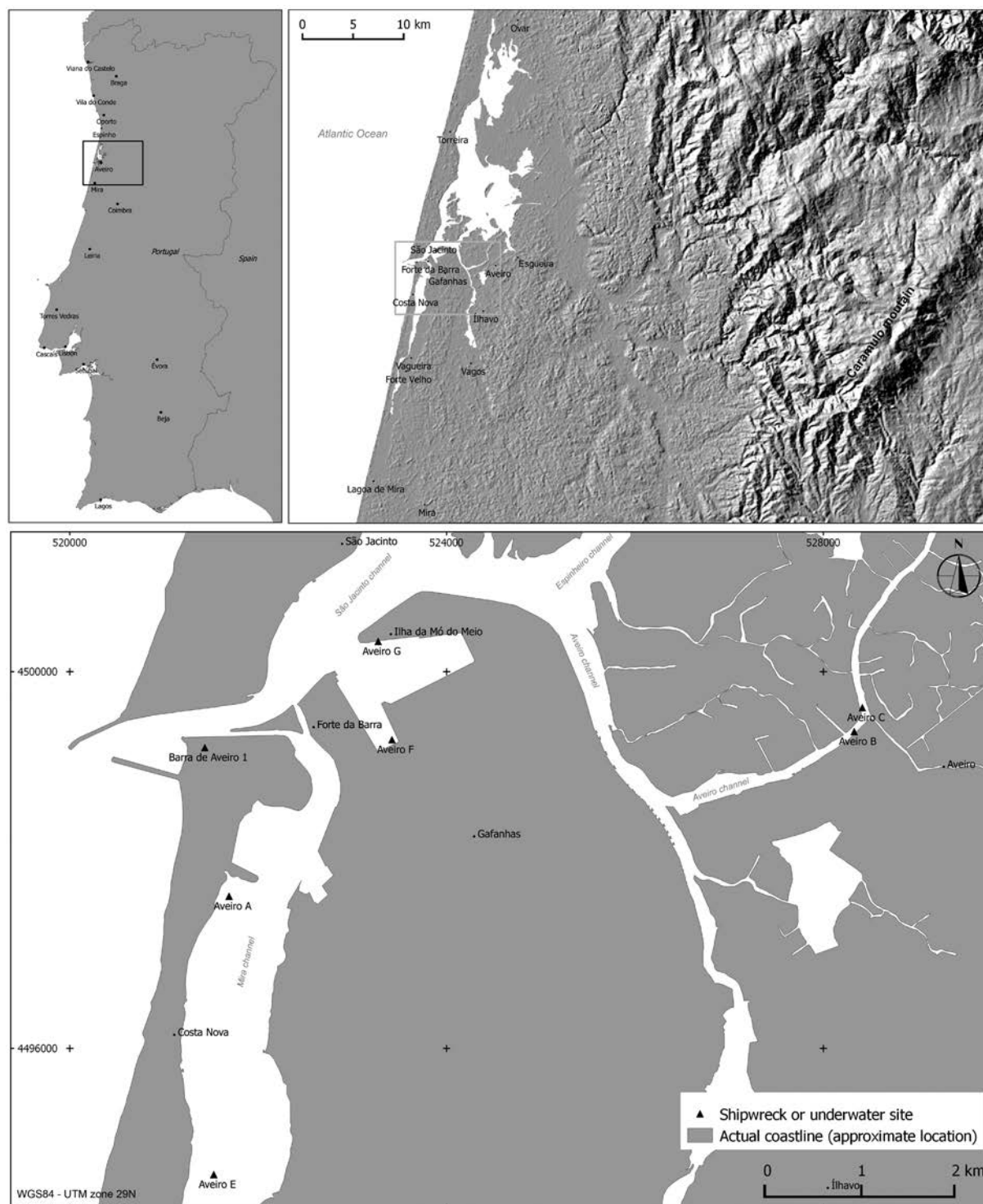


Figure 1. The location of the research area and the most relevant underwater sites recorded in Aveiro lagoon.

maps. In fact, a quick analysis of 1759 cartography shows a desert landscape in this area, with the exception of an area around Forte Novo that represents cultivated land and salt production areas (Amorim, 2008c: 44-46). In spite of this development, dispersed settlement patterns remained during the 19th century. Population concentrations only appeared in the 20th century.

The lagoon as an economic space

The lagoon also influenced the life of the populations, which combined agricultural activities with salt production, collecting *molicho* (a seaweed) and fishing. These economic activities, often seasonal and complementary, marked the lagoon's landscape. In fact, several maps show the salt production locations in the lagoon, such as the Lucas Waghenaer («Die zee caerte van Portugal; tusschen Camino en Montego...» c.1583) and Willem Blaeu («De Zeecosten van Portugal van Viana tot Aveiro», c.1638) maps or the 1634 «Atlas» by Pedro Teixeira de Albernaz (Amorim, 2008b: 39, 43).

The traditional solar salt production in the lagoon is well known and documented since the 10th century (Silva, 1991; Amorim, 2008a). This economic activity was the result of the favorable landscape and environmental conditions, like the vast extension of wetlands and the constant salinity levels in the lagoon water, which originated a salt production increase from the 13th century onwards (Rau, 1984). Actually, the Aveiro region played an important role in supplying salt –fundamental for fish preservation– to Northwestern Europe since the Middle Ages. During the 16th and 17th centuries, Aveiro also supplied the north of Spain, in particular Galicia and Asturias, as well as the Dutch market, especially after 1640 (Amorim, 2008a; Antunes, 2008).

Besides salt, the *molicho* was also a very important resource of the lagoon area. In the 18th century, this seaweed was collected by the populations and used as a natural soil fertilizer (DGARQ/TT, «Memórias Paroquiais», 1758, Ovar). The importance of this activity led to the development of a particular type of boat, called *moliceiro*, used until the 20th century and recently adapted to support touristic activities in the lagoon (Castro, 1943).

Fishing was also a resource used by these riverside villages, although in a complementary and seasonal manner. Evidence related to this activity is scarce; nevertheless, there are some references to the species and the fishing methods utilized in the lagoon. In the 18th century, the



Figure 2. Detail of the 18th century map (Pinto, 2011; Arquivo Nacional Torre do Tombo) representing a type of coastal fishing called *arte xávega*, and tents (possible seasonal coastal occupations).

most common species were eel, dab, flounder and mullet (DGARQ/TT, «Memórias Paroquiais», 1758; Aveiro and Ovar) and there is an 18th century map, recently discovered and published by a Portuguese colleague, that represents a type of coastal fishing (Pinto, 2011). This fishing technique used a type of seine net dragged by a small vessel to surround a certain area (Fig. 2). The net was then operated from the shore by the fishermen, thus bringing the fish to the beach (about fishing in Aveiro in the 18th century see, for example, Amorim, 1997).



Figure 3. Ria de Aveiro A wreck site: a view of the earthenware cargo deposits.

The seasonal nature of this activity led to the creation of seasonal coastal occupations, represented by tents in that 18th century map (Fig. 2). Their most recent parallels are a sort of seasonal housing (the so-called *palheiros*) used by the fishermen, which existed in the areas of Costa Nova, Vagueira or around Mira, in places located on the sand barrier that separates the lagoon from the sea. These costal occupations are mentioned in early 20th century cartography and literature and were also the subject of anthropological studies, since they started to disappear by the end of the 20th century (Direcção Geral dos Trabalhos Geodésicos e Topográficos, Carta de Portugal 1/50000, sheets 9-C e 10-C; Brandão, 2010; Brito, 1981).

The importance of fishing to the communities in this region wasn't limited to the area inside or around the lagoon, it actually reached a wider area in the Atlantic. Indeed, in the 16th century the Aveiro fleet counted 72 ships, some of them involved in the cod fisheries of Newfoundland. On the other hand, 17th century written sources mention fishing as a major occupation of the seamen from Aveiro and Esgueira villages (DGARQ/TT, CC, p. I, mç. 115, n.º 17).

The Aveiro region as an Atlantic port

Navigation dynamics are also documented by archaeological remains that have been recorded in the lagoon area since 1970, either on land or underwater, such as the remains of a ship discovered in 1973, near the Barra lighthouse (Bettencourt, 2009).

This discovery was followed by the Ria de Aveiro A wreck site, discovered in 1992. This is a small Iberian-Atlantic tradition ship of the early modern period featuring a large earthenware cargo from the Aveiro-Ovar region (Fig. 3). Its discovery was a starting point to review the distribution of Aveiro earthenware (Bettencourt/Carvalho, 2007-2008; Carvalho/Bettencourt, 2012). Similar ceramics were found in Portugal, particularly in the North (Viana do Castelo, Porto, Coimbra), but also in the Atlantic, in places like Newfoundland, or in contexts related to seasonal fishing settlements (Alves *et alii*, 2001; Bettencourt/Carvalho, 2007-2008; Carvalho/Bettencourt, 2012; Newstead, 2012).

The same type of ceramics was also recovered from the Ria de Aveiro E shipwreck site, found in 1999 (Bettencourt, 2009), and from the Ria de Aveiro B/C site, where numerous sugar molds were recovered on a waterway located close to the city (Coelho, 2012) (Fig. 4).

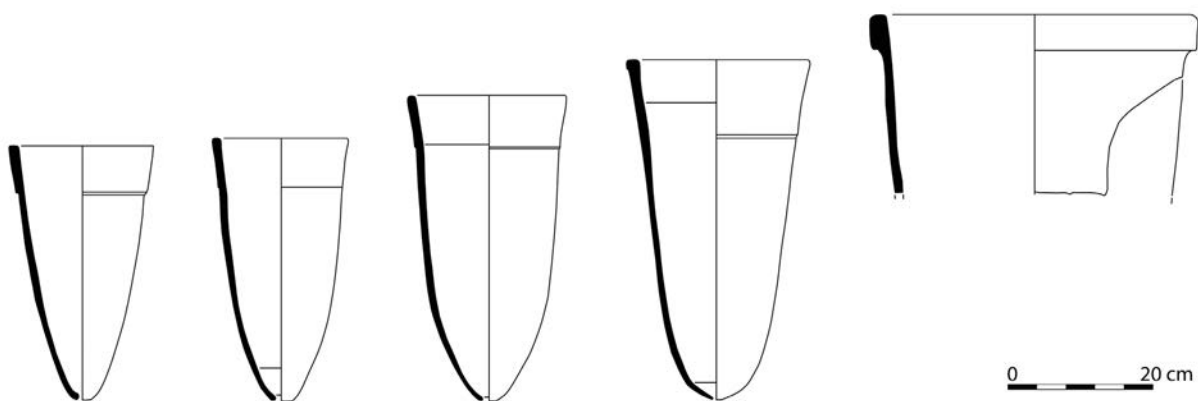


Figure 4. Ria de Aveiro B/C: sugar molds typology.

This Aveiro ceramic production was particularly important. Written sources suggest the important role of the region in the manufacture of industrial ceramics, providing large amounts of sugar molds for the Madeira Islands and for the Canary mills. For example, during the second half of the 16th century more than 13 000 sugar molds were imported from Aveiro into the Canary Islands; they were considered solid, good quality ware (Lobo, 1987: 8-11). They are common in sugar mill archaeological sites, and were identified in Gran Canaria Island, at the «Las Candelarias» mill and also on Madeira and Azores Islands (Sousa, 2012: 216; Coelho, 2012).

The Atlantic dimension of the Aveiro navigation is also documented by the remains of the Ria de Aveiro F ship, discovered in 2002 during dredging works in Aveiro harbor. Recent analyses of the timbers suggest that this vessel, built in the first half of the 16th century and incorporating some Mediterranean shipbuilding techniques, used tropical woods in its construction. Thus, it may constitute an evidence of shipbuilding or naval repairs taking place in colonial spaces (Bettencourt, 2009; Lopes, 2013).

Furthermore, the Aveiro B/C finds included a huge assemblage of Aveiro ceramics, but also several artifacts related to maritime activities, such as an astrolabe, inscribed with the date of 1575, or a nautical blow whistle. The ceramic assemblage includes some items from the Mediterranean and Northern Europe, such as Portuguese faience, olive jars, stoneware and kaolin pipes. Recovered from a port area and disturbed by dredging works carried out during the second half of the 20th century, these findings place Aveiro in the routes connecting the North and the South of Europe since the Middle Ages (Bettencourt, 2009; Coelho, 2012).

Finally, the Ria de Aveiro G clinker-hull ship, discovered during the port extension works and dated between the 13th and the 14th centuries, has some features that are typical of Northwest European shipbuilding. Therefore, it may constitute direct evidence for the relations with that region, namely the Bay of Biscay, where similar construction features were documented in the Guernika ship, dated from the 15th century (Bettencourt, 2009).

Navigation and access to the lagoon

Returning to the analysis of the lagoon, the distribution of these sites indicates that the wrecks have occurred in areas of access to Aveiro city. That distribution becomes even more significant if one considers its chronology: the oldest sites, Ria de Aveiro F and G, are located in the area that gave access to the lagoon entrance c. 1500, whereas the Ria de Aveiro A site is located in the Mira channel, which was the access to the lagoon during those centuries. Actually, the entrance was gradually displaced towards the South between the late-16th and the 18th centuries.

Exception is made to the ship located at the Barra Hotel (Barra de Aveiro 1), as its chronology remains undefined due to the lack of archaeological data. Nevertheless, the authors think that she should have lied outside the lagoon until the 19th century, when the entrance was artificially opened. Actually, navigation has been significantly conditioned by the morphosedimentary changes of the lagoon system.

These changes required the use of landscape marks as navigation aids. Viewed from the sea, the position of the entrance was marked by the Caramulo Mountain, which reaches a maximum height of some 1077 meters (Fig. 1).

Several landscape marks existed along the coast, to help sailors enter the lagoon and follow a safe course through the channels. Fortifications were often used as part of these land-

scape marks. Two of them are documented inside the lagoon: the Old Fort (Forte Velho) and the New Fort (Forte da Barra).

The Old Fort, in Vagueira, is represented in 18th and 19th century cartography and was a reference point for navigation because it marked the position of the lagoon entrance, which was located either to the north or to the south of this structure, between 1643 and 1838 (Cunha, 1959: 27).

This is shown on a 1764 drawing by the Dutch consul in Aveiro, which indicates that it would be demolished, as well as on a 1759 French survey and a 1778 chart (copied in 1876) (Amorim, 2008c: 44-45, 47, 128-129). The same name appears on an 18th century map, in the Gafanha side, opposite to S. Jacinto and next to the «Most Ancient entrance of 1500» («Barra Antiquíssima do Anno 1500»). It remains linked to that area until the 20th century, on the island of Mó do Meio, which might indicate the existence of an older fortification there (Pinto, 2011; IG-eoE, col. Continente, series M888, sheet 184). In fact, in the early-19th century, the person responsible for the construction works at the lagoon entrance refers the finding of a headstone with the year 1643 inscribed on it (Amorim, 2000: 616).

The New Fort, which appears in the same cartography as the old one, is supposed to be unfinished in the 1764 drawing; this was a major concern for the local authorities in 1759. Besides the lack of surveillance conditions, they also lacked the means to acquire vessels to control and guide ships entering the lagoon (Amorim, 2008c: 117). This military structure was located right at the new entrance, opened in 1808, at the confluence of the Mira and S. Jacinto channels. Today, part of this structure still stands and is called Forte da Barra.

Another important navigation landscape mark was the chapel of Senhora dos Navegantes in S. Jacinto, along with the nearby signal station (facho in Portuguese). According to a 1584 document, these structures replaced an old, ruined watchtower in the Aveiro entrance (Cunha, 1959: 7).

This chapel often appears in the cartography from the end of the 16th century onwards. In the representation of the coast of Portugal by Lucas Waghenaer (c.1583) and despite some inconsistencies, a religious building appears on the sand spit; the authors assume that it might be that chapel. The Pedro Teixeira de Albernaz's representation displays a religious building in the same area. Moreover, this map is particularly interesting because it shows a structure near the chapel, which might correspond to a signal station using flags to assist the entry of vessels, as, for instance, in the case of the «Facho» of Mount Brazil, in the Azores, represented by Jan Huygen van Linschoten in the 16th century.

The references to signal stations are also confirmed by written sources: the existence of a vessel that should watch the lagoon entrance and use flags to guide the ships is referred in 1641 (Aguilar/Meneses, 1640-1641). In fact, the 18th century drawing (Pinto, 2011) shows a small vessel towing a larger one on the lagoon entrance, and if one looks carefully it is possible to see another ship with a flag at the entrance. It might not be related to the signal station aboard the ship, but it still is interesting to notice (Fig. 5).

The same source mentions the existence of three masts that should provide the right alignment to enter the lagoon. These marks already appeared in the Lucas Waghenaer map by the end of the 16th century (c.1583) but are more clearly represented in the 1648 map by João Teixeira, with the remark «Masts to Mark Out the Entrance» («Paos para Baliza da Barra»). Besides these maps, it is also important to refer the Willem Blaeu chart (c.1638) that also traces the course to be followed, based on the masts' position.



Figure 5. Detail of the 18th century map (Pinto, 2011; Arquivo Nacional Torre do Tombo) representing a small vessel towing a larger one and a ship with a flag on the lagoon entrance – possible signal station aboard the ship.

Concluding remarks

This approach to the maritime cultural landscape of Ria de Aveiro points out the diversity and complexity of the study subjects: the evolution of the lagoon, the human settlement, the maritime economy and the port operation are just some examples. It also reveals the international expression of the maritime cultural heritage of this region, as a starting point for the analysis of the relationships between the Atlantic and Northern and Southern Europe.

The study requires information resulting from archaeological work, from written and iconographic sources or from anthropological studies, applying different methods of analysis that must also be interdisciplinary. However, this line of research is essential to establish the cultural framing of the underwater archaeological sites discovered in the last decades. Furthermore, it and can also be an important tool to assess the lagoon's maritime heritage.

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Coastal landscape archaeology in Sicily. A new approach for studying coastal cities and their palaeolandscapes

Arqueología del paisaje costero en Sicilia. Un nuevo enfoque para el estudio de las ciudades costeras y sus paleopaisajes

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Abstract: Palaeolandscapes are an important aspect of our heritage. Despite palaeolandscape studies addressing interdisciplinary aspects prevail in Europe, Sicily remains constrained to more simplistic approaches. As a result, investigation on coastal archaeological sites in Sicily with a focus on long-term relationships with the sea and the coast has never been undertaken extensively. This paper explores the potential of interdisciplinary approaches to investigate coastal landscape of two of the most important Greek and Roman coastal towns of ancient Sicily, namely Lipari and Selinus. By analyzing Sicilian coastal archaeological sites it was possible to investigate strategies adopted in antiquity to cope with environmental changes and natural hazards. Coastal palaeolandscape research on Sicilian archaeological sites finally helped to obtain a clear picture of over time sea-to-human landscape relationships over time and thus it makes a substantial contribution in developing sustainable urban planning and effective coast management plans of modern cities.

Key words: Palaeolandscape, Sicily, coastal archaeology, Lipari, Selinus.

Resumen: los paleopaisajes son un aspecto importante de nuestro patrimonio. A pesar de que en Europa las investigaciones sobre paleopaisajes se dirigen con una estrategia interdisciplinar, en Sicilia permanecen restringidas a un enfoque más simplista. Como resultado, la investigación en los yacimientos costeros de Sicilia nunca se ha llevado a cabo con un enfoque que tenga en cuenta las relaciones a largo plazo entre el mar y la costa. Este trabajo explora el potencial de un enfoque interdisciplinar para investigar el paisaje costero de dos de las más importantes ciudades de la Sicilia antigua como Lipari y Selinunte. Mediante este análisis fue posible investigar las estrategias adoptadas en la Antigüedad para hacer frente a los cambios ambientales y los

riesgos naturales. Esta investigación ayudó a obtener una imagen más clara de las relaciones ser humano-paisaje a través del tiempo y por lo tanto, contribuye al desarrollo de la planificación urbana de las ciudades costeras modernas.

Palabras clave: paleopaisajes, Sicilia, arqueología costera, Lipari, Selinunte.

Introduction

The Mediterranean Sea is well known to be one of the richest seas in the world in terms of submerged cultural heritage. The island of Sicily, in the Mediterranean Sea, was the center of millenarian intense crossroads and the place where some of the most important ancient civilizations have seen their development (Bernabò Brea, 1985).

Recent discoveries of submerged landscapes in Europe have increased the awareness of scholars on the existence of a submerged heritage different from shipwrecks (Bailey/Sakellariou, 2012). However, archaeological investigation on Sicilian coastal settlements has been limited to studies on land. Very little attention was devoted to understand the relationship of coastal towns with their environment and especially with the sea. Whereas it has been proved that the maritime aspect is the key element to investigate in order to broaden our understanding of the over time history of Sicily (Hesnard/ Marriner/Morhange, 2011; Marriner/Morhange, 2007). As a result of this gap there is now a lack in our knowledge of harbor-side infrastructures and waterfront architecture of almost all Greek and Roman shoreline settlements of Sicily. Also literature on human and coastal landscape/seascape relationships during antiquity is scarce.

The aim of this paper¹ is to try to fill these gaps by investigating key Sicilian coastal archaeological sites (Fig. 1) under a new perspective that focuses on the coastal landscape as a comprehensive sea-land natural environment where humans interact. This paper explores an interdisciplinary approach to investigate the palaeolandscape of two of the most important Greek and Roman coastal towns of ancient Sicily: Lipari in the Aeolian Archipelago north of Sicily and Selinus in western Sicily.

Methodology

Study of coastal and submerged palaeolandscapes helps to better understand how people lived in the past and how they experienced the sea; therefore it helps to better understand human-sea-landscape relationships in antiquity (Mazza, 2016). It has been proved that a holistic approach is a successful strategy to study archaeological coastal landscapes, in particular to obtain an accurate picture of changes in the coastal environment (Keay *et alii*, 2009; Marriner/Morhange/Goiran, 2010;

¹ This paper is based on the outcomes of the first years of the PhD research I am currently undertaking at the University of Sydney. I would like to acknowledge Prof. Sebastiano Tusa and the Soprintendenza del Mare that allow me to be part of the research team excavating LSM in 2013 and 2014. I additionally thank Soprintendenza del Mare archaeologists Roberto La Rocca, Francesca Oliveri, Philippe Tisseyre, the GIS specialist Claudio di Franco, Salvo Emma, Silvia Carusso and Prof. Vincenzo Liguori of Palermo University. I also thank Prof. Piergiorgio Spanu and Massimiliano Secci of Sassari University, the director and the staff of the Regional Archaeological Museum of Lipari, all the students and the volunteers involved in the excavation of LSM and the Coast Guard underwater unit. A special thank goes to my research supervisor Ted Robinson and my associate supervisor Martin Gibbs. Research reported in this article has been supported by Postgraduate Research Support Scheme funded by the University of Sydney, the International Postgraduate Research Scholarships funded by the Australian Government, the Australian Postgraduate Awards funded by the Commonwealth Government, the Carlyle Greenwell Research Fund (Archaeology) and the Hellenic Club Research Scholarship in Classical Archaeology.

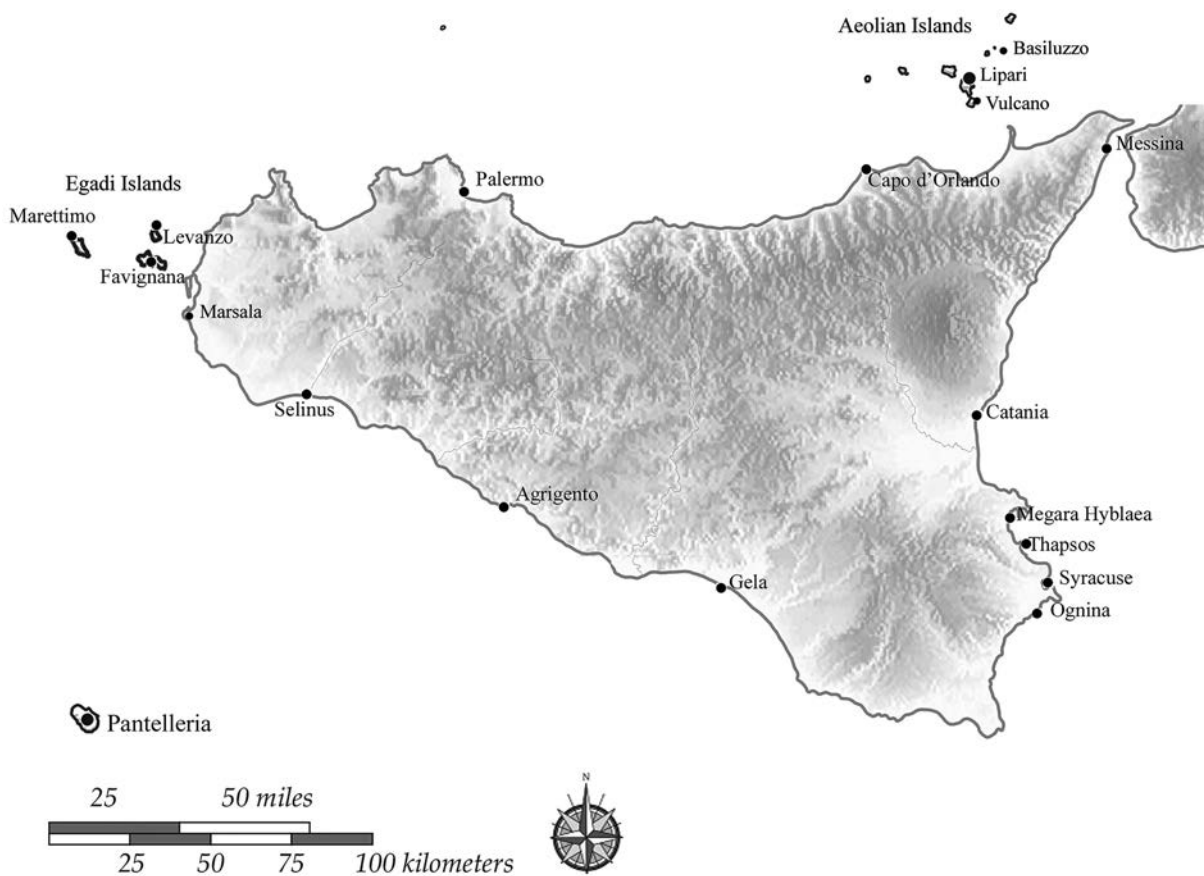


Figure 1. Map of Sicily with the sites discussed in the text edited by the author after LaFleur, R. A., Elliott T. et. al. Copyright 2001, Ancient World Mapping Center, (www.unc.edu/awmc) accessed 10/11/2015..

Morhange/Marriner/Bony, 2013; Rogers, 2013). Within the holistic approach this work focuses on many data sources such as on geomorphology, ancient historical sources, archaeological evidence, conservation plans, meteorology charts, risk and management plans.

Geomorphological aspect is a crucial component of the investigation (Marriner/Morhange, 2007; Marriner/Morhange/Goiran, 2010; Morhange/Marriner/Bony, 2013). Coastal areas with sufficient geomorphological investigation to allow paleogeographic reconstruction have been identified thanks to an extensive analysis of the literature.

Historical written sources from antiquity 7th century BC to the 7th century AD have been analyzed. Itineraria and portolani, historical cartography, ancient drawings from diaries of the Grand Tour voyagers of the 18th and 19th centuries, and ancient pictures of the past 150 years have also been included in this research.

Archaeological evidence on port infrastructure and harbor facilities has been searched in the published literature and in the GIS (Geographical Information System) of the Soprintendenza del Mare which also includes bathymetry, palaeo-bathymetry and palaeoshoreline data (Regione Siciliana, 2004b).

Conservation of cultural heritage reports together with management policies and risk plans for archaeological sites undergoing environmental stress conditions such as seismic activity and coastal erosion have been analyzed for the first time within a coastal landscape study (Regi-

one Siciliana, 2008; Regione Siciliana, 2003; Regione Siciliana/Centro, 2009; Regione Siciliana/Centro regionale, 2013; Regione Siciliana/Centro regionale, 2012; Regione Siciliana/Centro regionale, 2004).

Also palaeoclimate and meteorology data and sea level change data have been explored. Useful databases of historical meteorology data including of sea conditions, currents, tide, temperature and winds have been provided by government departments for environmental research (Istituto superiore, 2014) and Ministry of Defense (Ministero della difesa, 2014). Sea level change data have been searched in the literature and linked to the Medflood database (<http://www.medflood.org/results-2/webgis/> accessed 15/11/2015).

Coastal environment management plans, management plans and hazard mitigation strategies reports produced by government departments (Regione Siciliana, 2004a; Regione Siciliana/D'Andria, 1996) have been also searched as they include in-depth analysis of past and present human impact on coasts.

Key cities and their coastal archaeological heritage

Two key sites have been analyzed into details, they are the site of Sottomonastero in the island of Lipari north of Sicily, and Selinus, a coastal settlement in South West Sicily.

Lipari Sottomonastero

The site of Lipari Sottomonastero (LMS) is located at the present commercial and touristic harbor of the island of Lipari. Lipari is one of the seven volcanic islands of the Aeolian archipelago located in the South Tyrrhenian Sea. Since prehistory and for Greek, Roman and Medieval times Lipari was the central node in the network of trade and commerce of the Mediterranean Sea. Despite its importance, the coastal archaeological landscape of the island is unknown. In 2008 massive underwater structure was discovered at -8.70 m below sea level² (Figs. 2-4). The position of the site and its subsequent coexistence with the life of the modern tourist center of Lipari, challenged and limited the research to a small sector, consequently extension of the site and topographic relationship with the urban plan of ancient Lipari are research points still under investigation.

The structure consists of in-place basis (or capitals) of columns placed above a floor of cemented beach lava stones. An in-place artificial terrace on two levels made by squared lava stones and imported white marble supports the floor. The stratigraphic investigation shows that the blocks were placed on the platform after its construction. The structure date is controversial; it can be dated to the late 3rd century-2nd century BC (Tisseyre, in press), or to the 2nd century AD (Tusa, 2013).

The structure lies under multiple alluvial sediments 2 m thick interlaid with pyroclastic components. Preliminary studies of coastal geomorphology show that the alluvial sediments were originated from the nearby S. Lucia stream that was covered and channeled in modern times. Investigation of pyroclastic materials and their stratification suggests a possible connection to the formation of the nearby Vulcanello, a volcanic island formed at 183 B.C. (Plinius) or

² After the discovery, the Soprintendenza del Mare in collaboration with Sassari University, the Regional Archaeological Museum of Lipari, the IBAM and the University of Sydney investigated the submerged archaeological site of Lipari Sottomonastero (LSM) in 2010, 2013 and 2014.

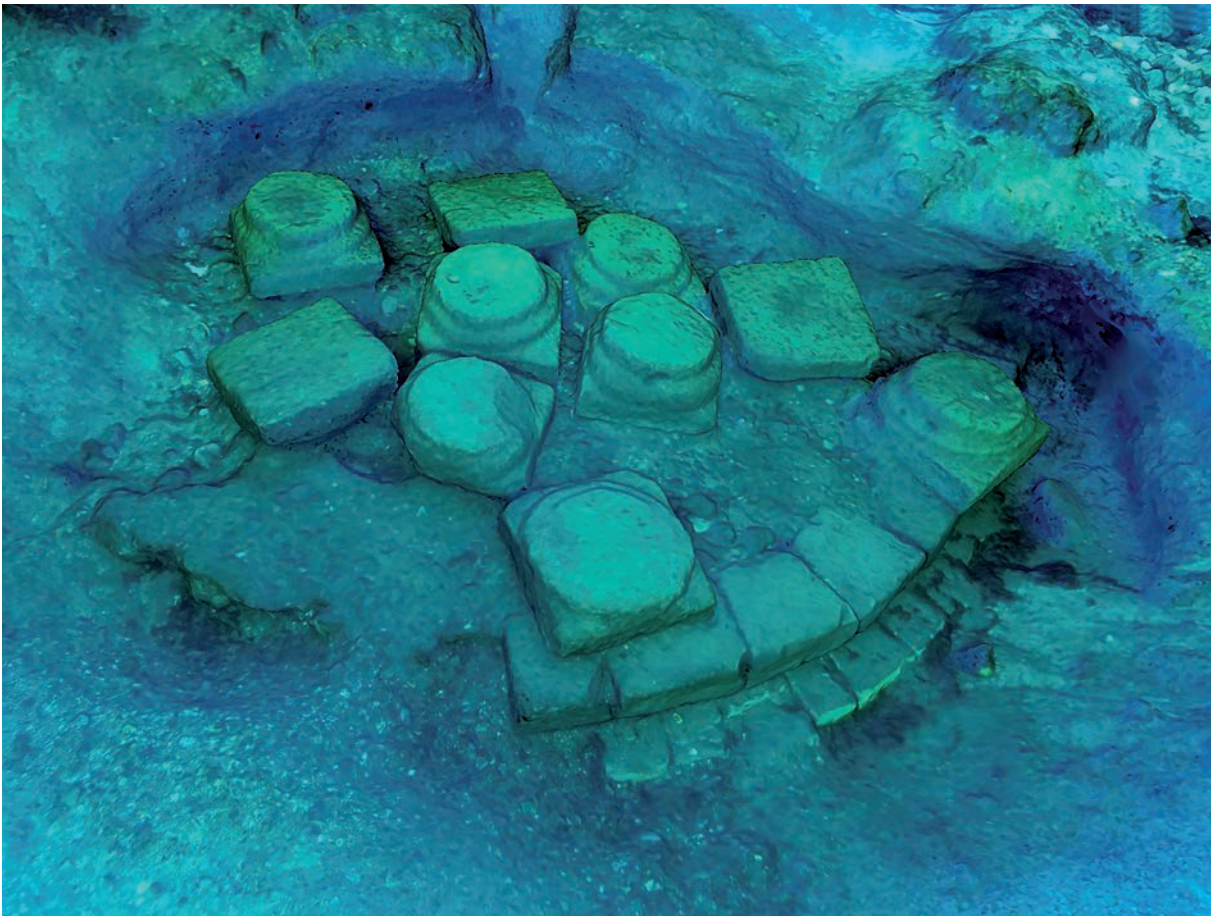


Figure 2. 3D of the submerged archaeological site of Lipari Sottomonastero LSM, courtesy of the Soprintendenza del Mare, edited by Massimiliano Secci-Sassari University.

126 B.C. (Strabo) quoted by De Fiore (1922), and now connected to the island of Vulcano by an isthmus. It is possible thus to suggest that due to the action of predominant winds coming from the second quadrant, especially the SE Sirocco, the pyroclastic material found in the stratigraphy of LSM site could belong to a tephra layer of the first eruption of Vulcanello³. (Gioncada *et alii*, 2003) However, to confirm this it would be necessary to sample those layers for chemical-physical analysis. This sector of the island has undergone substantial coastal changes at least since the 3rd century BC, and most likely even since prehistory (Mazza, 2008; Tusa, 2013). Survey undertaken in 2009 by Catania University (De Guidi *et alii*, in press) show clear evidence of subsidence in the area from LSM to Pignataro di Fuori. A detailed MBES mapping of the site by Anzidei *et alii* (2016) suggests that in addition to the local volcano-tectonic land subsidence also relative sea level changes active since the end of the last glacial maximum need to be considered.

Changes in coastal landscape, mainly due to subsidence, provoked land sinking and sea inundation. Thus it is possible that a sort of flood control system was created by employing blocks in order to create a breakwater as a protection and a defense to limit sea inundation (Regione Siciliana, 2014; Regione Siciliana, 2013). Lipari's inhabitants were aware of the consequences of a flood would have created and tried to limit the damages by creating an artificial

³ Specific studies on the formation of Vulcanello show that volcanic activity continued in the 6th and in the 16th century CE. In 1550 CE Vulcanello joined Vulcano by a connection created by the accumulation of sand and debris.



Figure 3. LSM during 2014 excavation, courtesy of the Soprintendenza del Mare (Photo by Salvo Emma).



Figure 4. LSM, detail of the platform on which the blocks are placed, courtesy of the Soprintendenza del Mare [color].

barrier. They attempted to protect their waterfront from a continuous and irreversible sinking process that eventually created a visible and dramatic effect: the sea invaded houses and public buildings. Indeed, all the possible harbor-related constructions such as piers, docks, ship sheds, port infrastructures, temples, storage rooms and harbor facilities, whose archaeological evidence has not been found yet, would be the most damaged structures. The site of LSM how people in antiquity faced the challenges of living in a changing environment and the ways in which they coped with changing landscape. Environmental dynamics make LSM an interesting case study from a social point of view. For example, it is likely that such dramatic changes to the coastal environment increased community awareness on a social issue and fostered a joint action from the population in response to this.

Selinus

Selinus, founded by the colony of Megara Hyblaea at about 628 BC, was one of the most important of the Greek colonies in Sicily (Figs. 5-6). Surprisingly, despite the importance of Selinus within the history of Sicily researches were never oriented to palaeolandscape study. As a result many points of the history of the city are unclear, such as the pre-Greek presence. Also crucial evidence of the first settlement discovered at the Cottone (Mertens, 2003; Mertens/Schützenberger, 2006) in what is now a lowland area 500 m far from the present shoreline provide little information as it lacks of a proper palaeolandscape contextualization. It has always been suggested that the river Modione on the West side of the acropolis and the river Cottone on the

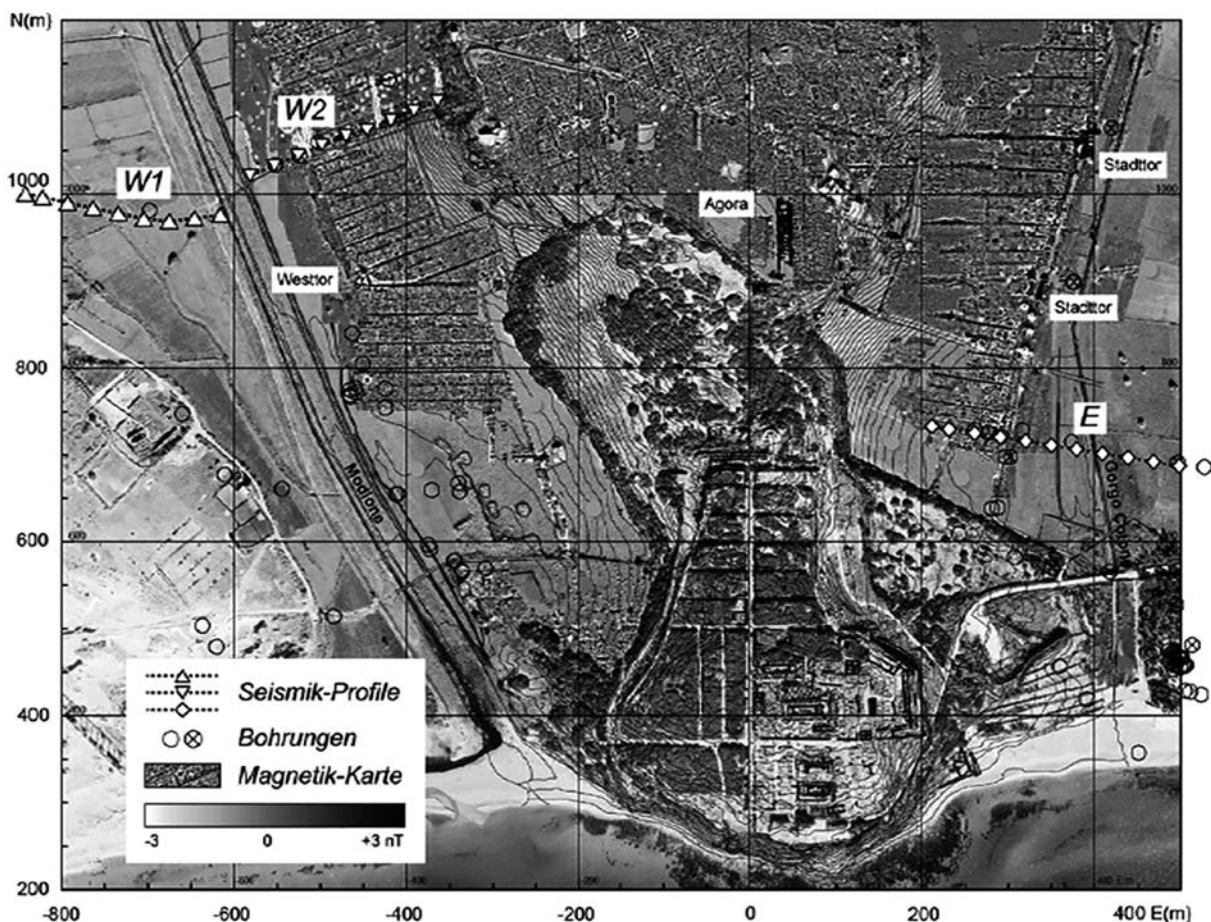


Figure 5. Map of the seismic profiles and coring in the Modione and the Cottone river valley-Selinus, after Rabbel 2014[B/N].

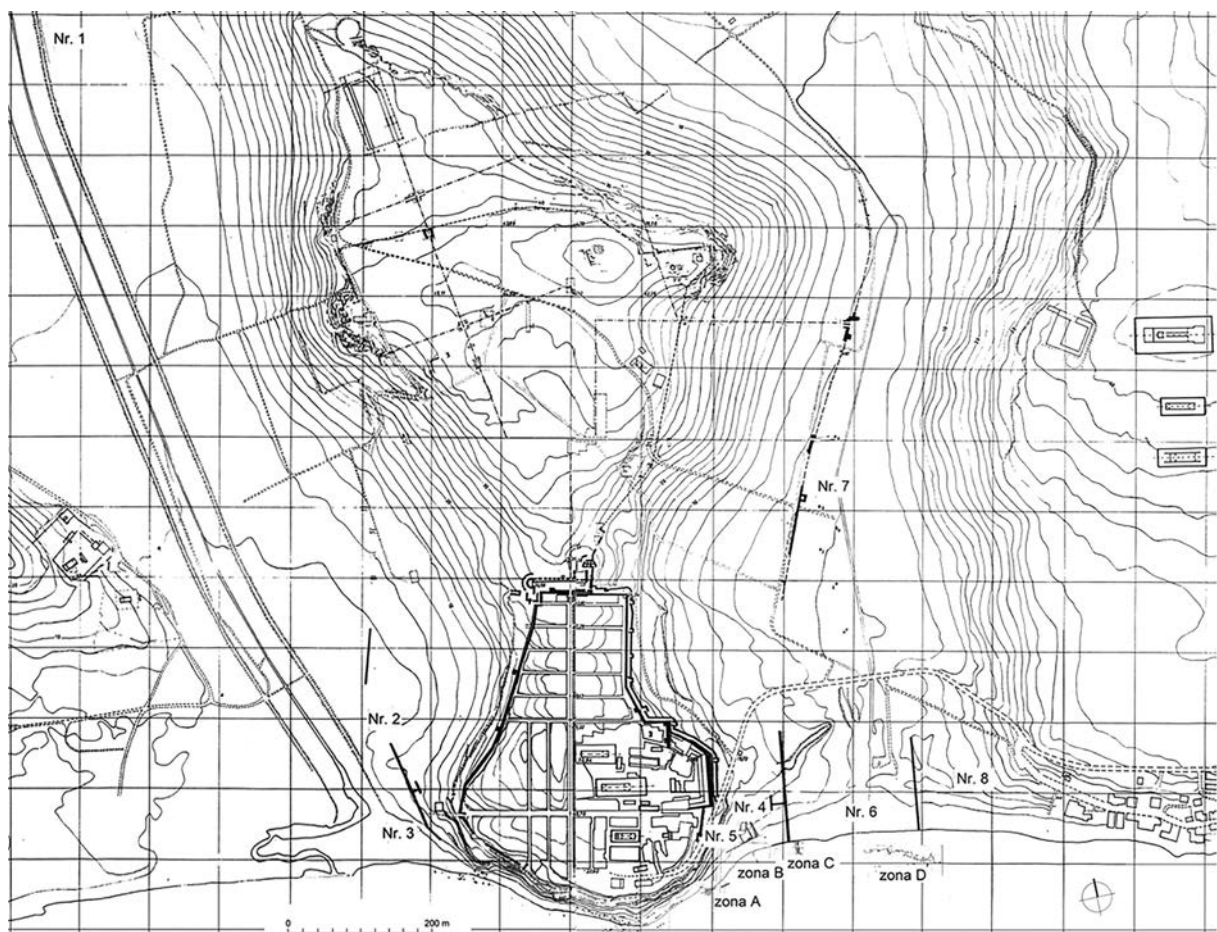


Figure 6. Map of Selinus after Hermanns 2014 with the harbor-related infrastructures [B/N].

n.º 1: structures discovered in the 1980 ca.

n.º 2: harbor structures discovered by Cavallari and observed by Hulot and Fougères

n.º 3: early Christian coastal settlements infrastructures

n.º 4: structures discovered in 1995

n.º 5: banchina structures mentioned by Bovio Maroni

n.º 6: the two elongated structures identified by Jean-Pierre Houel in the 1772 and located in a map by William Harris in the 1826

n.º 7: part of the defensive structures of the eastern wall

n.º 8: coring samples gave traces of the existence of a possible pineta

East side were the natural harbors of the Greek city. However, little archaeological evidence supports this.

Ancient written sources provide one of the first images of the coastal environment of Selinus. Diodorus of Ephesus, who reported on Diogenes Laertius (VIII, 20) mentions Empedocles who reclaimed the water of the rivers from a swampy unhealthy environment (Rambaldi, 2010). Traces of such a marshy landscape have been identified in later historical evidence.

In fact, thanks to drawings and description of the 18th century voyagers, details of the geography of the city and especially on the hydrography had been given. Houel was the first that identified in the late 1700's possible port-related structures on the Cottone marshy riverbed (Houel, 1787). The same structures were mentioned in the work of Harris and Angel (1826) and in the map of Hittorff and Zanth, (1827) the Duke of Serradifalco (Lo Faso Pietrasanta Duca di Serradifalco, 1834), Schubring (1865), Cavallari (Cavallari, 1872; Cavallari, 1879) and Benndorf (1873). Hulot in

1910 produced maps and accurate reconstructions of the possible extension of fluvial harbors incorporating real data coming from archaeological excavation and the author's imagination.

Shoreline structures pertaining to port facilities were exposed in the lower SE sector of the acropolis thanks to winter and spring storms. They were investigated by Salinas in 1886, 1888, 1902 and 1904 (Salinas, 1886; Salinas/Patricolo, 1888) by Bovio Marconi in 1950-51 and by the Germanic Institute of Archaeology in 1995. Little has been published, only Purpura published pictures of Salinas' and Bovio Marconi's excavations (Purpura, 1986; Purpura, 1991), while pictures of the Germanic Institute excavation have been analyzed by Tilotta (Tilotta, 2008) and published by Tusa (Tusa, 2010). Very little effort was devoted to understanding this evidence in a broader context of harbor-related infrastructures such as landing places, storage rooms, ship sheds, lighthouses and sacred harbor spaces which would have possibly existed.

A recent geophysical study of the Cottone and Modione riverbeds (Rabbell *et alii*, 2014) provides the first geomorphological data in support of the archaeological evidence (Hermanns, 2014) (Figs. 5 and 6). Evidence of an embankment on the Cottone river and a coastal pinewood has been suggested (Rabbell *et alii*, 2014). However date of those features has not been yet provided. Seismic data confirmed the existence of a lagoon connected to the sea at the Cottone river. The lagoon silted over time and a marshy environment eventually formed. The marshy environment lasted up to 1500 AD when the ancient writer Fazello (Fazello, 1558) described the area as unhealthy and a source of malaria. The area continued to be characterized by ponds and marshes in the following centuries. The travelers Hulot (Hulot/Fougères, 1910), Houel (1782) and Serradifalco (Lo Faso Pietrasanta Duca di Serradifalco, 1834) attest the environmental situation in their maps.

It is likely that in Greek times the Cottone area was one of the natural fluvial harbour of the city, however, due to its natural features it required continuous maintenance in order to avoid siltation. Indeed, it is possible that right after the abandonment of the city and irreversible sedimentation phenomenon caused by the rivers' deposits started. This would have produced difficulties for the use of the Cottone river mouth as a fluvial harbor leading to a definitive and complete abandonment of it. The Modione river mouth was also used as a harbor. Indeed recent excavations at the Modione/Selinus/Lanaricum provided evidence pertaining to commercial building and docks dated to the late Roman times (Lentini, 2010a; Lentini, 2010b). The presence at the Modione river mouth of port infrastructure dated to the Greek time has not yet been found. However, as temples and shrines dated to the Greek period have been found on the western bank of the Modione river (Gabrici, 1927; Tusa, 1986; Tusa *et alii*, 1984) and a natural freshwater spring was also in place, it is likely that some port facilities dated to the Greek period would have once existed in order to facilitate the access to those areas.

For the case of Selinus, sedimentation acted as a main factor for changes in river navigability and caused shore transgression. The silting of the rivers and coastal transgression challenged inhabitants of the city that would have coped with these changes by adopting a strategy based on continuous management of the river basin and adjustment of the coastal infrastructure in relation to the over time shifting of the shoreline. One of the future challenges for scholars aiming to study Selinus is thus to search and date traces of these environmental features in the palaeolandscape.

Conclusion

This paper explored a holistic approach to the study of Sicilian coastal palaeolandscape. Interdisciplinary investigation is the key strategy to study past societies and their over time relation with

the sea. This study involved geomorphological analysis, study of ancient written sources and archaeological evidence, conservation issues, palaeoclimatic data and evidence of environmental changes that affect coastal sites has been collected and analyzed. Results from two archaeological sites —Lipari Sottomonastero (LSM), in the Aeolian Archipelago North of Sicily and Selinus, in the South Western part of Sicily— have been presented. As a result the maritime and coastal landscape of these important archaeological sites has been pictured more effectively.

Preliminary results on the investigation of Lipari Sottomonastero and Selinus also provided insight for the study of social issues connected to the coastal landscape and its changes. Thus it has been possible to analyze how people who lived in the past faced the challenge of living in a changing landscape. By knowing natural causes of coastal changes and by reconstructing catastrophic events and strategies that coastal inhabitants adopted to cope with those changes, it has been possible to enhance our understanding of past coastal issues. This gathered knowledge could eventually be applied to help in solving present time coastal issues.

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Moving Targets: mapping the shoreline of Cyprus

«Moving Targets»: mapeo de la costa de Chipre

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Abstract: In 2013 an Honor Frost Foundation funded project undertook a scuba-led survey off the Late Bronze Age (LBA) site of Tochni-*Lakkia*, on the south-central coast of Cyprus. This was motivated by the rapid erosion of coastal features as well as evidence suggesting annual loss of land of up to one meter. Additional exploration in neighbouring sites made clear that erosion is detrimental to the archaeological remains of this part of the island. With specific regard to the island's maritime heritage, we consider that the most sustainable way to record and protect the information that these features hold for future generations, involves a study of diachronic coastal alteration. This may include an assessment of sea level rise, microclimate, tourism and harbour development, and an examination of cartographic evidence and aerial photographs. Our paper introduces some preliminary results from the Cyprus Ancient Shoreline Project and focuses on the cartographic evidence and satellite imagery that form the baseline for a historical and archaeological reconstruction of the shoreline.

Key words: Coastal erosion, shoreline, cartography, aerial photography, anchorage.

Resumen: en 2013, un proyecto financiado por la Fundación Honor Frost realizó una prospección subacuática cerca del yacimiento del Bronce Final de Tochni-Lakkia, en la costa meridional

de Chipre. Esta prospección fue motivada por la rápida erosión costera y la evidencia de importantes pérdidas anuales. La investigación efectuada en yacimientos próximos confirmó que esta erosión es perjudicial para los restos arqueológicos. Por ello, consideramos que la forma más sostenible de estudiar y proteger el patrimonio marítimo de la isla para generaciones futuras es a través de un estudio diacrónico de la alteración costera. Esto podría incluir una evaluación del aumento del nivel del mar, el microclima, el desarrollo turístico y portuario, el análisis de la evidencia cartográfica y de la fotografía aérea. Nuestro artículo introduce algunos resultados preliminares del Proyecto «Cyprus Ancient Shoreline», centrándose en evidencias cartográficas e imágenes de satélite que forman la base de una reconstrucción diacrónica de la actividad costera.

Palabras clave: erosión costera, costa, cartografía, fotografía aérea, fondeadero.

Introducing a Problem

Coastal erosion is a topic of multidisciplinary concern with researchers citing a wide range of natural and anthropogenic factors that lead to the gradual encroachment of land by the sea (Eurosion, 2004a: 15). Moreover, erosion has perpetually raised concern regarding its impact on private property with an annual approximation of 15 km² estimated to be seriously impacted within the European coastline (Eurosion, 2004a: 26). According to Roca *et alii* (2008: 400) the most vulnerable areas are low lying, including coastal plains, barrier coasts, river deltas and estuaries. It is no surprise, then, that archaeological sites within areas of dense human occupation and anthropogenic alteration to the environment are equally threatened by coastal erosion (Erlandson, 2008: 167; Reeder *et alii*, 2012: 187). Finally, considering Erlandson's estimation that 50% of the global population lives within 100 km of coastlines and - in early 2000s- approximately 100 million people directly occupy coastal areas with an elevation of less than 1 m (2012: 138), one can assume that a significant number of culturally valuable archaeological and historical coastal sites along with the important information they hold for future generations are constantly eroding and often disappearing.

Coastal erosion is a long acknowledged problem also in Cyprus with estimates suggesting that over 30% of the coast is suffering from it - a phenomenon, which ranks the island as highly threatened among the coastal European states (Triton Consultants, 2002: 4; Κορωνίδα, 2008: 8). Since the 1980s this problem was addressed with hard solutions such as offshore breakwaters and groynes (Triton Consultants, 2002: 19). The first inclusive study of coastal erosion in Cyprus dates to 1981 (Thomas, 1981) and dealt with the island's southern coastline. Regarding archaeology, eroding sites were recorded when they fell within the purview of regional surveys. However, the low visibility of sites, often buried under layers of alluvium or colluvium, frequently rendered their identification difficult. This uncertainty potentially impeded the pro-active protection of the aforementioned surveyed fields. One such site is the LBA Toch-ni-Lakkia, which was initially recorded in the 1970s by the Vasilikos Valley Project (Todd, 2004: 133-134). The site was described as a possible settlement with few, but noticeable, diagnostic LBA specimens. Despite the exposed coastal sections of the field, which contained LBA and Iron Age pottery, the material representation was quite low so that it appeared to be a minor coastal settlement at most. This position has changed in the recent years due to the destructive erosive forces that have altered drastically the site revealing many more walls, floors and features. With this newly exposed evidence, one may understand the LBA maritime activity at the south-central coast of Cyprus as part of a much more complex socio-economic network than previously thought.

For that reason and generously funded by the Honor Frost Foundation (www.honorfrost-foundation.org), we established the Cyprus Ancient Shoreline Project (hereafter CASP). Our goal

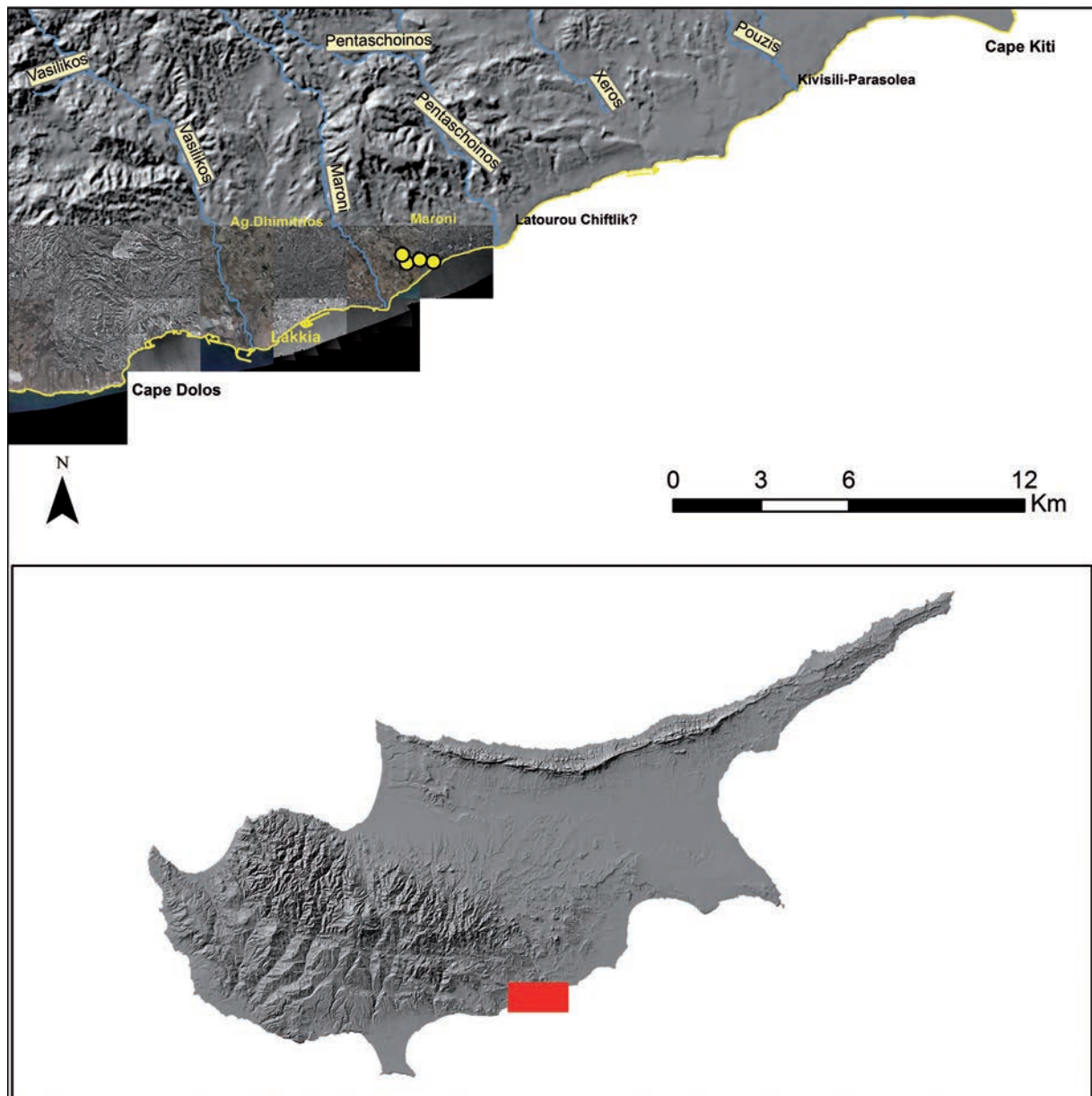


Figure 1. The Cyprus Ancient Shoreline Area of Investigation (produced by G.M. Andreou with input data from the Department of Lands and Surveys, Republic of Cyprus).

was to form a framework for ascertaining local drivers of coastal erosion, assessing the extent of land-loss and its impact on cultural heritage and using that to propose mitigation measures and legal frames to protect the Cypriot coastal heritage. To do so, we employed an in-depth study of diachronic coastal alteration, including *in situ* visits, comparative aerial photography and historic cartography.

The Cyprus Ancient Shoreline Project

CASP's area of investigation extends from a small port west of the Vasilikos industrial zone ($33^{\circ}18'22.371^{\circ}\text{E}$ $34^{\circ}43'22.542^{\circ}\text{N}$) in the west to the east bank of the Pentaschoinos river ($33^{\circ}24'44.82^{\circ}\text{E}$ $34^{\circ}45'1.618^{\circ}\text{N}$) in the East (Fig. 1). This coastal zone exhibits an eroding cliff-like

appearance comprised of soft material and narrow gravelly beaches (Thomas, 1981: 4-5). The choice of geographic location is based on the one hand on our previous investigation in the Vasilikos and Maroni valleys, and on the other on the results of the EUROSION project (www.euroasion.org). Together they demonstrated that a 20 km segment of coastline between Cape Dolos (Governor's Beach) to the West and Cape Kiti to the East exhibits severe erosion of up to 0.5 m per year (Triton Consultants, 2002: 32).

Our research focuses specifically on the coastal cultural heritage of this area and has been recording exposed features using archaeological illustration, photography (Fig. 2) and, on occasion, scanning. The aim was to monitor the extent and severity of erosion. The gradual accumulation of a corpus of comparative data became sufficient to support a desk-based assessment aiming to frame and possibly quantify the reasons behind this remarkable phenomenon. However, before proceeding to discussing CASP's results, it is necessary to list what we know to be currently under extreme threat on the area under investigation.

This area contains the LBA Tochni-*Lakkia* and Maroni-*Tsaroukkas* and the almost completely vanished Late Roman site of Zygi-*Petrini* (Manning *et alii*, 2000). Amongst these sites, Tochni-*Lakkia* contains the more extensive section of archaeological features. To begin, the site provides evidence of often substantial LBA structures and potential *pottery* production installations. These are evidenced in what we may reasonably identify as a kiln- a chamber with a burned, petrified surface and stone-lined features containing a clay-like substance. Throughout a long exposed coastal section, one may also observe stratified floors, *pithoi* (large storage vessels) installations, stone-filled pits, burnt surfaces and stratified pottery from the LBA and the Iron Age. Due to recent developments in the already heavily industrialised south-central coast of Cyprus, CASP's terrestrial investigations concentrated on a careful section clearing and trial trenching within the British Eastern Mediterranean Relay station area –a fenced industrial area surrounded by reclaimed land previously unavailable for archaeological investigation–. One trial trench produced a LBA floor, cut by a pit that was found to contain a notably high concentration of fragments from large vessels all dating to the LBA.

After intensive work at Tochni, we expanded the coastal investigation eastward with a preliminary recording survey. Through our investigation we collected geographical data for the heavily eroded Zygi-*Petrini* (Manning *et alii*, 2000), photo-documented and referenced Maroni-*Vrysouthia* (Manning *et alii*, 1994: 367; 2002: 78) excavated eroding walls and an LBA chamber tomb at Maroni-*Tsaroukkas* and recorded an eroding Byzantine building located west of *Vrysoudhia*, and some probably Roman walls at Kivisili-*Parasoleas*. According to Leonard (2005), the coastal area of Alaminos-*Latourou Ciflik* at the mouth of Pentaschoinos River contained eroding pottery, including Bronze Age fragments. At the moment of visit (June 2014), however, no archaeological evidence was observed. Nevertheless, it would not be surprising if a larger number and different components are observed in a subsequent visit.

Overall, the archaeological features we have recorded in the eroding sections are both a blessing and a curse. On the one hand the sections contain a uniquely long continuous stratigraphic sequence of sites, which would otherwise be available through extensive archaeological excavation. However, the constant erosion of this archaeology and the associated changes to the information it contains suggest that an unknown quantity of archaeological data has been irreparably lost between our visits. In addition, questions emerge regarding the amount of land lost since the abandonment of the aforementioned archaeological sites.

To address some of these questions, we co-operated with an underwater survey team that covered part of the investigated area in order to assess the potential location of an ancient shoreline (report available online at: www.honorfrostfoundation.org). However, current

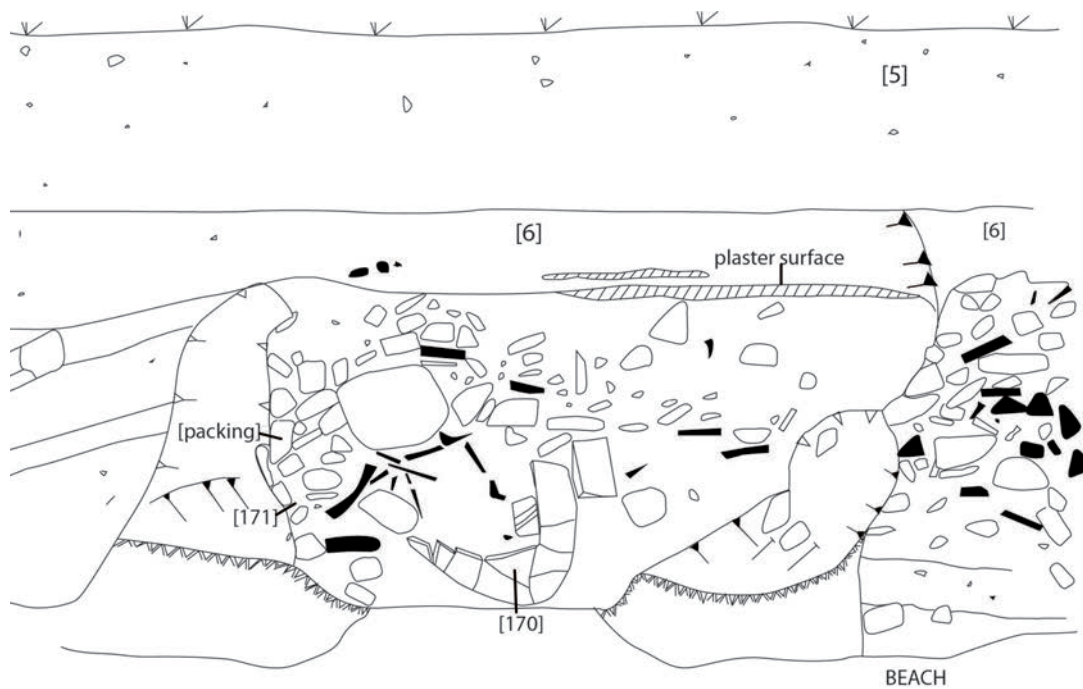


Figure 2. Archaeological feature eroding at Tochni-Lakkia containing pithos and packing stones (photographed by D.A. Sewell and illustrated by G.M. Andreou).

conditions in the area affected the underwater survey (Fig. 3). Contrary to a large number of anchors recorded in the past years at the coast off Maroni (Manning *et alii*, 2002: 122) and relocated in 2013, Tochni provides less robust underwater information. The current state of

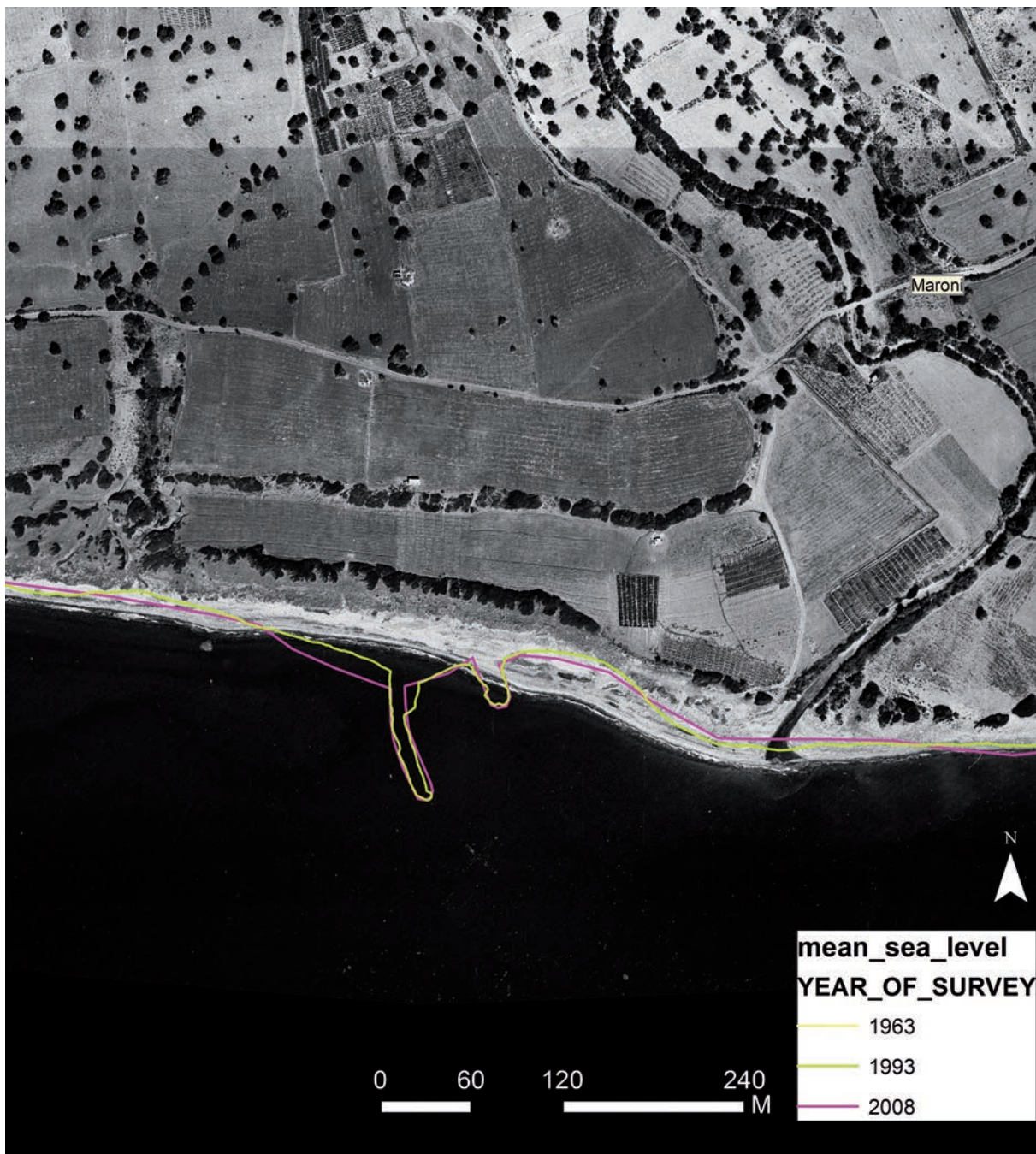


Figure 3. Breakwater and adjacent diachronic land-loss west of Maroni River (produced by G.M. Andreou with input data from the Department of Lands and Surveys, Republic of Cyprus).

the seabed including stone debris, sediment, algal and plant growth were a significant impediment to archaeological visibility and artefact preservation, and only a small number of recently eroded pottery was located at a short distance from the modern coastline. It appears, then, that the problem of erosion and the answer to our research questions is more synthetic than previously thought and requires a diachronic study and patterned understanding of various factors that affect coastal erosion and underwater visibility in the area under investigation.

Land-loss: causes and impact

The area explored by CASP includes a combination of industrial, agricultural and touristic development that jointly contribute to the erosion of cultural heritage in different ways. The industrial zone involves a rapid and unprecedented modification of the coast, including dredging, gravel quarrying, land reclamation and breakwater construction. Breakwaters, especially those constructed without impact assessment, are often found to be unsuitable for generalised coastal protection (Triton Consultants, 2002: 48-49). Moreover, the erosive impact of breakwaters, especially in adjacent fields may also be demonstrated through a comparative investigation of aerial photographs taken between 1963 and 2008, which chronologically span between the early stages of the Vasilikos industrialisation and the more recent tourist development. One can observe that the coast close to breakwaters has, through time, receded significantly (Fig. 4). This of course is not solely associated with these defensive structures. Comparable studies have also shown that river damming is exacerbating and accelerating the erosion of coastlines, due to the decrease in sedimentary input and a more direct

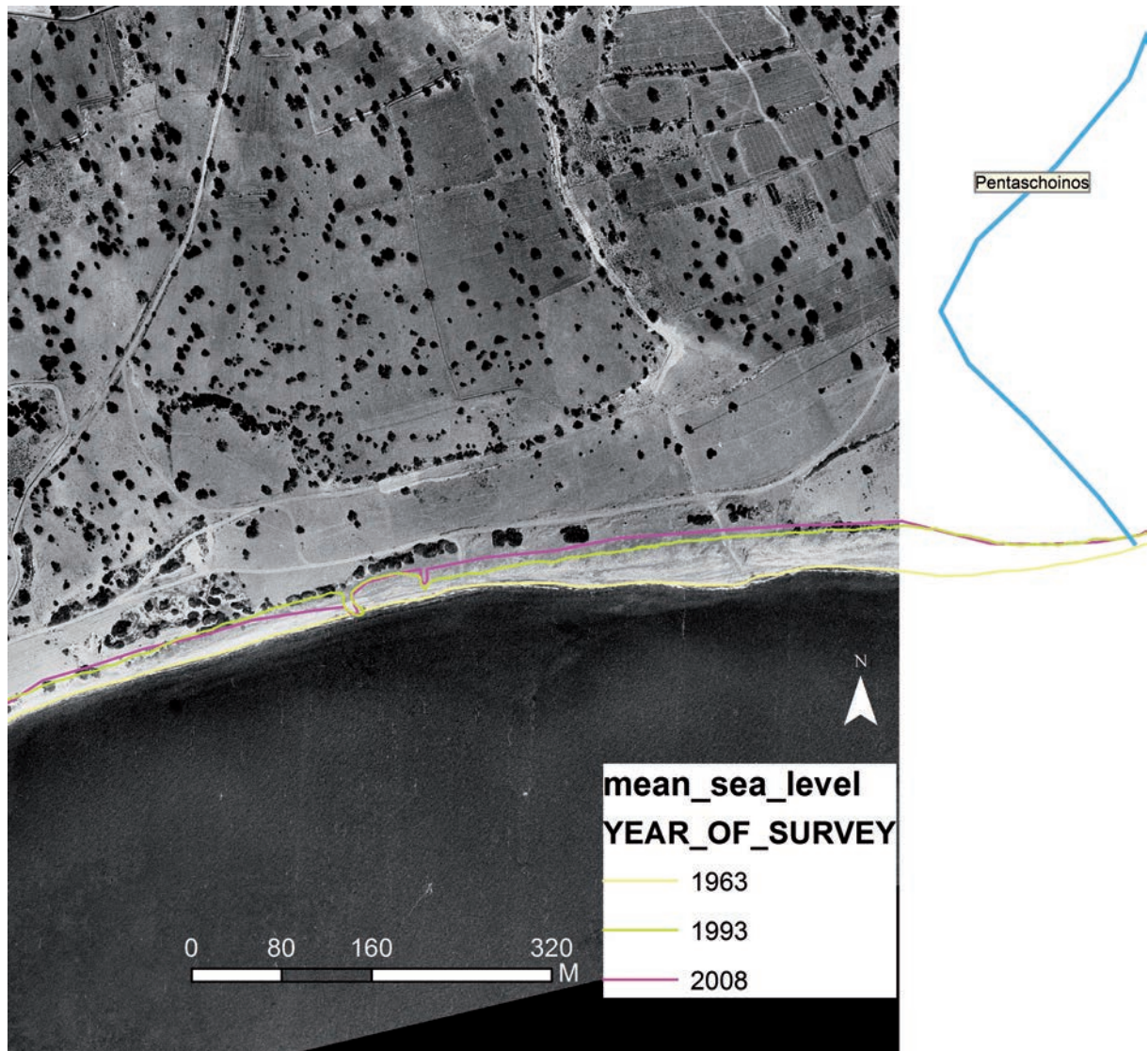


Figure 4. Breakwater and adjacent diachronic land-loss west of Pentaschoinos River (produced by G.M. Andreou with input data from the Department of Lands and Surveys, Republic of Cyprus).

exposure of the coast to wave action (Κορωνίδα, 2006: 3; Fitzpatrick, 2012: 180). Moreover, although estimations on annual river-borne sediment are unavailable, it has been estimated that solely the damming of Pentaschoinos and Tremithos rivers further to the East reduced sediment inputs by approximately 87 000 m³ (Delft Hydraulics, 1993: 48). The impact of this topographical change on the adjacent coastline, however, cannot be accurately quantified.

Drastic environmental alterations in the area under investigation appear to be a 20th century phenomenon, which has transformed this previously traditional fishing area into a centre of industrial and tourism development, industrial and navy port installation, and subsequently increased marine traffic. For these reasons, one can assume that the dramatic erosion of more than 0.5 m of shoreline annually was potentially not so marked following the abandonment of the archaeological sites in antiquity. To be more precise, it is rather unlikely that since the 2nd millennium BCE the south-central coast of Cyprus has been receding by 0.5 m annually and has receded by approximately 2 km in total. It is more likely that prior to the industrialisation of the south-central coast erosion patterns were functioning in a less aggressive manner. Therefore, the rapid erosion of archaeological evidence and the loss of underwater remains, which jointly affect our hypotheses regarding maritime trade in antiquity, are likely tied to human-induced environmental alterations of the past 50 years. It is possible, also, that an investigation of visual representations of the coast prior to its industrialisation can shed light on its diachronic use and provide additional information regarding the impact of erosion.

Historical Cartography

CASP incorporated historical cartographic information to reconstruct past land use patterns and record the diachronic perception of this particular landscape.

Before proceeding to an analytical presentation of evidence it must be noted that despite the amount and impressive chronological depth of cartographic information, all mapping attempts prior to Kitchener's work suffer from geographic inaccuracy; thus, information for the purposes of this study is often inferred.

A first point of interest is the c. 1432 AD Chronicle of Leontios Makhairas, who associates the Vasilikos River with St. Helen's arrival to the island in the mid-3rd century AD. According to his narrative, she and her crew allegedly cast anchor at Βασιλοπόταμον (Vasilopotamon) and subsequently fell asleep (Dawkins, 1932: 6, f.3 v). After an ominous dream, she found a piece of the Holy Cross by the riverbank, and a voice guided her to construct a church in the nearby Τόγνη (Tochni) (Dawkins, 1932: 8, f.4 r). Following this voice she built the church of the Holy Cross, which is widely identified with Stavrovouni.

«Καὶ ὄνταν ἐπεσῶσαν καὶ ἐράξαν εἰς τὴν γῆν ἔβγαλεν τὸ σεντούκιν μὲ τοὺς β' σταυροὺς, καὶ ἔφαν εἰς τὸ Βασιλοπόταμον. Καὶ ὄνταν ἀπόφαν, ἔπεσεν ἀπὸ τὸν κόπον τῆς θαλάσσου καὶ ἐκοιμήθην, καὶ εἶδεν ἕνα ὄρωμαν, ὅτι ἕνας παιδίος ἄνθρωπος εἶπεν τῆς: «Κυρία μου Ἑλένη, ὡς γοιὸν ἐποίκες εἰς τὴν Ἱερουσαλὴμ καὶ ἔκτισες πολλοὺς ναοὺς, ἡττοῦ ποῖσε καὶ ὧδε, ὅτι ὁρισμὸς εἶνε εἰς τὴν αὐτὴν χώρα νὰ κατοικοῦσιν ἄνθρωποι ἕως τῆς συντελείας, καὶ νὰ μὲν ξηλειφθῇ εἰς τοὺς αἰῶνας· καὶ κτίσε ναὸν εἰς τὸ ὄνομα τοῦ τιμίου καὶ ζωοποίου σταυροῦ καὶ βάλε ἀπὸ τὰ τίμα ξύλα, ἀπὸ βλαστᾶς.» Καὶ ἐξύπνησεν καὶ ἐσηκώθη ἀπὸ τὸν ὕπνον καὶ ἐγύρεψεν τὸ σεντούκιν καὶ τοὺς σταυροὺς τοὺς μεγάλους· ὃ τοῦ θαύματος! ὁ ν-εἰς μέγας ἐχάθη· καὶ ἔπεψεν γυρεύγοντά του, καὶ εὗρέθη εἰς τὸ βουνὸν τὸ λεγόμενον Ὀλυμπία, διὰ τὸν σταυρὸν τοῦ Ὀλυμπᾶ, τὸ ὄνομα τοῦ καλοῦ ληστή· καὶ ἔκτισε ναὸν τοῦ τιμίου σταυροῦ καὶ ἔβαλεν εἰς τὴν καρδίαν τοῦ σταυροῦ μερικὸν ἀπὸ τὸ τίμιον ξύλον. Τάπισα εἶδεν ἕνα στύλλον λαμπρὸν ἀπὸ τὴν γῆν ὡς τὸν οὐρανόν, καὶ ἐπήγε νὰ τὸ ἰδῇ τὸ

θαῦμα, καὶ ἤρην εἰς τὸ πλευρὸν τοῦ ποταμοῦ τὸν ἕναν μικρὸν σταυρὸν ἀπὸ τοὺς δ', καὶ φωνὴ ἀπὸ τὸν οὐρανὸν καὶ εἶπεν: «Ἐλένη, ποίσει νὰ κτίσης ὡδὰ ἐκκλησίαν εἰς τὸν αὐτὸν τόπον λεγόμενον Τόγνην.» Καὶ ἐποίησε ναὸν τοῦ τιμίου σταυροῦ καὶ ἕναν γιοφύριν νὰ περνοῦν οἱ ἄνθρωποι, καὶ ἐσήμωσεν τὸν αὐτὸν σταυρὸν μετὰ ἀργύρου καὶ χρυσοῦ καὶ μαργ(α)ιτάρου» (Λεόντιος Μαχαιράς, Χρονικὸν Κύπρου, I: 8).

Despite all fictional aspects of this story, its descriptive details are important. The fact that the Vasilikos estuary at the unknown time of the creation of this legend was an anchorage provides insight into maritime activities in the area in the 15th century AD and likely the 3rd century AD. Therefore, it is possible, indeed likely, that Vasilopotamon estuaries provided a considerable call point for boats.

In the following years, maps produced by sailors, travellers and cartographers depicted the south coast as a series of bays, often with boats approaching. For instance, when a main theme in the cartography of Cyprus and the Eastern Mediterranean was the expansion of the Ottoman Empire and the invasion of the island, an unsigned map published in Augsburg in 1570 shows the village of Calauaso (Kalavassos) close to Potamo (= river - Vasilikos) and boats approaching various parts of the island, including the south-central coast (Stylianou/Stylianou, 1980: 56, Fig. 63).

Visitors have also provided useful information. For example, Ali Bey, a Spanish travel-

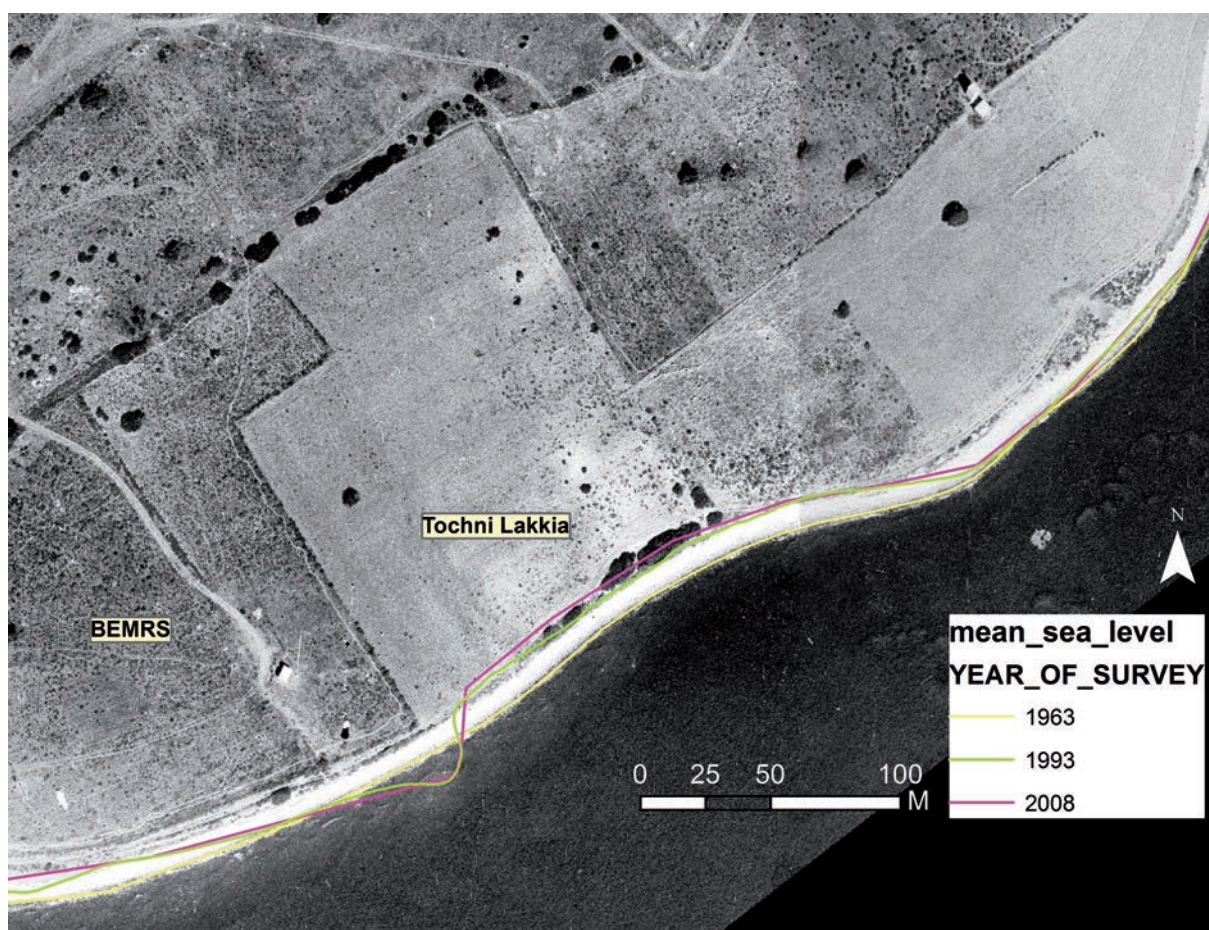


Figure 5. Diachronic land-loss at Tochni-Lakkia, east of the Vasilikos River (produced by G.M. Andreou with input data from the Department of Lands and Surveys, Republic of Cyprus).

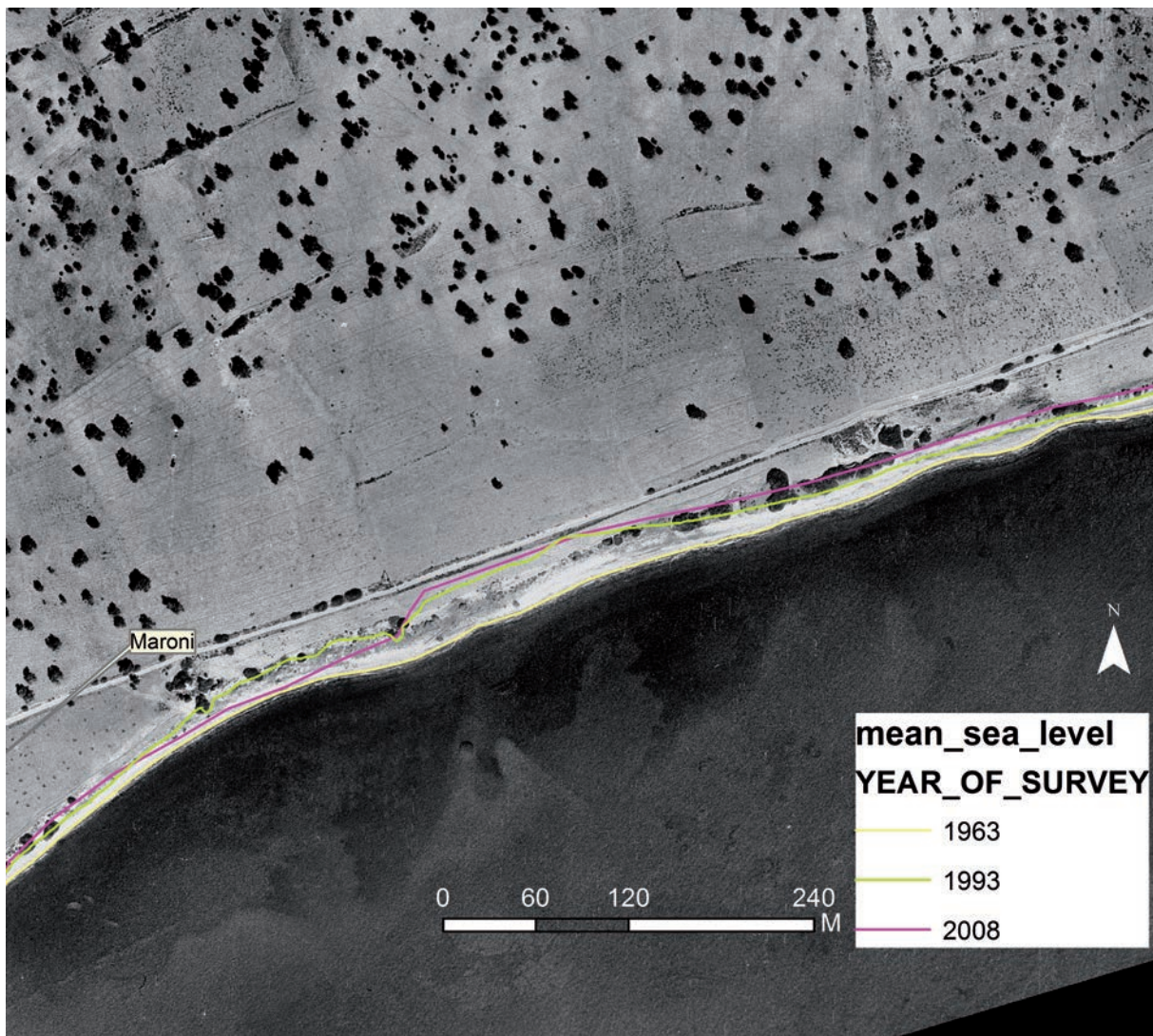


Figure 6. Diachronic land-loss at the archaeologically rich Maroni coast (produced by G.M. Andreou with input data from the Department of Lands and Surveys, Republic of Cyprus).

ler, who in 1806 travelled from Larnaca to Limassol along the coastal road, mentions the existence of a small port at the mouth of the St. Helena river (Cobham, 1908: 403). This is probably the same area that was visited by G. Marini during the 18th century, who recounted St. Helen's legend, and discussed Vasilopotamos river in conjunction with the nearby village Mari and the seasonal exportation of crop from large numbers of carob trees (Cobham, 1971: 81). At this point we should address the toponym «Cape Caroubière», which in 1878, was argued by R. H. Lang to coincide with the general Mari area (Lang, 1878: 232-234). This cape appears as «Khar-noupas» in Kitchener's 1878-1883 map (associated with carobs) and is located near *Lakkia*. Interestingly, at present, no cape survives in this area.

Kitchener's first full triangulated survey and mapping of the island produced an impressively detailed map, which is however unavailable in a geo-referenced form. As part of this study we attempted to reference sheet 15, following the standard ArcGIS procedures for geo-referencing raster images. We overlaid a scanned raster image of Kitchener's map, with geo-referenced roads, streets and villages surveyed by the Department of Lands and Surveys of the Republic of Cyprus; however, the low degree of cartographic resolution,

along with the high standard deviation error could not produce a reliable geo-referenced map. Moreover, as consulted by coastal engineers, Kitchener did not map the coastline, but instead coastal field boundaries, which do not always correspond with the late 19th century coastline.

A desirable degree of accuracy was possible though a comparison of aerial photographs dating between 1963 and 2008. The 1963 aerial photographs were used as a base map, while the 1993 and 2008 coastlines are represented with yellow and pink colour respectively. Land loss became immediately obvious, with areas located close to river mouths and adjacent to breakwaters suffering most intensively from erosion. It is important to note that it is not possible or reliable to attempt a high-resolution quantification of land loss, such as discussing centimetres, due to deviation errors during geo-referencing. For that reason we produced comparative results throughout the years between different segments of the area under investigation, and classified those segments in two groups. The first group exhibits annual land loss higher than 0.5 m and the second group lower than 0.5 m. This classification follows a previous research in coastal erosion (Delft Hydraulics, 1993: 35). A comparative study of two classes of eroding coastline came to confirm that a series of natural and more recent anthropogenic factors have contributed to coastal destabilisation, including damming, breakwater construction -often lacking environmental impact assessment-, dredging and unmonitored sand and gravel quarrying for the construction industry (Figs. 5 and 6).

What's next?

As the impact of erosion on cultural heritage is irreversible, CASP explored also ways in which we can monitor, legally defend and protect in the long term eroding archaeological sites. We consulted legal documents concerning antiquities and coastal management, to observe that eroding antiquities, due to their particular nature, are often in a legal grey zone and their protection often takes place on an ad hoc basis (Galili, 1999; 2006; Wickham-Jones, 2010; Rick/Fitzpatrick, 2012: 135). This is exacerbated by the lack of clear understanding of the dynamic nature of the coast (EuroSION, 2004a: 48).

For example, in Cyprus there is no clear consensus in legal documents of what consists of coast and coastal zone. According to the Foreshore Protection Act (acts 59, 22/61, 17/64, 8/72) the land limit of the coastal zone is a distance of 100 yards from the winter tide. According to the Town Planning and Housing Law of 1972 (enforced in 1990) the coastal zone for reasons of town planning is a 100 meter wide strip from the coastline (Triton Consultants, 2002: 15; EuroSION, 2004b: 5). There is currently no official estimation of the winter tide. As such, risk and vulnerability assessment is not yet plausible. This is problematic; especially in cases where the position of the coastline in maps used for town planning may rely on estimations dating as early as 1924. This means that in an estimation of 100 meters from the coastline, the erosion of the last 50-60 years may not always be included. As a result buildings may be intruding on the coastal protection zone and simultaneously jeopardised by erosion (Triton Consultants, 2002: 15). Overall, a lack of clear definition for the coastline also contributes to a poor understanding of erosion patterns and by extension their impact on archaeological remains.

With the new information deriving from CASP we are promoting a closer incorporation of eroding antiquities in the coastal management legal system, something that has been implemented successfully in other contexts, such as Israel and Scotland (SCAPE, www.scapetrust.org), which launched a large scale survey assessment of the coast and employed mitigation measures to protect its cultural heritage. Future plans include, but are not limited to, expansion

of the coastal survey to provide a clearer understanding of the extent and impact of coastal erosion on Cypriot cultural heritage and the investigation of mitigation measures and legal frameworks of other coastal Mediterranean countries for a more holistic proposal of a relevant legislation. It is hoped that changes in the planning requirements for offshore and near shore infrastructure projects in the future will help to protect this valuable, unique and non-renewable resource.

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Collection of the data for CASP was possible with the kind help and assistance of many people and organisations. We are very grateful to the Honor Frost Foundation that largely funded this project. We would like to thank the Cyprus Department of Geological Surveys for providing a series of geo-referenced information concerning the geological and geomorphological background along with satellite images of the area under investigation. Aerial photographs, digitised maps and geo-referenced data were provided by the Cyprus Department of Lands and Surveys. X. Loizides, coastal engineer from Isotech Ltd Environmental Research and Consultancy and coordinator of AKTI Project and Research Centre provided valuable reports and information regarding coastal erosion of the past 100 years. Special mention may be made of the excellent work of the Bank of Cyprus Cultural Foundation in digitising historic maps of the island. More maps were accessed through the Royal Commission of the Ancient and Historical Monuments of Scotland (RCHAMS).

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Study of the *Fougueux* wreck (1805) and the remains of the Fort Lacy (1813) as indicators of paleocoastline

El estudio del pecio *Fougueux* (1805) y los restos del fuerte Lacy (1813) como indicadores de la paleocosta

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Abstract: The archaeological prospection applying geophysical techniques in a near-shore zone in SW Spain has revealed the remains of a wreck associated with the French ship *Fougueux*, which was involved in the Battle of Trafalgar (1805). The remains appear aligned about 500 m away from the present coastline. Furthermore, the rests of a fort outcropped in 2010, during a severe storm. These ruins correspond to the fort Lacy, constructed in 1813 in the Bay of Cadiz during the Independence War. Comparison between these results and historical maps, related to the shipwreck and the fort, allows us to localize the coastline at the beginning of the nineteenth century in this area. In addition, recent shoreline trends derived from aerial photographs were calculated and related to actual coastal circulation patterns and wave conditions obtained using numerical modeling tools. Results show an important erosive trend in the area with coastline retreats of 200-250 m.

Key words: Shipwreck, coastline retreat, geophysical prospection, site formation.

Resumen: mediante la prospección arqueológica a través de técnicas geofísicas en el SW de España fueron localizados los restos de un naufragio asociado con el navío francés *Fougueux* (Batalla de Trafalgar, 1805). Los restos aparecen a 500 m de la línea de costa actual alineados paralelamente. Asimismo, los restos de un fuerte descubiertos tras un temporal en 2010, fueron relacionados con el fuerte Lacy, construido en 1813 en la bahía de Cádiz durante la Guerra de la Independencia. Estos resultados comparados con mapas históricos de la época del naufragio y del fuerte han permitido localizar la línea costera de principios del siglo XIX en el área. Además, recientes cambios en la línea costera analizados mediante el uso de fotografías aéreas han sido comparados con los patrones hidrodinámicos y de oleaje actuales obtenidos mediante modelos numéricos. Los resultados muestran una importante tendencia erosiva, con retrocesos de la línea costera de 200-250 m.

Palabras clave: pecio, erosión costera, prospección geofísica, formación, sitio arqueológico.

Introduction

From an archaeological point of view, the knowledge of historical shoreline position can be beneficial for the study and interpretation of archaeological sites. In addition, taken into account the *in situ* protection strategy assumed during the last decade by the underwater archaeology community, shoreline changes should be considered from a conservational point of view. Underwater cultural heritage (UCH) is being affected by marine processes which must be understood in order to better protect the remains (Bethencourt *et alli*, 2007: 52; Plets *et alli*, 2011: 87-98) and to predict future changes in the environment which can affect to their conservation.

On the other hand, from a geological focus, geoarchaeology has become a very valuable discipline in coastal studies due to its interest and relevance in fields such as historical shoreline reconstruction and location, recent sea level changes (Sivan *et alli*, 2001: 101-117), coastal evolution and trends (Paskoff/Oueslati 1991: 149-162), or in the study of historical catastrophic events (Forsythe *et alli*, 2000: 247-259; Peterson *et alli*, 2011: 219-244).

A common difficulty inherent to this kind of studies is the accurate definition of paleocoastlines prior to modern cartography development. Thus, no accurate data exists on cartography maps before the end of 19th century. Therefore, the location of archaeological remains could help to the location of the historical shoreline. Two main typologies of archaeological evidences are commonly used to this purpose. At first place man-made structures, such as water-front structures, whose constructive typology and functionality determine their original location more or

less near to the coastline. A second typology of archaeological evidences is formed by shipwrecks and the distribution of their scattered remains. It could allow the palaeodynamic reconstructions for the inner shelf and sublittoral zone. If the remains were related to a historical running aground of a vessel, their location could indicate the location of the coastline at that time. In this case they may help in reconstructing shoreline evolution from that moment to the present day. Nevertheless, caution must be assumed as certain remains are continuously scattered and transported by local marine processes.

In the present work the study of both typologies mentioned above, scattered artifacts from the *Fougueux* shipwreck site and the military stronghold Lacy, were used to reconstruct the paleocoastal line in the early years of the 19th century. A geophysical prospecting was conducted to identify and locate a group of scattered remains belonging to the *Fougueux* shipwreck site, allowing the analysis of the remains' spatial distribution. Results were compared with data of shoreline trend analysis based on historical maps, as well as more recent shoreline trends derived from aerial photographs. Next, we related the estimated shoreline changes to the coastal circulation patterns and wave conditions existing in the area, as obtained from numerical models. Finally, the military stronghold lacy remains location confirms the local shoreline trends derived from the present study.

Materials and Methods

Study site

The study site is located on the SW coast of the Iberian Peninsula (off the Strait of Gibraltar) (Fig. 1a). It extends over the coastal stripe from La Albufera embayment to Sanctipetri tidal creek, and includes the Sanctipetri sand spit (Fig. 1b). The spit is a southwest-facing sandy body 7 km long with a very variable and dynamic southern tip (Benavente *et alli*, 2002: 23-32). The coast is oriented NNW-SSE. The seafloor in the study area is mainly composed by medium and fine quartz sand, with some bedrock crops in the study area (Fig. 1a). The seafloor has a shallow gradient, with an average slope of 0.005, and the beaches located in the sand spit present a dissipative profile (Gracia *et alli*, 2005: 40-58).

Meteorological conditions are characterized by the prevailing Atlantic winds from the W and WNW, and the less frequent but more intense Mediterranean ESE winds. Wind waves come mostly from W and WSW, with a significant wave height (H_s) < 1 m for 50% of the year, although during extreme storm events H_s exceeds 4 m. The coastline is meso-tidal (mean spring range of 2.96 m). Current velocity have a dominant NNW orientation for flood and SSE for ebb tide conditions, with mean values of 0.15-0.25 ms⁻¹, reaching up to 0.5 ms⁻¹ during wave and wind storm events.

Archaeological sites

- *Fougueux*, a 74-gun Temeraire-class French ship of the line took part in the Battle of Trafalgar (1805). She was sunk in front of the Sanctipetri sand spit (Cadiz), during the violent storm that struck the coast of Cadiz after the battle, which drove it, onto a rocky shoal. 32 guns, a large anchor and the central part of the hull are preserved at the site (Fig. 1c) (Rodríguez/Rieth/Izaguirre, 2010); conversely bow and stern section along with the rest of the artillery are not at the original site. Therefore, we hypothesize that breaking and scattering of the rest of *Fougueux* remains took place during the storm following the battle.

- Fort Lacy: The other archaeological site used in this work corresponds with the military stronghold Lacy. This defensive fortification was built by the British army in 1813, during the Independence War, in order to reinforce the defensive line of the Sancti Petri tidal creek. The defensive construction shows an hexagonal ground shape (Fig. 1d).

Prospection of the *Fougueux* shipwreck site area

The prospection of *Fougueux* shipwreck site and the surrounding area was performed in two different phases. First, in the Archaeological Easement Zone a geophysical survey was conducted using side scan sonar (Klein®) along with a high resolution magnetometer (Explorer model, Marine Magnetics®). Positioning of the geophysical survey was performed with a submetric differen-

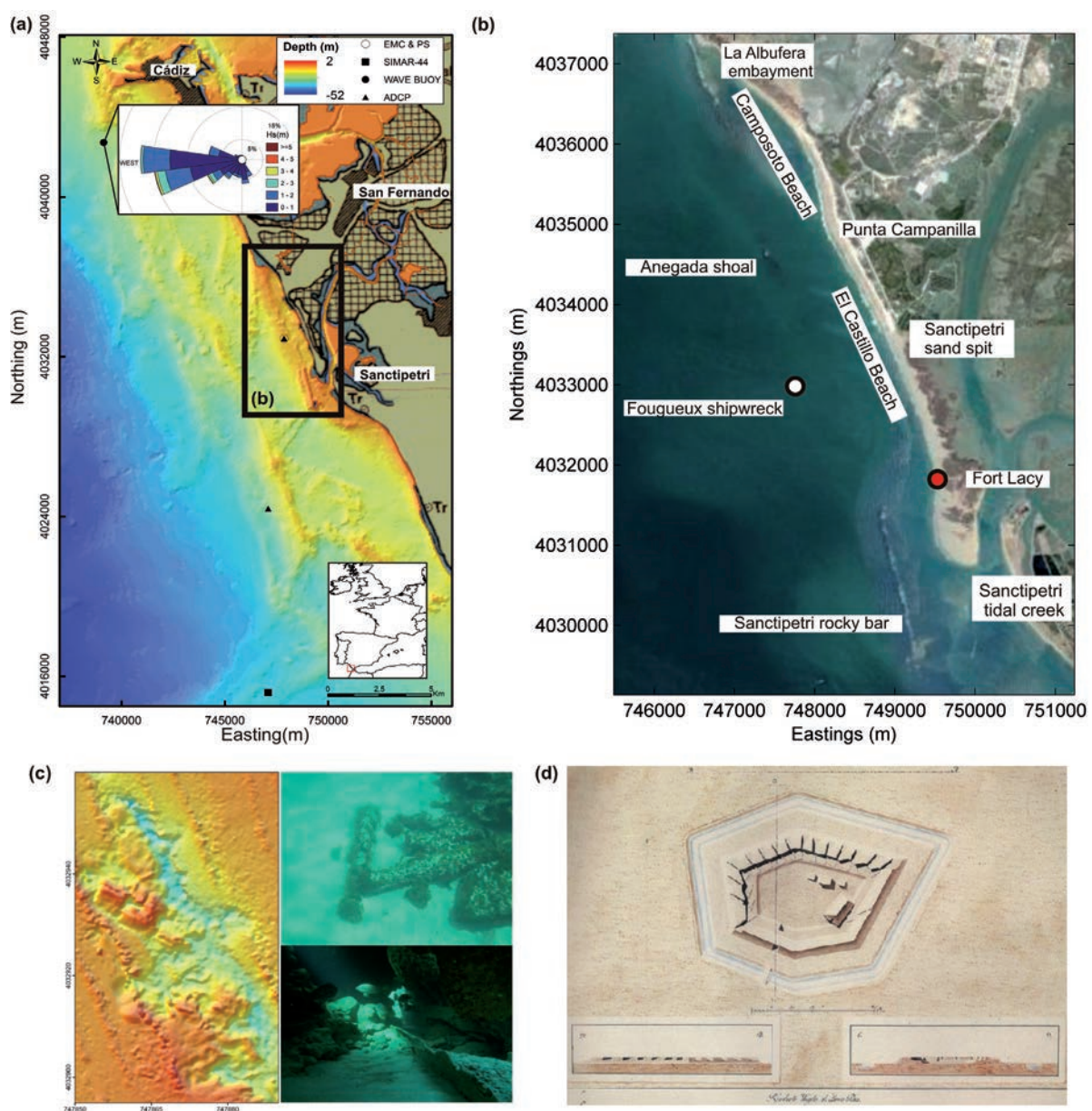


Figure 1. (a) Overview of bathymetric map of the study area, wave rose from wave buoy and mooring position of oceanographic instrument. (b) Detailed map of Sancti Petri sand spit. (c) Detailed map of the original *Fougueux* shipwreck site derived from MBES bathymetric survey. (d) Detailed plane and side view of military stronghold Lacy.

tial GPS (Trimble®, model DMS132). Different graphic representations were produced with the obtained data including thematic maps of geomagnetic and sonar data. On the other hand, inspection diving was made systematically in the very shallow areas where no geophysical survey was possible, while in the surveyed zone it was focused on the anomalies detected. Four divers swimming in parallel, 3 m apart from each other, covered the zone until a maximum depth of 12 m.

Analysis of coastline trends of the study area

The coastline trends of the study area were analysed through shoreline digitalization of two different datasets: historic maps were used to characterize the medium term evolution and historical shoreline positions; aerial photographs were used to characterize the more recent shoreline changes in the study area.

Historical maps and documents analysis

Documentary research and historical maps analysis were conducted in order to set the position of the shoreline at the time of the *Fougueux* wreck (1805) and its evolution until the Fort Lacy construction (1813). It should be noted that, despite the difficulties inherent to the extraction of precise information from historical maps (Crowell/Leatherman/Buckley, 1991: 839-852; Giles, 2002: 6-16; Plaziat/Augustinus, 2004: 127-143), the high quality nautical charts selected allowed to avoid important positional errors. The following three historic maps were used: Royal Spanish navy chart, 1787; Royal French navy, 1807; and Royal French Corps of Engineers, 1823. The work flow applied to the historic maps was as follows:

1. The nautical charts were georeferenced to a common coordinate reference system (ED50, zone 30).
2. Georeferencing was performed in ESRI® ArcGIS 9.3™ software by using as ground control points (GCPs) distinctive historical landmarks (such as lighthouses or coastal batteries), which were identified on 2008 orthophotographs.
3. Digitalization of the shoreline position on each map.

Aerial photographs analysis

Recent coastline changes in the study area were analysed using 6 sets of aerial photographs and orthophotographs spanning the period 1956-2008. The scales of the photographs employed vary between 1:15000 and 1:33000. The photographs were examined through stereoscopic photointerpretation and GIS software, with the aim of obtaining high accuracy shoreline change data. The sets of orthophotographs were directly used as input for coastal change calculations, while the paper print photographs were scanned at high resolution and georeferenced. High-water line (HWL) and the dune foot were digitized and used as shoreline proxies for assessing the rate of shoreline change. DSAS 3.2 (ArcGIS extension) was used to calculate coastal changes. 25 m spaced shore-normal transects were drawn, and rates of shoreline change between 1956 and 2008 were computed on each transect by linear regression.

Local hydrodynamic and wave conditions

In order to study the local circulation pattern and wave conditions we resort to numerical simulations using the Delft3D model. In particular, the hydrodynamic module Delft3D-FLOW and the

wave module Delft3D-WAVE for wave conditions. The Delft3D-FLOW and Delft-3D-WAVE exchange information by means of an online coupling, allowing the simulation of wave-induced currents, changes in water levels and wave-current interaction effects. Delft3d-FLOW model set-up was applied using a 2D depth-averaged scheme, and three nested computational grids to achieve a higher resolution. The computational domain extends from Trafalgar Cape to Chipiona. The tidal open boundary conditions of the coarser domain included the 6 main tidal constituents (O1, K1, K2, N2, S2, M2) taken from the global tidal model AG95.1 (Andersen, 1995: 249-259).

Delft-3D-WAVE model setup comprised only one computational grid (50 m resolution). Wave boundary conditions were set from the wave directional buoy of the REDCOS network of the Spanish agency, Puertos del Estado (Fig. 1a).

Both models were calibrated and validated against current velocity and wave data measured at different locations in the area under study (Fig. 1a). Subsequently, conditions corresponding to an average storm event were simulated, allowing obtaining the fields of wave characteristics and current velocity in the area.

Results and Discussion

Geophysical Survey

Side scan sonar and magnetometer surveys (Fig. 2) allowed the detection of several anomalies. The magnetometer record shown in figure 2c, reveals a large number of emerging elements. Most of them were identified as modern artifacts during *in situ* diving inspection, but other were

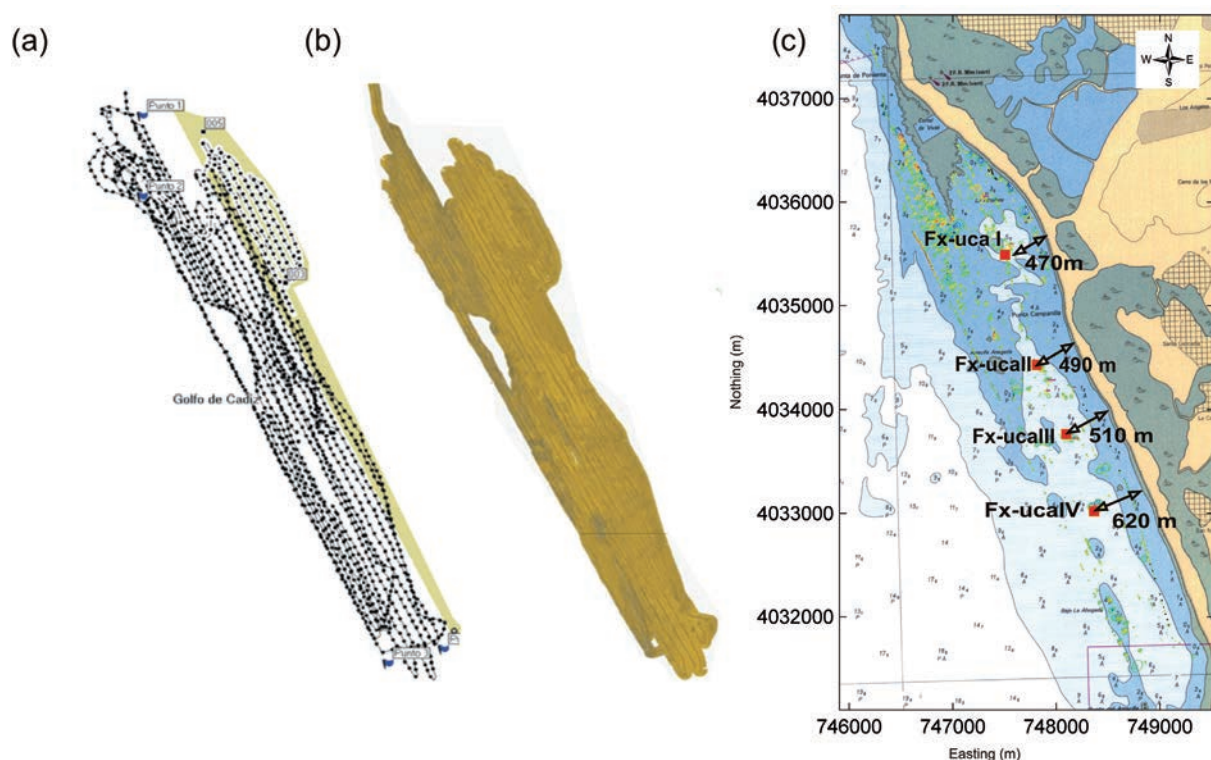


Figure 2. (a) Trackchart of the magnetometer and side scan sonar surveys in Sanctipetri sand spit (b) Side scan sonar mosaic on the study area. (c) Map of geomagnetic anomalies, and identification of those determined as *Fougueux* remains. Background: 1998 nautical chart (Navy Hydrographic Institute).

recognized as archaeological remains of a vessel. These anomalies were classified into four scattered groups located at different distances and code-named as Fx-uca I to Fx-uca IV. Fx-uca I, is one cast cannon. Fx-uca II is formed by 1 anchor, a set of 9 cast cannons and 2 isolated cannons. Fx-uca III comprises 17 cast cannons, an anchor and other minor metallic elements. Fx-uca IV contains 2 cannons and 2 anchors. The correspondence between these scattered remains and the French vessel *Fougueux* was established after analyzing the cannons, which exactly follow the old French Ordinances between 1778 and 1786. In addition, a comparative analysis of the chemical composition of the copper sheathings located at Fx-uca II site and at the original *Fougueux* site confirmed this conclusion.

The groups of cannons Fx-uca I to IV are aligned in NNW-SSE direction, parallel to the present shoreline. As shown in figure 2c, the average distance of remains to the present-day lowest low water (LLW) is 522.5m, varying from 470 m in Fx-uca I to 620 in Fx-uca IV. The depths at the sites of the discovered remains fluctuate between 4 m (Fx-uca I) and nearly 7 m (Fx-uca II- Fx-uca IV) below LLW.

Although a direct relation between *Fougueux* remains alignment and historical coastal line could be established, remains alignment does not have to represent exactly the paleocoast line. We have to acknowledge a high degree of uncertainty in several issues. On one hand, it is not known the precise time of grounding, and therefore the tidal level is unknown. On the other hand, the uncertainty respect to the draft of the piece of hull where the cannons drifted during the storm. Assuming that the dissipative profile of the beach has not changed from historic time to present, and taking into account the characteristic mesotidal regime in the area, both error sources could suppose variations of an order of hundreds of meters. Therefore, the remains found should be considered solely as a proxy of the historic shoreline in 1805.

Analysis of coastline trends

The analysis of historical maps allowed obtaining the approximate position of the coastline in years close the Battle of Trafalgar (1805), as depicted in figure 3. According to 1787 map (V. Toñño), a quite rectilinear shoreline is located between 200 and 500 m seaward of the present-day LLW. The coastlines corresponding to the 1807 nautical chart (F. Etienne) and the 1823 map (unknown) were located between 100 and 250 m seaward of the present-day LLW, there are little differences between these maps, the exception being the southernmost area. The central portion of the sand spit shows a relative stability with minor variations. However, northern and southern portions are subject to significant changes, showing the coastline a notable curvature in La Albufera embayment and the southern area. The free end of the sand spit shows greater variability, as usually occurs in these geomorphological features. The results derived of the three historical maps analysis reveal a markedly shoreline retreat at the medium term scale in the study area.

The analysis of aerial photographs (Fig. 4) reveals a moderately eroding trend in the last decades. The dune foot recession in the northernmost sector of La Albufera embayment and in central Camposoto beach showed averaged values of 0.9 m/yr for the whole 1956-2008 period. Maximum values of dune foot retreat reach up to 1.4 m/yr in some points.

The high water line has revealed a retreat rate specially high at northern Albufera embayment, where it averages 1.4 m/yr, and at the southern part with a mean erosion rate of 1.1 m/yr. Aerial photographs have revealed shoreline changes fairly irregular, with great spatial variations, mainly due to the presence of numerous washover fans on the dunes, which produce contrasting trends alongshore. However a very general retreating trend of about 1 m/yr can be estimated for this coast in the last decades.

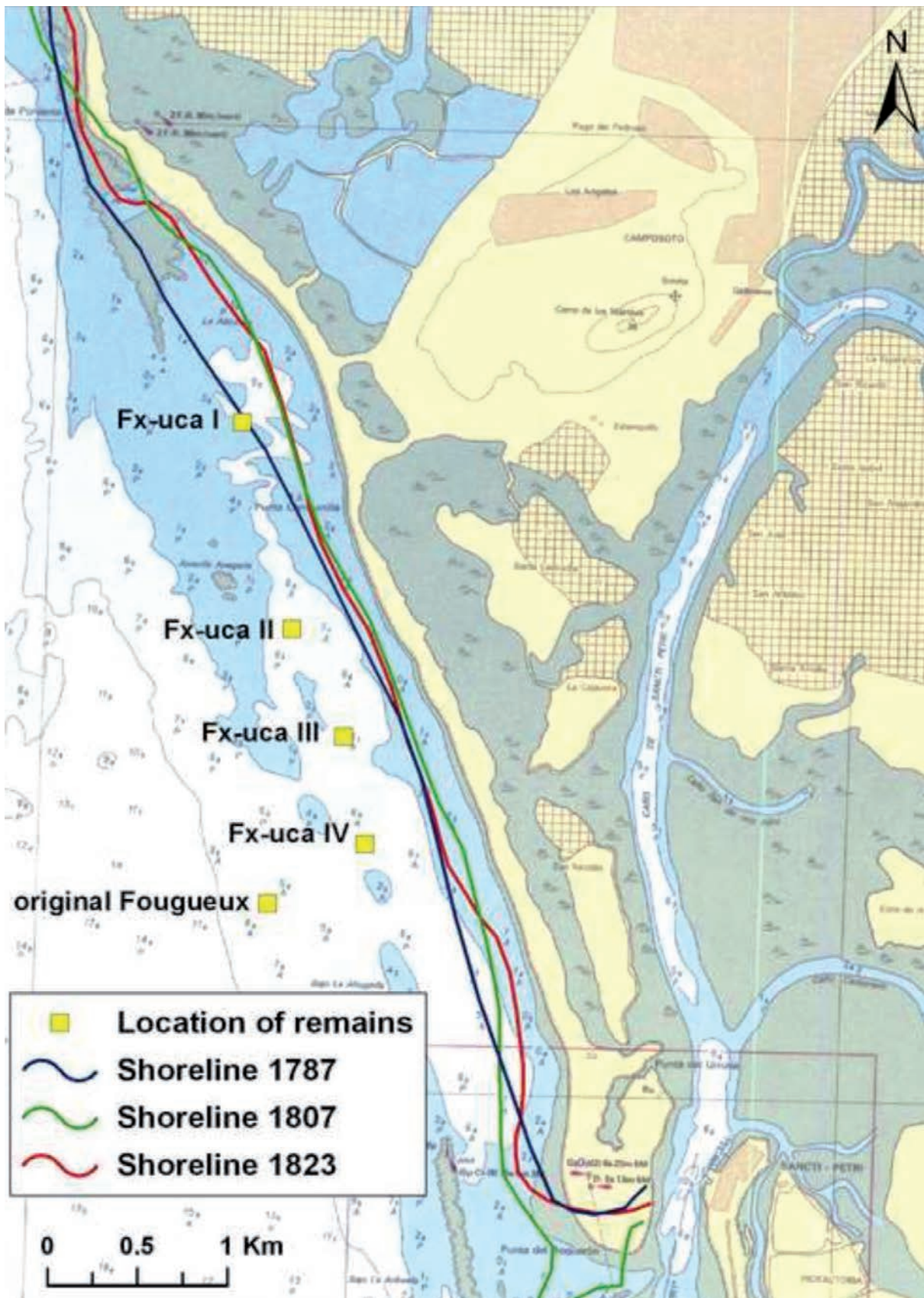


Figure 3. Shoreline positions extracted from the historical nautical charts of 1787, 1807 and 1823. Background: 1998 nautical chart (Navy Hydrographic Institute).

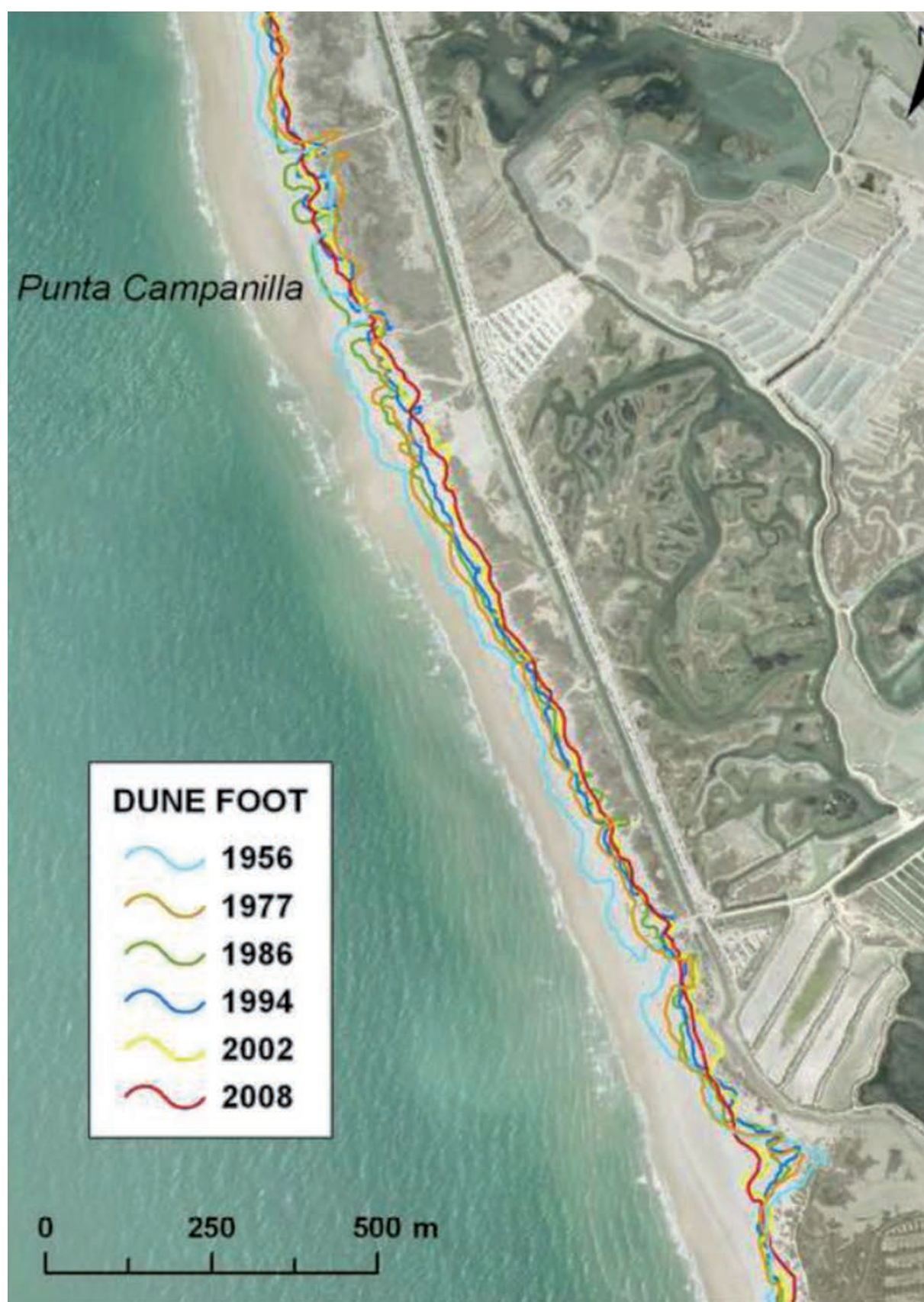


Figure 4. Example of recent shoreline changes in the central sector of Sancti Petri sandspit, corresponding to Camposoto beach. Background: 2009 orthophotograph (Andalusian 651 Institute of Cartography).

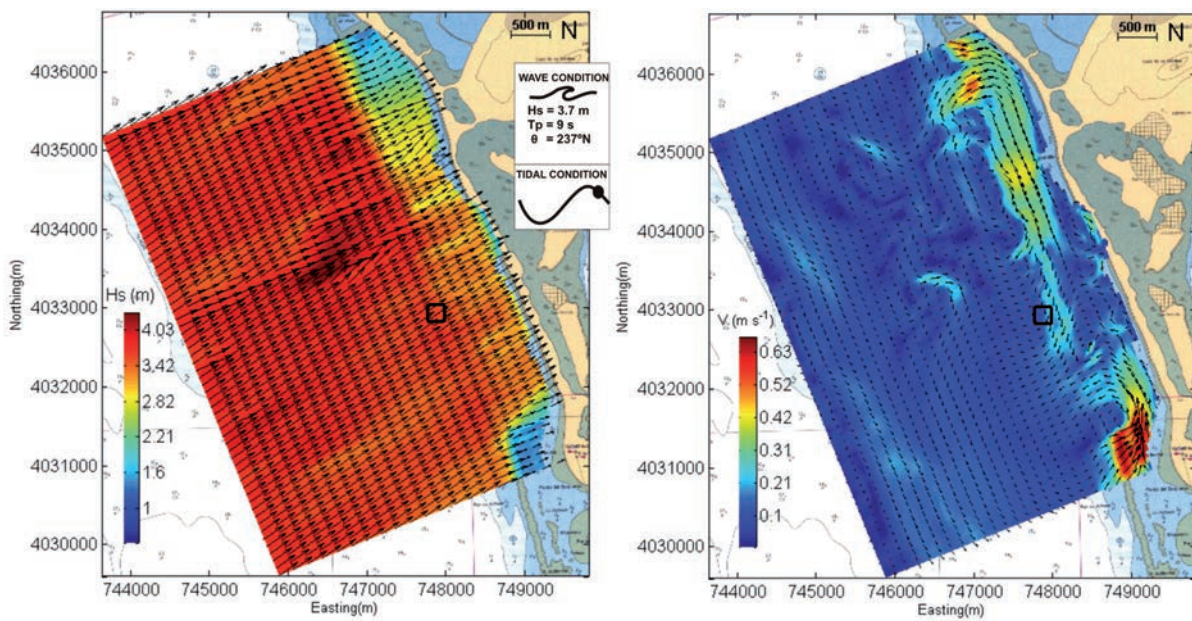


Figure 5. Local pattern obtained with Delf3D model. (a) Local pattern of significant wave height during a mean storm event. (b) Local pattern of current velocity during a mean storm event.

Local hydrodynamic patterns and wave conditions

Local hydrodynamic patterns and wave conditions have been depicted in figure 5. A great variability in the significant wave height (Hs) that reach the shoreline at the Sanctipetri sand spit can be observed in fig 5a. Rocky outcrops (Fig. 1a) produce the wave refraction allowing that differences in wave height in the study area.

The Sanctipetri rocky bar in the southern part of the study area, and the rock shoal off the Albufera embayment act as wave-breakers, limiting the Hs to 1-1.5. At the same way, wave breaking at the Anegada shoal (Fig. 1b) reduces Hs to 2.8 m at the central part of Camposoto beach and Punta Campanilla. However, in the Castillo beach the significant wave height exceeds 3.4 m.

The current pattern in the area (Fig. 5b) is formed by two important recirculation cells at the northern and southern parts of the Sanctipetri sand spit. These can be related with the currents derived from wave breaking on these areas. Current are of 0.4 and 0.6 m s⁻¹ in Albufera embayment and Sancti Petri rocky bar, respectively. A clear intensification of the longshore current occurs between the end of the Albufera embayment and Punta Campanilla, with an increase in velocity up to 0.3-0.4 m s⁻¹.

Hydrodynamic and wave pattern show an spatial coincidence with the areas where the shoreline retreat has been markedly greater at medium term, as well as with the result of greater erosion rates in the dune foot revealed by aerial photographs analysis.

Fort Lacy: the evidence

The Fort Lacy was located in the georeferenced historic map of 1823 (Fig. 6a). Figure 6b shows the Fort Lacy seated 250 m inland from shoreline in 1823. The fort was discovered after a series

of consecutive extreme storm events occurred in winter 2010, which promoted a great erosive process, with the result of coast line retreat at the Castillo beach. Thus, Fort Lacy which remained buried by beach and sand dunes deposit, was unearthed. Only the Fort Lacy foundations, along with some wood structures, have been conserved (Fig. 1c).

The coastline retreat at Fort Lacy site, 250 m during 1823-2010, shows a value similar to that obtained with the shoreline analysis of historical maps. Moreover, the derived erosion rate estimate of 1.3 m/yr is very close to the 1.4 m/yr obtained from aerial photograph analysis at this portion of the Sanctipetri sand spit.

Fort Lacy evidence shows that an erosive trend characterizes this part of the coast. This sand spit is affected by erosion during storm episodes, which promote the loss of dry beach surface, as well as the generation of vertical escarpments in dunes as signed by black arrows in fig. 1c.

Conclusions

The study allowed the location of the historic shoreline from 1787-1823 in the Sancti Petri sand spit. Results from historical maps and archaeological remains show an acceptable agreement with actual coastal erosion trend and dynamics in the area, revealing a mean retreat of 200 m in the shoreline (rates ~ 1 m/yr).

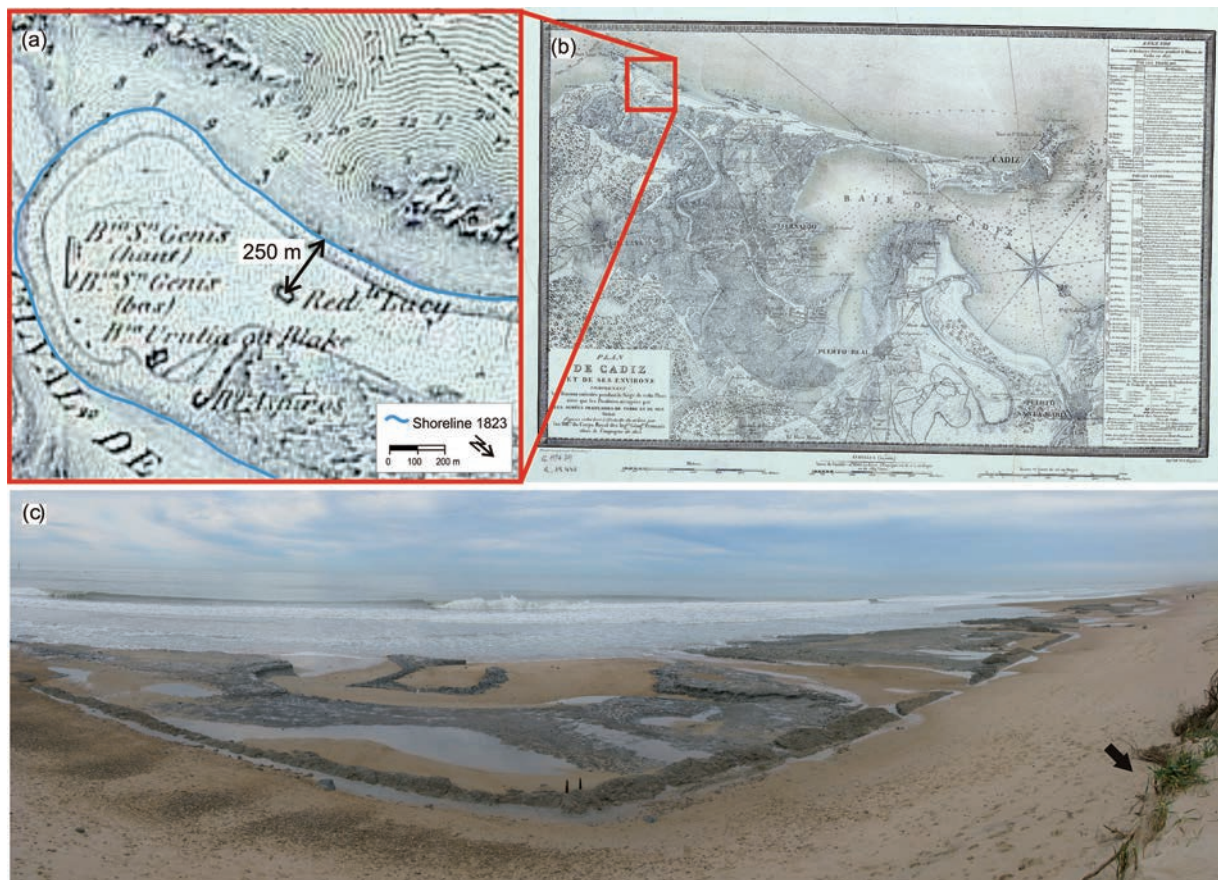


Figure 6. (a) Details of Fort Lacy situation respect to the shoreline in 1823. (b) Location of Fort Lacy in the historic map of 1823 (Officers from the Royal French Corps of Engineers). (c) View of the rests of Fort Lacy in 2010.

Scattered remains can be used as a proxy for the historical shoreline. The main advantage is that they represent a wider coastal stretch. However, there are limitations associated with the unknown distance from shoreline to the remains location during the ran aground moment.

Archaeological remains such as man-made structures allow the historical shoreline determination with good accuracy. Nevertheless, results should be carefully considered, since they represent a relatively limited area. This is the case of the present study, where erosion rates in the coastline can vary widely in a relative small portion of coast.

From a management point of view, shoreline variations have a crucial role for UCH located in littoral or sub-littoral areas, changing the conservation status of the UCH. Thus, coastal erosion may endanger the emerged remains of Lacy. However, this process might contribute positively in the stability and conservation of the scattered *Fougueux* remains, which are nowadays further from an extremely energetic environment.

Acknowledgements

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Arqueología de las marismas en el tramo meridional del Caño de Sancti Petri (Bahía de Cádiz, España). Actualización de datos y nuevas perspectivas geoarqueológicas

Archaeology of the marshlands in the southern area of Caño de Sancti Petri (Cadiz Bay, Spain). Some updates and recent geoarchaeological results

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Resumen: el actual Caño de Sancti Petri y los sistemas de marismas que lo definen debieron constituir desde su consolidación como hito geográfico en la etapa prerromana uno de los principales escenarios de actividad económica de la mitad meridional de la bahía de Cádiz en relación al tráfico marítimo, el comercio y la explotación de recursos marinos. Es notable también la proximidad del templo principal de la ciudad de Gadir/Gades, el santuario de Melqart-Hercules. Nuestra atención se ha centrado en el caso del asentamiento romano del Coto de la Isleta (Chiclana). La revisión de los testimonios muebles e inmuebles resultantes de la erosión litoral permiten confirmar la existencia de un establecimiento industrial para la elaboración de productos piscícolas activo entre mediados del siglo I a.C. y a lo largo del I d.C. Otros asentamientos romanos detectados en la Antipolis (la actual San Fernando), correspondientes también con instalaciones productivas y embarcaderos confirman un intenso aprovechamiento de estas marismas.

Palabras clave: Gadir, Gades, geoarqueología, salazones romanas, marismas.

Abstract: The current Caño de Sancti Petri and the marshlands connected with this main salty-stream would have played an important role as a major economic scenario in the southern part

of Cadiz Bay regarding the maritime traffic and trade and the exploitation of marine resources. It is also worth to note the vicinity of those marshlands with the most important extra-urban sanctuary of Gadir/Gades devoted to Melqart-Hercules. Our most recent efforts have been focused on the Roman site of Coto de la Isleta (Chiclana). The review of the material culture and building remains uncovered due to the coastal erosive process has verified the existence of an industrial Roman settlement linked to the production of fish by-products dating from mid-1st c. BC to the late 1st c. AD. Other Roman sites uncovered in the opposite shoreline of Sancti Petri, in the southern stretch of the Strabo's Antipolis (current San Fernando), suggest an intensive use of these wetlands in Antiquity.

Key words: Gadir, Gades, geoarchaeology, roman fish-salting, marshlands.

ARCHAEOLOGY OF THE MARSHLANDS OF THE SOUTHERN AREA OF THE CAÑO DE SANCTI PETRI (CADIZ BAY, SPAIN). SOME UPDATES AND RECENT GEOARCHAEOLOGICAL RESULTS.



The site of Coto de la Isleta was first mentioned in 1995 in a paper (Gracia et al. 1995 & 1999) that focused on the post-glacial levels of this marsh environment close to Sancti Petri tidal salty-stream. In this first approach the existence of two fish-salting vats was outlined (uncovered in the survey), and also a brief mention of the discovery of prehistoric (Neolithic) and Roman materials. The Roman pottery and building remains were dated on the late-Republican (2nd-1st c. BC) and the early-Imperial period (1st-2nd c. AD).

These first published data of the main archaeological features of the site has been reproduced without further fieldwork by several authors. Thus, L. Lágostena (2002) and J. A. Expósito (2004) include Coto de la Isleta as one of the various salting facilities engaged in fishing activities within Cadiz Bay. However, none of the aforementioned recent publications developed a closer approach to the archaeological context of the Roman site or promoted new excavations to improve the stratigraphic and contextual available information.

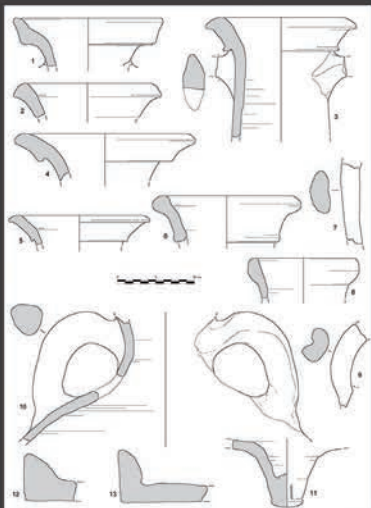
Our recent activities in the site has made possible to relocate the Roman remains of the industrial settlement, supporting the initial hypothesis that defined the site as a isolated plant related to the exploitation of the marine resources of the southern part of the Caño de Sancti Petri. The most recent work has revealed that the pair of vats is currently located in the intertidal marsh area, suggesting the presence of more vats in the immediate surroundings. Not far inside the island some opus signinum pavements have been identified, and also the remains of some walls and foundations, frequently linked to building elements (tegulae and tiles). Especially in areas where the tidal erosion have transgressed the coastal profile large amount of pottery fragments have been found, mainly local amphorae and imports (terra sigillata, italic cooking wares, thin-walled vessels, etc.). The analysis of the pottery found in the surroundings of the signinum floors and the vats point to a activity developed in the (possible) cetaria of Coto de la Isleta between the mid-1st c. BC and the late-1st c. AD.



Location of the site

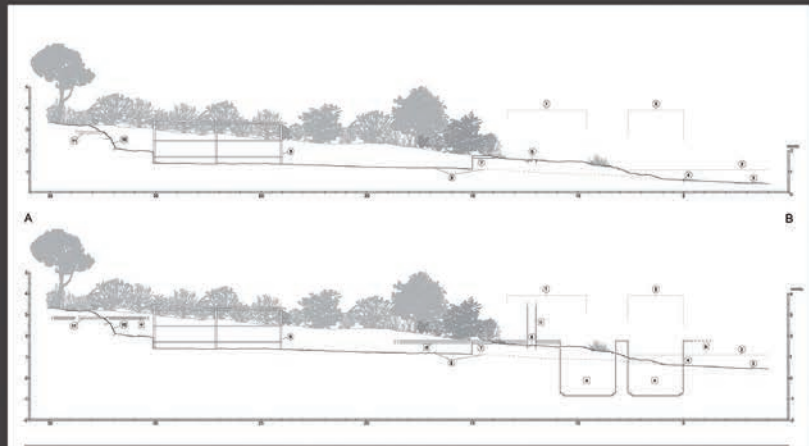


Plan of the Roman site



Pottery from the Roman site of Coto de la Isleta:

Amphorae: Ovoid Gaditana (1), Dressel 7/11 (2-7), olive oil transport vessels from Guadalquivir valley (8-11); Tegulae (12-13). As well, fragments of Italian and Hispanic sigillata, imported and local thin-walled bowls, Campanian cooking wares, etc. were uncovered at the site.



Stratigraphical section of the Roman site (above) and hypothetical reconstruction (below):

1. Current path. 2. Maximum Sea Level. 3. Gray Marsh-bed. 4. Remains of Roman vat emerging. 5. Size of the vat. 6. Foundation of Roman wall. 7. Opus signinum floor. 8. Current floor level next to 20th c. building. 9. 20th c. hut. 10. Possible Roman wall or foundation. 11. Opus signinum. a) Unexplored Roman vats. b) original Roman flooring level. c) Roman wall. d) & e) opus signinum pavement (courtyard of the salting plant?).

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Archaeology of a Lagoon: the anthropogenic landscapes of Aquileia (Italy) between land and sea

Arqueología de una laguna: los paisajes antropogénicos de Aquileia (Italia) entre la tierra y el mar

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Abstract: Aquileia (Italy), once one of the largest cities of the Roman Empire, was located at the head of the Adriatic Sea, about 20 km from the modern sea coast line. Nowadays, Aquileia sits at the edge of a brackish water lagoon that largely occupies its once vast southern suburban landscape. Using sophisticated remote sensing (RS) techniques over both coastal and lagoon areas, research undertaken within the «Beyond the city walls» project has revealed a number of previously unrevealed supplementary canals connected to well known ancient features and a number of not-as-yet identified coastal settlements adjoining them, as well as a number of underwater traces that can be interpreted as preserved archaeological structures. This poster showcases some of the most recent discoveries at those sites and explores the challenges and the opportunities connected with using remote sensing techniques in a lagoon and in a semi-humid environment.

Key words: Tidal archaeology, semi-humid archaeology, remote sensing, hyperspectral imagery, Aquileia.

Resumen: Aquileia (Italia), que fue una de las mayores ciudades del Imperio romano, estaba localizada junto al mar Adriático a unos 20 km de la línea de costa moderna. Hoy en día, Aquileia se sitúa en el borde de una laguna de agua salobre que ocupa gran parte de su vasto paisaje suburbano meridional antiguo. Usando sofisticadas técnicas de teledetección sobre ambas zonas, costeras y lagunares, la investigación realizada dentro del proyecto «Más allá de la muralla de la ciudad» (dirigida por la autora), ha descubierto una serie de canales complementarios previamente desconocidos conectados a elementos antiguos conocidos y un número de asentamientos costeros adyacentes a ellos aún no identificados, así como una serie de vestigios subacuáticos que pueden ser interpretados como estructuras arqueológicas. Este póster muestra algunos de los descubrimientos más recientes en estos yacimientos y explora los retos y las oportunidades del uso de técnicas de teledetección en una laguna y en un entorno semihúmedo.

Palabras clave: arqueología de las mareas, arqueología semihúmeda, teledetección, imágenes hiperespectrales, Aquileia.

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The 5th International Congress on Underwater Archaeology.
Cartagena (Spain) 15-19 October 2014



Archaeology of a Lagoon: the anthropogenic landscapes of Aquileia (Italy) between land and sea

Arianna Traviglia

ABSTRACT

Aquileia (NE Italy), once one of the largest cities of the Roman Empire, was located at the head of the Adriatic sea about 20 km from the modern sea coast line and was connected to it through a sophisticated network of artificial canals and natural waterways. Ancient sources celebrate Aquileia's famous fluvial port: soon after its foundation the original hydrological network surrounding the city was reshaped to maximise its navigability and integrate it with the impressive Roman road system, making the Aquileian port the nodal point of the trade traffic between the Danubian regions and the Mediterranean basin. Nowadays Aquileia sits at the edge of a brackish water lagoon which largely occupies its once vast Southern suburban landscape. The area South of the ancient city has been, in the past 4 years, the focus of the 'Beyond the city walls' project, a multidisciplinary project aiming to understand the complex relationships between the urban core of Aquileia and its dependent landscapes. Using sophisticated remote sensing (RS) techniques, including processing of hyperspectral and multispectral satellite data, over both coastal and lagoon areas, the research has revealed a number of previously unknown supplementary canals connected to well known ancient features and a number of not-as-yet identified coastal settlements adjoining them as well as a number of underwater traces within the lagoon that can be interpreted as preserved underwater archaeological structures. This poster will showcase some of the most recent discoveries at those sites and will explore the challenges and the opportunities connected with using remote sensing techniques in a lagoon and in a semi-humid environment.



- Aquileia was a major Roman city founded in 181 BCE
- 'Ninth amongst celebrated cities' of the Roman Empire in 4th cent.
- Located in a key area for commercial exchanges between the Danubian regions and the Mediterranean basin.

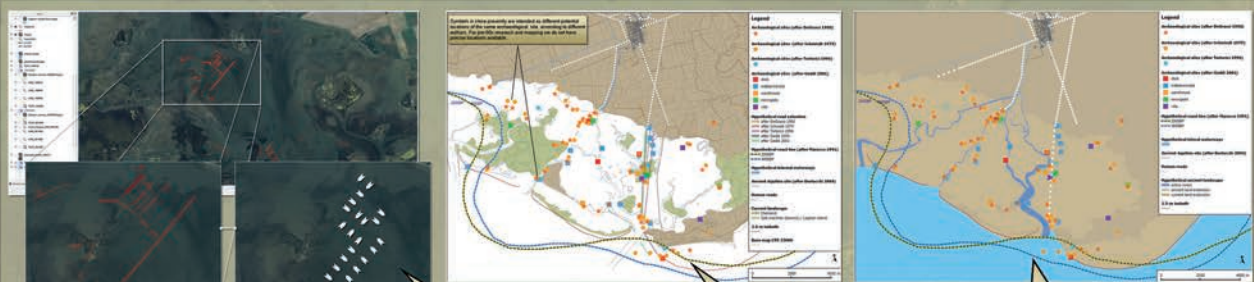
- "IN PALUDIBUS MOENIA CONSTITUTA": 'a city is built in a marshy situation' (Vitruvius)
- "MOENIBUS ET PORTU CELEBRATA": 'highly famed for walls and harbour' (Aulus Gellius)

- Local rivers played a fundamental function as part of the communication and trading network
- Large navigable rivers flowed into the Adriatic Sea few miles South of the city.

- Artificial canals were excavated to increase the potential of the river network
- This hydraulic system complemented the road network
- Aquileia was a nodal point in the distribution of goods in North East Adriatic.

- The coast line was modified by natural flow regimes of river alterations and subsidence phenomena after the Roman period
- Current lagoon was likely a plain above sea level
- Several archaeological sites were identified underwater.

Remote sensing data processing → Importing data into GIS → Visualising and inspecting data → Mapping features → Contrasting with existing datasets → Interpreting features



Hyperspectral MIVIS sensor provides excellent water penetration in shallow waters and produces imagery where channels and traces are easily identifiable.

- A large dataset of Remote Sensing data (including aerial and satellite panchromatic and multispectral imagery) was acquired and processed
- Processed imagery was imported in a GIS for analysis
- Underwater features were identified and mapped.

- All the identified underwater, and above sea level archaeological sites were mapped within the GIS and tagged
- Geological and hydro-morphological data were added
- Mapped features were contrasted to those datasets.

- Features were selected based on a 'reliability' index
- Features were interpreted based on shape, size, orientation, proximity to known sites etc.
- A reconstructive map of the landscape in Roman times was created using available datasets.



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Nombres e historias de la mar y la realidad de su patrimonio subacuático en Galicia

Names and stories of the sea and the reality of its underwater heritage in Galicia

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Resumen: el hombre ha dominado el paisaje, y en su espacio marítimo, al apropiarse y usarlo lo ha moldeado y marcado, con hitos que a través de las comunidades se han perpetuado sin dejar un resto material. Estos perviven como realidades que el especialista debe interpretar a la hora de enfrentarse con un paisaje cultural marítimo. Mostraremos aquí a través de ejemplos recopilados en la geografía gallega, que las fuentes de tradición oral sirven como «marcador» de realidades arqueológicas del patrimonio cultural subacuático. El trabajo previo de consulta oral ofrece datos que tras ser interpretados, pueden ser usados como herramientas de búsqueda, elaboración y detección de yacimientos arqueológicos subacuáticos de diversa índole. No debemos olvidar la importancia de la cultura, el folklore y tradición que genera la interacción diaria con el medio marino y que puede llegar a ser fundamental para nuestra investigación.

Palabras clave: Galicia, topónimo, tradición oral, leyendas, patrimonio cultural subacuático.

Abstract: Mankind has dominated the environment, and in its maritime area, since they took possession of it, they shaped it and marked it with historic events that came across different communities without leaving a physical trace. These marks survive as facts that the specialist must analyze when it comes to study a maritime cultural landscape. We have the objective of demonstrating through gathered examples of the Galician geography, that nowadays there still are traditional oral sources that last in maritime communities, sources that still are used as indicators of archaeological facts of the underwater cultural heritage. The previous job of oral research gives information, which after being interpreted, can be used as a tool for searching, elaborating the study or detection of underwater archaeological places of different types. We can't forget the importance of the culture, folklore and their own tradition, generated by their daily relation with the sea, which can be fundamental for our investigation.

Key words: Galicia, toponym, oral tradition, legends, underwater cultural heritage.

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Nombres e historias de la mar y la realidad de su patrimonio subacuático en Galicia.

Introducción:

En el inicio de todo proceso de investigación arqueológica es fundamental la información de las comunidades locales sobre su entorno transmitido de forma oral, muchas veces plasmada en tradiciones, leyendas o en los nombres que estas personas dan al paisaje con el que interactúan diariamente. La memoria colectiva de una comunidad sobre su pasado debe servirnos como una herramienta más de trabajo para complementar información científica de un proyecto o ayudarnos en la localización de elementos del Patrimonio Arqueológico.

La tradición oral forma parte del patrimonio cultural inmaterial, constituido por los "usos, representaciones, expresiones, conocimientos y técnicas -junto con los instrumentos, objetos, artefactos y espacios culturales que les son inherentes- que las comunidades, los grupos y en algunos casos los individuos reconozcan como parte integrante de su patrimonio cultural. Este patrimonio cultural inmaterial, que se transmite de generación en generación, es recreado constantemente por las comunidades y grupos en función de su entorno, su interacción con la naturaleza y su historia, infundiéndoles un sentimiento de identidad y continuidad y contribuyendo así a promover el respeto de la diversidad cultural y la creatividad humana" (art 2.1. UNESCO: Convención para la Salvaguardia del Patrimonio Inmaterial, París 2003).

Tipos de patrimonio cultural inmaterial útil para una investigación arqueológica subacuática

NOMBRES

En su interacción diaria la gente de mar ha modelado su espacio inmediato, llenando de nombres el mar y la costa donde desarrollan su trabajo y su vida cotidiana, creando así, marcas e identificadores de las virtudes y riesgos del medio que nombran, localizan y describen, y no sólo le ayudan a dominarlo y conocerlo mejor sino que también aluden a los lugares que forman parte de su historia y cultura marítima, acontecimientos trágicos y/o traumáticos para la comunidad, o hechos muy relevantes para su historia local.

Dependiendo del lugar, estos nombres son conocidos como **topónimos**, cuando hacen referencia a espacios terrestres, **hidrotopónimos** en relación con el agua y **talasónimos** (VILAR PEDREIRA 2013: 32), en la superficie de mar, franja intermareal, asentamientos e instalaciones portuarias, fondo del mar o marcas de enfiliación en tierra.

El talasónimo "*A Baleaza*" en Baiona corresponde probablemente al hundimiento de dos galeras del siglo XVI (VILAR PEDREIRA 2013: 39).

Otro caso análogo es "*Punta Galeza*", en Camariñas, donde se supone el hundimiento de una galera berberisca en 1617. (LEMA MOUZO 2014:229).

En 1987 se realizó la prospección en la ensenada de Mera, en la ría de A Coruña, siendo una de las zonas conocida como "*furna dos canóns*" y en donde se localizaron dos piezas de hierro. (GARRIDO MARTÍNEZ et al., 1991: 254)



Fotografía de la pieza de hierro encontrada en la ensenada de Mera. (Foto: David Fernández Abella)

En 1987, se realizó una campaña de excavación en "*Punta do diñeiro*", entre Cabo Cee y Cabo Finisterre. Este topónimo surgió como consecuencia de hallazgos casuales de restos, lo cual se confirmó tras la excavación con la aparición de multitud de monedas pertenecientes al pecio del Galeón San Jerónimo. (MARTÍN BUENO: 1989).



Fotografía de monedas encontradas en el pecio del Galeón San Jerónimo. (Foto: David Fernández Abella)

El talasónimo del bajo "*Cunchán*", en Cabo Silleiro (Pontevedra), hace referencia al naufragio en este punto del barco inglés Collingham en el año 1906. El boca a boca de la tradición oral y la adaptación del nombre inglés, transformo el nombre original por el de "*Cunchán*". (VILAR PEDREIRA, 2008: 79).

HISTORIAS

Las historias generadas sobre naufragios o relatos históricos de acontecimientos marítimos se expresan en el saber popular a través de cuentos, leyendas o cantares, que aún partiendo de un hecho real, se adornan y desfiguran por la fantasía o simplemente son deformados al pasar de boca en boca y de generación en generación, a lo largo de los años.

Es labor del arqueólogo saber interpretar la subjetividad de estas historias y sacar de ellas la mayor información científica posible, que en muchos casos, y en el mar no es una excepción, encierran claves históricas, referencias o pistas acerca de yacimientos que no aparecen o no han sido localizados en la documentación conservada.

En la confluencia de las rías de Ferrol, A Coruña, Ares, Mugardos, Pontedeume, Sada y Betanzos, se levanta un peñasco en el mar conocido como pena da Marola, lugar conocido por la dificultad de la navegación por las fuertes corrientes en diversas direcciones. Las desgracias que ha ocasionado este peligro ha dado lugar a la creación de un refrán popular que sentenciaba que "*o que pasou a Marola pasou a mar toda*". (RIVAS BARROS, M., 2011, nota 7).

Una cantiga baionesa narra tres tragedias de naufragios entre 1923 y 1929 a la entrada de Baiona, donde se hundieron el T.H.Skogland, el noruegués Aslaug y el Highland Pride (VILAR PEDREIRA, 2013: 43-44.)

"Hoy se siente desgastada nuestra ría,
a la entrada encolló el Aslaug,
hase meses que varó el Gran Pride,
y hase años el Escorlán."



Fotografía del barco Highland Pride hundido. (Foto: VILAR PEDREIRA, 2013)

Cuenta la leyenda que yendo a casarse Ana María de Neoburgo con el rey Carlos II en 1691, su barco tocó fondo en la ría de Ferrol intentando escapar de un temporal, dando el nombre de "*cui da raíña*" (*culo de la reina*) a una piedra, cuya forma dicen que recuerda al momento en el que la reina se sentó en ella a esperar. (PINEIRO DE SAN MIGUEL et al., 1997: 38).



Fotografía de la piedra conocida como 'culo de la reina'. (Foto: David Fernández Abella)

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AGUAS CONTINENTALES

INLAND WATERS

Scottish Crannogs: A case study in historic changes to lacustrine environments and its impact on the archaeological record

«Scottish Crannogs»: un ejemplo de estudio de los cambios históricos en ambientes lacustres y su impacto en el registro arqueológico

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Abstract: Scotland is renowned for its lochs (lakes) and the history associated with them. Less widely appreciated are the changes to these landscapes caused by the adoption of new agricultural practices in the 18th and 19th centuries that drained lacustrine environments impacting the archaeology within them. Utilising historic and cartographic records, a method was developed for quantifying these changes and their impacts to the archaeological record. The results show that in some areas around 90% of lochs were drained or significantly lowered. Additionally, the timing and location of drainage impacted the recorded distribution of the most notable inland water archaeological feature of Scotland – the crannog. Scotland's drainage history shaped the trajectory of research on crannogs, and is still reflected in modern research strategies and interpretations. This paper serves as a model for understanding how historic land-use change impacted the inland water archaeological resource, and how historic drainage shapes modern research strategies and interpretations in Scotland.

Key words: Crannogs, Scotland, lacustrine environment, land-use change, lake-dwellings.

Resumen: Escocia es conocida por sus lagos y por la historia asociada a ellos. Menos conocidos son los cambios paisajísticos que las nuevas técnicas agrícolas trajeron en los siglos XVIII y XIX, los cuales incluyeron el drenado masivo de lagos, afectando al registro arqueológico. Se ha desarrollado un método para la cuantificación de estos cambios y su impacto arqueológico mediante el uso de cartografía histórica. Los resultados muestran que en algunas áreas hasta el 90 por ciento de los lagos fueron drenados o sustancialmente reducidos de nivel. El momento y

localización de dichas labores afectaron a la distribución del elemento arqueológico acuático de interior más relevante: los «crannogs». Ello ha determinado hasta hoy las líneas de investigación estratégicas y la interpretación arqueológica actual en Escocia. Este artículo sirve como modelo para entender cómo los cambios de uso históricos afectan a las fuentes arqueológicas.

Palabras clave: *crannogs*, Escocia, ambiente lacustre, cambio de uso del suelo, vivienda lacustre.

Introduction

This paper brings together two lines of evidence that demonstrate how inland water archaeology can be impacted by changes in land-use associated with the development of agricultural practices. The results reviewed here will show that beyond simply impacting the archaeological record objectively, land-use changes have shaped and guided the trajectory of research of inland water archaeology, in at least the example studied here, Scottish crannogs. The first line of evidence to be discussed is the results of a recent analysis conducted by the author that used historic cartographic resources to assess lake (loch) drainage through time. The second line of evidence that will be discussed is the history of research into Scotland's artificial island dwelling tradition – sites usually called crannogs. When viewed together it is apparent that antiquarian investigation of crannogs stemmed directly from programmes of drainage that occurred at different times across the country, and this corpus of antiquarian work has guided modern research strategies to such a degree that our current understanding of crannogs continues to reflect drainage patterns of the 18th and 19th centuries.

The analysis presented here demonstrates that spatial dimensions and patterns of change to the inland water archaeological record can be understood using historic and contemporary cartographic and written records. Furthermore, it is likely that in many cases around the world the inland water archaeological record, including that of lacustrine environments, has been impacted heavily by land-use changes of the past 300 years associated with the development of agricultural practices (see Cook/Williamson, 1999; Chapman/Van de Noort, 2001: 365). It has been well established in ecological literature that inland water environments are among the most sensitive to anthropogenic activity, in particular farming techniques (see Brinson/Malvárez, 2002; Strayer/ Dudgeon, 2010; O'Connell *et alii*, 2012). However, archaeological research has mostly sought to characterise the preservation conditions of known waterlogged and submerged material (e.g. Chapman/Cheetham, 2002), rather than understand historic landscape scale changes that shaped the archaeological record. This has led to research and management strategies of inland water archaeology which are geographically limited and often do not strive to account fully for the variable nature of surviving inland water archaeology. This is the pattern regarding Scottish crannogs, which have been identified as the most numerous and notable feature of Scotland's inland water archaeological resource (Henderson, 2004: 170-172). While it is now commonplace for underwater archaeology to discuss the paleogeography of submerged continental shelves, infrequently does inland water archaeology conduct paleogeographical research relating to a more recent and discernible phenomena that has served to form the archaeological record as well as guide archaeological inquiry.

Paleogeography of inland water: Cartographic analysis of the Roy Military Survey of Scotland

Scotland's rural landscape, including its inland water, is largely a product of 18th and 19th century agricultural practices. At the beginning of the 18th century, agricultural practices started to move from a system of unenclosed fields surrounding small hamlets or «fermtouns» to a system of en-

closed fields, crop rotations and new land tenancy agreements (see Caird, 1964; Whittington, 1975). Scotland is among only a few places in Europe where agricultural practices moved away from feudal farming and adopted the practices of a capitalist agrarian economy very quickly, which began in earnest following the defeat of the Jacobite Rebellion in 1746 (Davidson 2004: 418-421). The middle of the 18th century is often quoted as the beginning of this «Improvement» period as it is known in Scotland, and resulted in a near total reorganisation of the rural landscape. The practice most often associated with the Improvement period and its impact to the archaeological record is enclosing fields which has been extensively studied (e.g. Boyle, 2009). Alongside the move from unenclosed land to enclosed land, there was also a drive to drain land. This took many forms, from simply improving the drainage of perennially wet fields to the wholesale drainage of large inland bodies of water. The goal was to increase and improve arable and grazing land. Water management of this kind has been noted as an important aspect of British agricultural practice (e.g. Cook/Williamson, 1999), but mapping this history of drainage, and its impact on the archaeological record, has been little studied, and rarely on more than a local scale.

The Roy Map

In addition to improvements in agricultural practice, the 18th century also saw the rapid development of cartography and surveying, making maps more available. The development of agriculture and cartography went hand in hand, as estate maps in particular, were produced to aid the implementation of new enclosed fields and planting regimes. These estate maps are a rich resource in Scotland for historical and geographical inquiry, and several archaeological investigations have utilised them extensively (e.g. Boyle, 2009; Geddes, 2012). However, maps were also being produced at much larger scales.

One such example is the Roy Military Survey of Scotland (1747-1755) (Roy, 2007). The map was produced as tool for the British military following the 1745 Jacobite Rebellion in Scotland. A chain and sighted theodolite were used to survey major landscape features with the detail being sketched in or copied from existing maps, this was a simple technique, even by 18th century standards (Skelton, 1967: 8; Fleet/Kowal, 2007: 196). The Roy Map was unique in the 18th century for its complete coverage (all of mainland Scotland) at such a detailed scale. Known contemporarily as the «Great Map», it was produced at a one inch to 1000 yards (2.54 cm: 0.9144 km), and the original sheets, when laid out, measure nine by six metres (Fleet/Kowal, 2007: 194). The map is separated into two sections, a northern portion referred to as the «Highland» section and a southern portion referred to as the «Lowland» section. It has been used for various historical and geographical analyses, but its geometric inaccuracies and the inconsistent labelling of features has often troubled attempts to utilise the map (Whittington, 1986a; 1986b). However, a digitised version of the map has been georectified, and is now freely accessible online (<http://maps.nls.uk/roy/>) greatly improving the map's research potential (Fleet/Kowal, 2007).

The Method

The analysis of the Roy Military Survey of Scotland (1747-1755) very simply identified each loch depicted on the map. The localities of each loch were then identified on the First Edition of the 6 Inch County Series of the Ordnance Survey (1843-1888) and their character as of that edition of the Ordnance Survey was assessed as either «drained», «lowered», «no change» or «dammed» (see fig. 1). This historic edition of the Ordnance Survey is also available on the National Library of Scotland's website (<http://maps.nls.uk/os/>). On the same basis, these individual sites were again assessed, this time compared to a modern edition of the Ordnance Survey. The resultant data set captures an impression of the state of lacustrine environment in Scotland in roughly 120 year intervals (Stratigos, 2016).

Category	Description
Drained	where the loch was removed or lowered to a point where there is no open water
Lowered	where the surface area of the loch was reduced through effective drainage efforts
No Change	where the surface area of the loch has not changed
Dammed	where a dam has increased the surface area of the loch

Figure 1. Table defining categorisation of loch identified on the Roy Map.

Results

Lochs

The results of the above methodology suggest that Scotland saw lacustrine environments drained at variable intensities in different regions since the production of the Roy Map. 1796 lochs were identified on the Roy Map, of which 1745 were successfully located in real world coordinates (Fig. 3). It appears from this data that lochs were drained somewhat later in south-west Scotland compared to eastern Scotland (Fig. 3). In northern and western Scotland, there was relatively little loch drainage at any time (Fig. 3). Another trend in the data is that lowland lochs (those below 200 m OD) were drained at much higher levels than those above that threshold. It is clear that lochs within highly productive agricultural land were drained earlier and more frequently (Fig. 2). This is an expected result, as agricultural improvements were made where there was likely to be sufficient return on investment.

A less expected result of the analysis was the intensity of drainage in some areas. In some areas c. 90% of lochs have been drained or significantly lowered (see Moray (below 200 m OD in Fig. 2). This constitutes a near total loss of the lacustrine environment, and must surely also represent a similar level of impact on the archaeological record in these environments. It follows that the inland water archaeology that does survive in areas of such intense drainage represent very rare survivals. Despite many finds turning up during drainage programmes, most of this material, largely organic, has been lost owing to the lack of conservation methods at the time. Our resulting understanding of this archaeology is based on antiquarian accounts, historic records and rare survivals that can only be considered to have recorded a tiny fraction of the material affected by drainage. This pattern has been observed, although not rigorously tested, in the survival of logboats in Scotland collated by Robert Mowat (1996, 1998). With regard to crannogs, Scotland's most numerous and significant inland water archaeology feature, this pattern in survival has only been cursorily observed (see Morrison, 1985: 2), and never tested or examined.

Modern Council	Number of lochs on RMS	Drained		Lowered		No Change		Dammed	
		1st Edition OS	Modern OS	1st Edition OS	Modern OS	1st Edition OS	Modern OS	1st Edition OS	Modern OS
Aberdeenshire	48	27%	31%	15%	19%	58%	50%	0%	0%
Aberdeenshire (below 200m OD)	18	39%	44%	39%	44%	22%	11%	0%	0%
Angus	27	56%	48%	15%	22%	30%	22%	0%	7%

Modern Council	Number of lochs on RMS	Drained		Lowered		No Change		Dammed	
		1st Edition OS	Modern OS	1st Edition OS	Modern OS	1st Edition OS	Modern OS	1st Edition OS	Modern OS
Angus (below 200m OD)	19	68%	58%	16%	32%	16%	11%	0%	0%
Argyll and Bute	209	7%	9%	3%	4%	89%	80%	1%	6%
Argyll and Bute (below 200m OD)	118	11%	14%	5%	7%	82%	70%	2%	8%
Dumfries and Galloway	170	19%	27%	20%	33%	58%	36%	3%	4%
Dumfries and Galloway (below 200m OD)	149	22%	31%	23%	36%	52%	30%	3%	3%
East Dunbartonshire	11	18%	45%	18%	9%	64%	45%	0%	0%
East Dunbartonshire (below 200m OD)	11	18%	45%	18%	9%	64%	45%	0%	0%
Fife	25	60%	56%	12%	24%	28%	20%	0%	0%
Fife (below 200m OD)	23	56%	61%	9%	22%	26%	17%	0%	0%
Highland	930	7%	7%	3%	5%	89%	84%	1%	5%
Highland (below 200m OD)	633	7%	8%	3%	5%	88%	83%	1%	4%
Moray	46	57%	70%	13%	2%	28%	24%	2%	4%
Moray (below 200m OD)	35	74%	91%	17%	3%	6%	0%	3%	6%
Perth and Kinross	53	2%	2%	8%	11%	91%	74%	0%	13%
Perth and Kinross (below 200m OD)	18	6%	6%	11%	22%	83%	67%	0%	6%
South Ayrshire	48	4%	13%	25%	23%	71%	54%	0%	10%
South Ayrshire (below 200m OD)	24	8%	25%	33%	29%	58%	46%	0%	0%
South Lanarkshire	10	40%	60%	40%	30%	20%	10%	0%	0%
South Lanarkshire (below 200m OD)	0	Null	Null	Null	Null	Null	Null	Null	Null
Stirling	41	2%	15%	17%	20%	68%	51%	12%	15%
Stirling (below 200m OD)	30	0%	13%	23%	23%	63%	47%	13%	17%
The Scottish Borders	45	33%	40%	13%	9%	53%	44%	0%	7%
The Scottish Borders (below 200m OD)	18	56%	72%	22%	6%	22%	22%	0%	0%

Figure 2. Table displaying percentage of lochs from each modern council with more than 10 lochs identified on the Roy Map compared to the 1st Edition of the 6 Inch Ordnance Survey and modern Ordnance Survey.

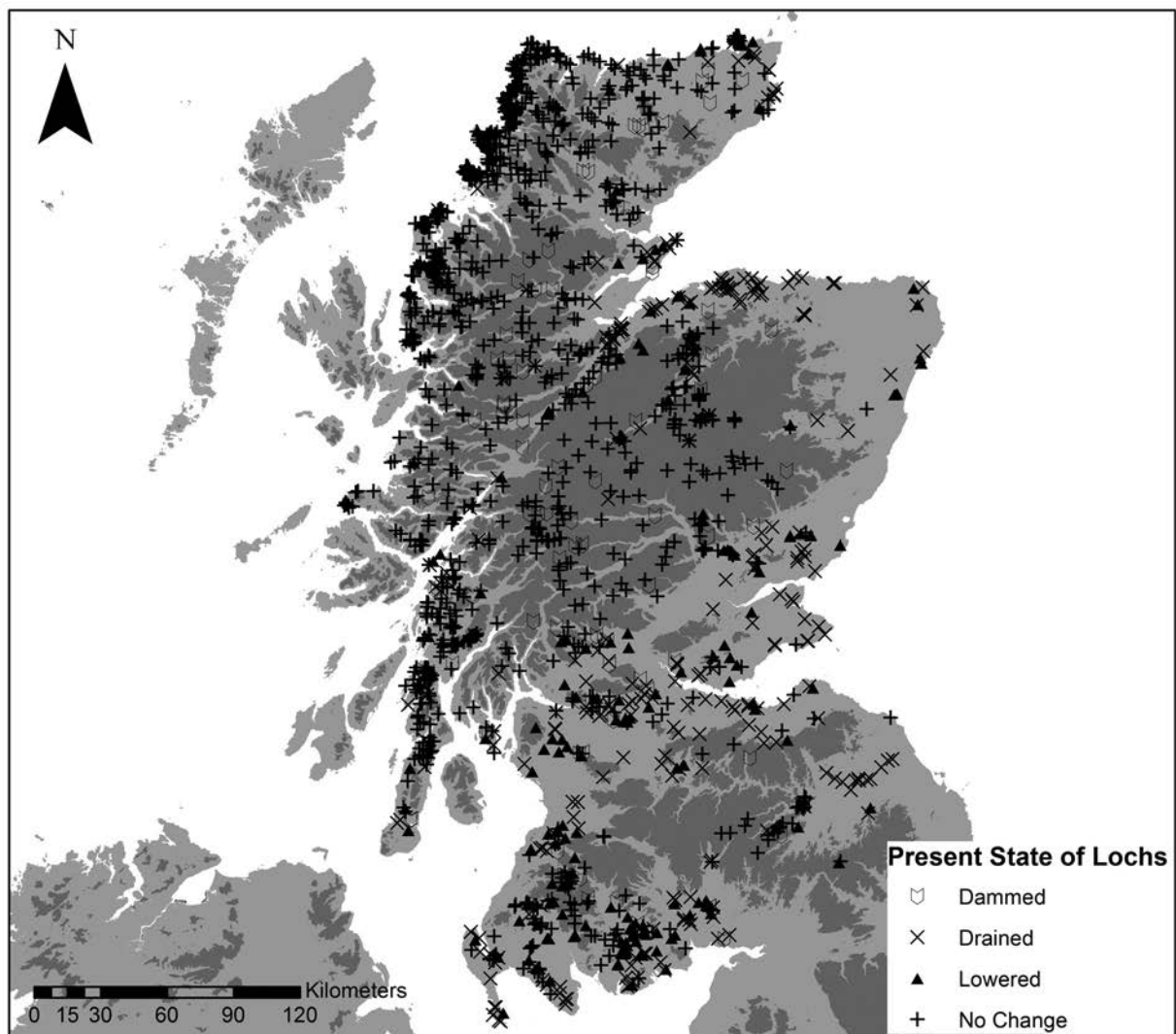


Figure 3. Map showing every loch identified on the Roy Map in real world coordinates, and the condition compared to modern Ordnance Survey.

Crannogs

Further analysis by the author has looked at the individual lochs identified as lowered or drained and examined those localities for recorded archaeology. In many instances, those localities were devoid of archaeological features, consistent with that area being formerly submerged. On the basis of this work, a total of 78 sites have been identified as possible crannogs and are not currently recorded as such in the National Monuments Record of Scotland. In 54 instances across all mainland Scotland these features had been recorded as a variety of site-types that bear resemblance to crannogs in drained contexts. 24 of the 54 sites that have been identified come from eastern Scotland, a region that has not been considered to have many crannogs. In addition to those 24 sites, a further 11 features have been identified as possible crannogs that are unrecorded and still submerged. Should all 35 sites be crannogs, this would represent a near threefold increase in the number of recorded crannogs in this region and would now total 50 different sites (Fig. 4). These figures should also be understood alongside the knowledge that most crannogs encountered during drainage programmes were probably removed without being recorded, particularly for lochs drained/lowered before c. 1850 (see Stratigos, 2016 for full discussion of the methodology and results).

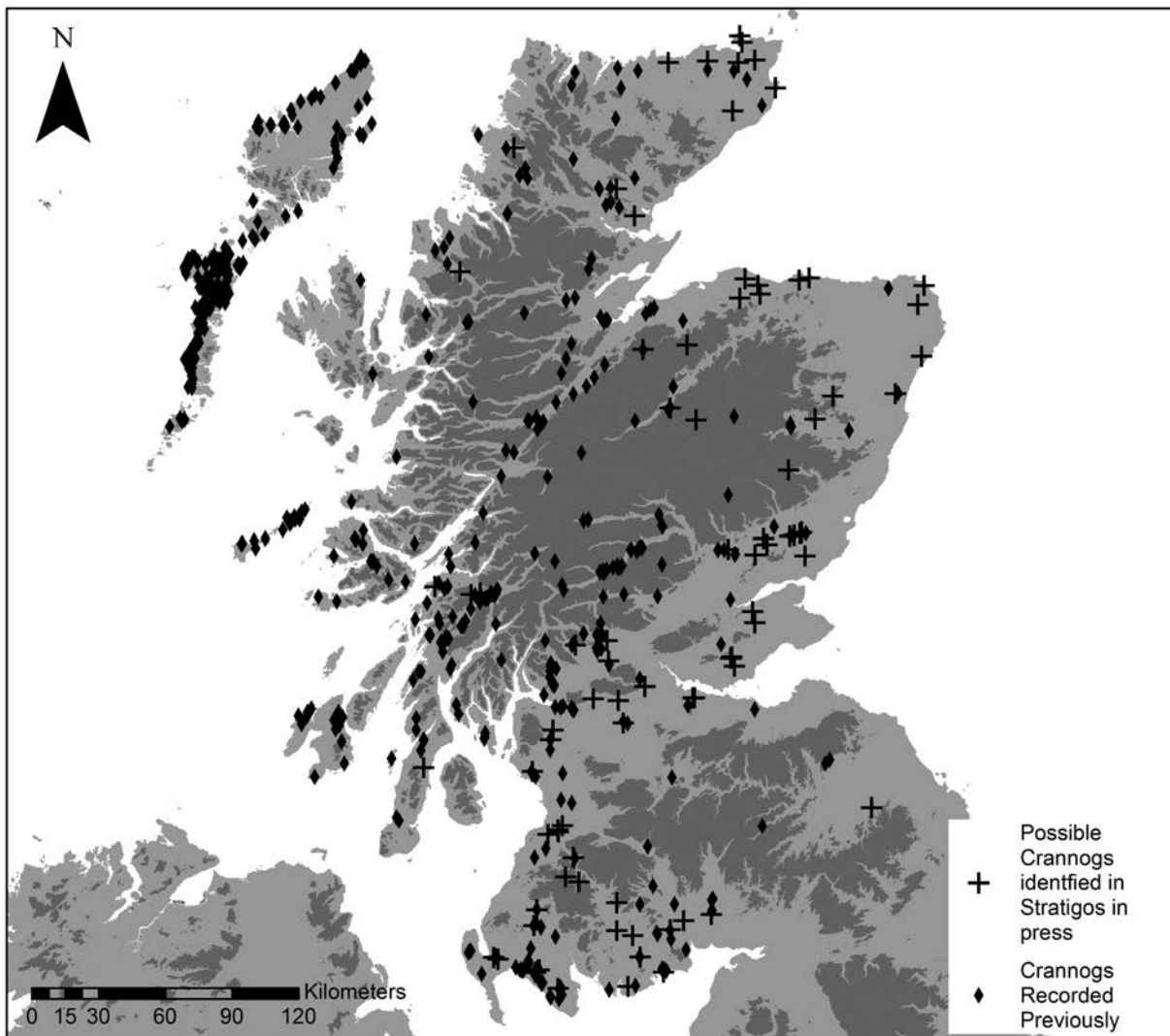


Figure 4. Map of currently recorded crannogs based on Lenfert 2012, and those identified in Stratigos in press.

The impact of this drainage on crannog sites was significant, not only in the loss of individual sites, but also in establishing a regional framework that assumed sites were most frequently found in western Scotland, the south-west in particular. The patterns apparent in the loch drainage statistics matches well with the history of crannog research which saw numerous crannog discoveries, including most excavations, during drainage programmes of the second half of the 19th century. At this time, most loch drainage had already occurred in eastern Scotland, while it was still ongoing in south-west Scotland. The timing of drainage is crucial as before c. 1850 there was not an awareness of crannogs as a subject of archaeological inquiry (see below). Prior to this point, it must be assumed that most crannogs encountered during drainage operations were simply removed as an obstacle to improving newly reclaimed land, or indeed targeted as a source of raw material (stone, timber, organic material, etc.). The examples which survived are probably a small portion of the total encountered during drainage operations pre-1850. After c. 1850, awareness of crannogs as a source of archaeological knowledge was heightened, and drainage facilitated investigation by making sites accessible. But at this time the majority of drainage programmes were taking place in south-west Scotland (Fig. 2).

Scottish Crannogs: a brief history of research

This section will highlight the connection between the history of crannog research and the history of loch drainage that the data presented above demonstrates. It will be apparent that drainage made crannogs accessible and was in part responsible for making them a subject of archaeological inquiry. As modern investigations of crannogs began in the 1980s, archaeologists returned to areas that were established as regions of known crannogs. Subsequent work has repeatedly examined these areas at the expense of other regions. This geographically focused body of research has left our understanding of sites outside of these regions poor, and also made wider interpretations of crannogs difficult to accept since the evidence does not necessarily represent the whole. This is an example of the danger inherent in inland water archaeology if changes to the lacustrine environment are not sufficiently accounted for when examining broader spatial patterns that form interpretations and research strategies.

Antiquarian Investigations

Crannogs have been known as artificial islands in Scotland since the late 18th century (Gordon, 1794: 624-625), but sustained antiquarian interest began in the second half of the 19th century. The discovery and investigation of crannogs in Ireland (e.g. Wilde, 1857) and lake-dwellings in continental Europe (e.g. Keller, 1866) spurred interest in Scottish crannogs (see Midgley/Sanders, 2012). These antiquarian investigations of crannogs necessarily followed programmes of drainage that were part of a broader suite of agricultural and land-use changes occurring at that time. Critically, at the time crannogs became a target of antiquarian interest, drainage was taking place mostly in south-west Scotland (Fig. 2), and it was through drainage that the quantity and extent of these sites became known. The drainage programme in 1865 at Dowalton Loch, Dumfries and Galloway, south-west Scotland is particularly notable as it resulted in the identification of seven crannogs from within this single loch. A number of these were investigated by the local landowner and antiquarians (Stuart, 1866), and the discoveries at Dowalton Loch served to draw further antiquarian interest to the region, including the investigations of Robert Munro.

Munro was the first to systematically and scientifically investigate crannogs, and his work was ahead of its time in its rigorous execution and recording (Munro, 1882; Midgley/Sanders, 2012: 30-31). He partially excavated no less than five crannogs (Fig. 5), which were the best recorded examples at that time, and subsequently became the best well known. They are referred to often in his seminal works on the subject of lake-dwellings – *Ancient Scottish lake-dwellings or crannogs* (1882) and *The Lake-dwellings of Europe* (1890). His early interpretations still influence crannog research today (Dixon, 2004: 60), in particular, his suggestion that crannogs were a phenomenon centred in south-west Scotland (Munro, 1882: 248).

Figure 5 shows every crannog in Scotland that was excavated prior to 1950. There are three notable exceptions to the focus of crannog research on western Scotland, and the south-west in particular. They are notable for the relatively early date they were excavated and their location in north-eastern Scotland (Fig. 5). The earliest recorded excavation of a crannog in Scotland comes from the Loch of Leys near Banchory, Aberdeenshire which was excavated following a programme of drainage in 1850 (Burnett, 1851). The other two excavations of crannogs in eastern Scotland in the 1860s also followed programmes of drainage at the Loch of the Clans, Narinshire (Grigor, 1863) and at Forfar Loch, Forfarshire (Stuart, 1872). These examples of excavations are exceptions that prove the rule that drainage served to record crannogs and spur investigations. The reason the three exceptions did not spur re-

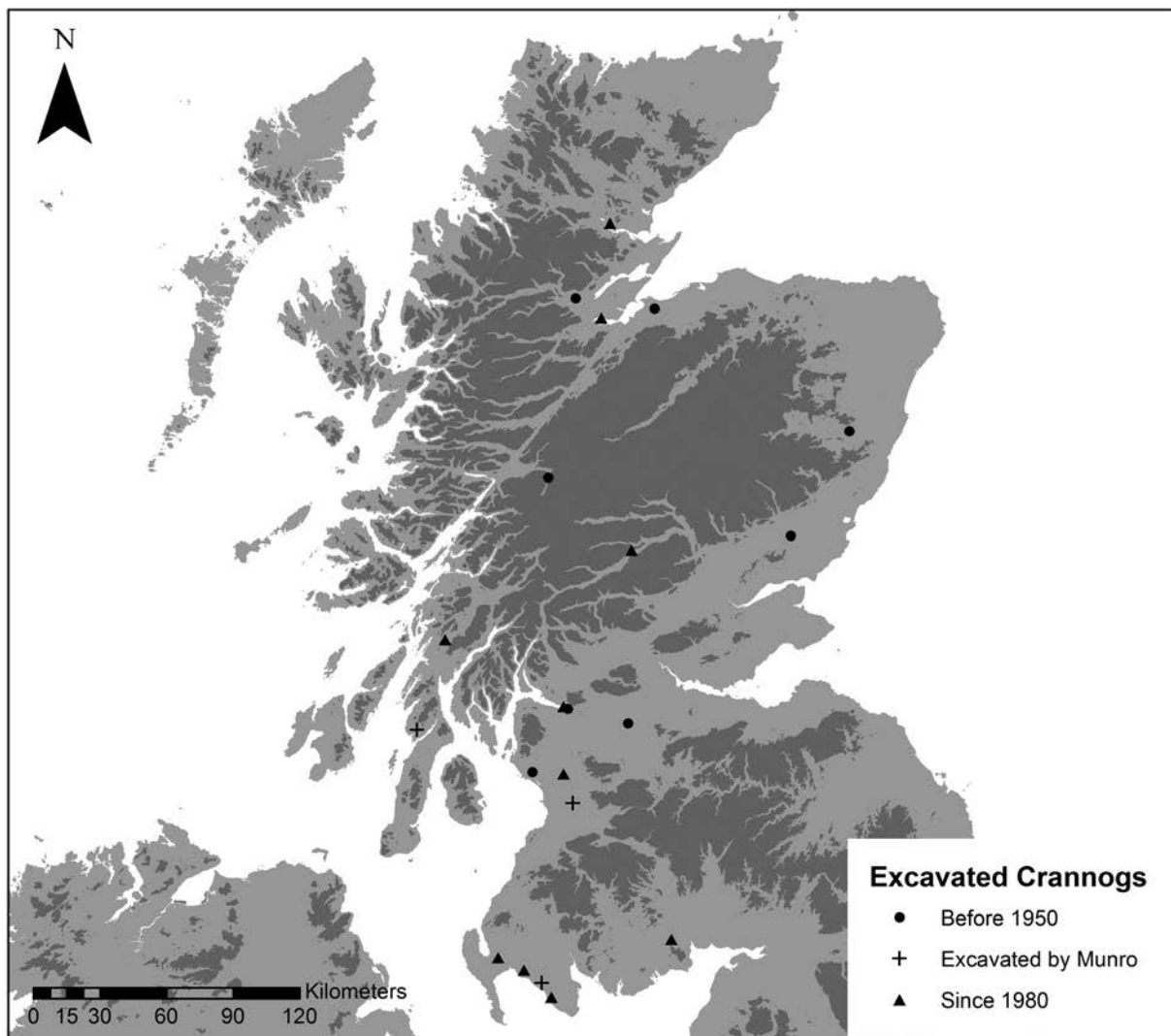


Figure 5. Map of crannogs excavated before 1950, those excavated by Robert Munro, and crannogs excavated after 1980. Note the distribution is skewed to the south-west of the country.

search on in north-east Scotland is attributable to patterns of drainage. Unlike in south-west Scotland, these three lochs were rare surviving lochs in north-east Scotland in the second half of the 19th century, most others had been drained in the previous 100 years (Fig. 2). Couple the pattern of drainage with the legacy of Robert Munro and it becomes apparent that south-west Scotland became the focus for crannog research due to the pattern of historic land-use change not as result of the actual past distribution of crannogs in Scotland. Crannogs did not see sustained modern research again until the 1980s, and by this time almost all attention was paid to regions with a better known crannog resource in western Scotland, the south-west in particular.

Modern Research

Modern programmes of research have sought out regions with a known crannog resource, the region with the most notable resource being south-west Scotland. Since 1980, ten crannogs have been partially excavated, seven of which are in south-west Scotland (although one of these has

been interpreted as a loch-side village rather than a crannog, see below) (Fig. 5). Many of the excavations have been associated with the recent South-West Crannog Survey, which was conducted under the umbrella of the Scottish Wetland Archaeology Programme (see Henderson, 2004; Henderson/Cavers/Crone, 2006). A majority of radiocarbon dates from crannogs are also from sites in the south-west, though the trend with radiocarbon dates is less concentrated on the south-west owing to programmes of survey in Perthshire and Loch Tay in particular (Dixon, 1982; 2007; Dixon/Shelley, 2006). This quantity of research is in contrast to eastern Scotland where no modern investigation of crannogs has taken place other than the author's own preliminary investigation at Loch Kinord, Aberdeenshire (Stratigos/Noble, 2014: fig. 6). This is despite recognition that at least some crannogs do survive in these regions (Burnett, 1851; Grigor, 1863; Stuart, 1872; Hale, 2007; Stratigos/Noble, 2014). Very recently investigations of what was presumed to be a crannog in Dumfries and Galloway were carried out, although the excavators have interpreted the site as a loch-side village rather than a true crannog (Cavers/Crone, 2013). This is an important development for our understanding of lacustrine settlement in Scotland, but again it has come from within south-west Scotland, and its implications outside of that region remain unclear.

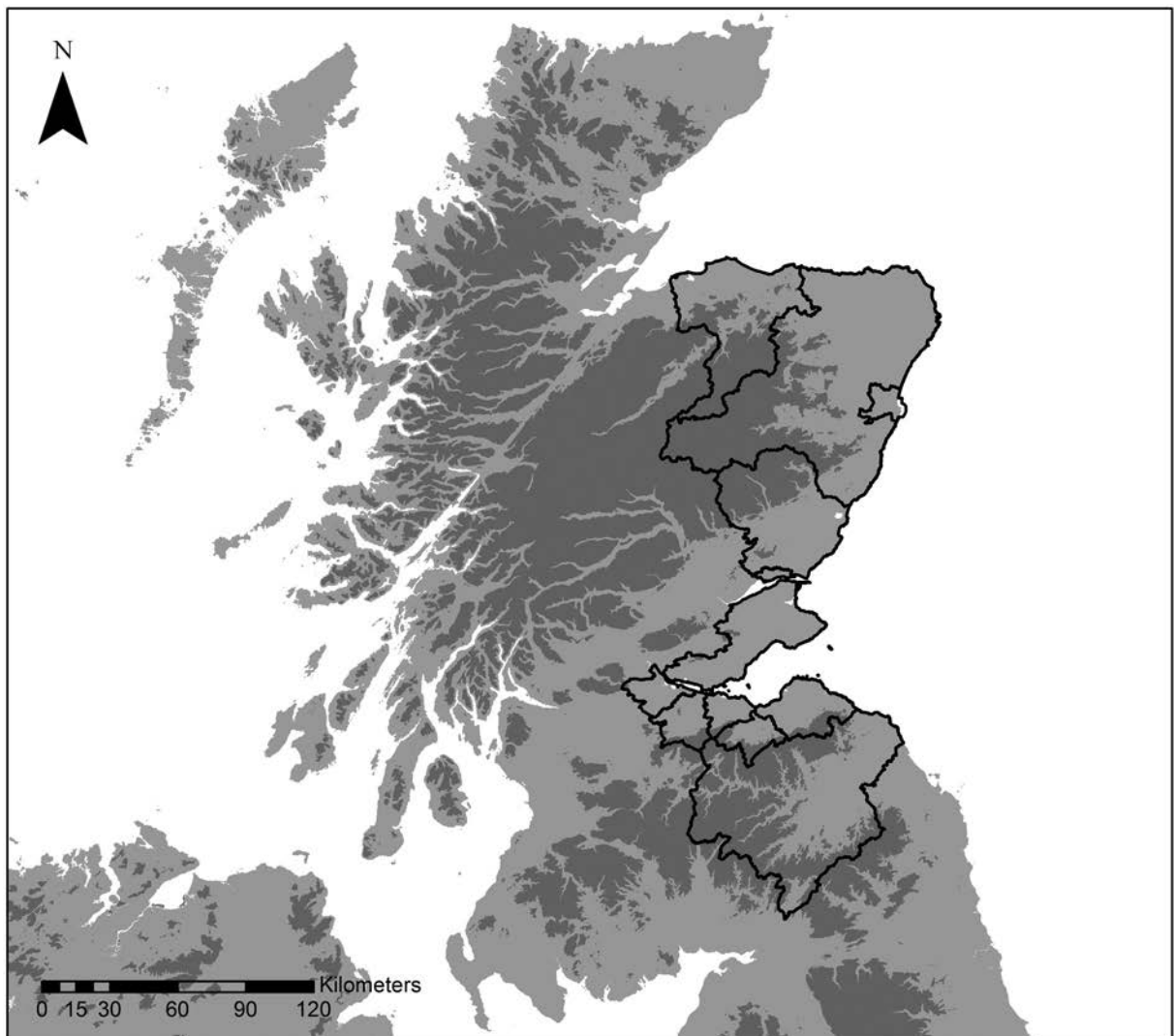


Figure 6. Map showing modern councils (outlined) where no modern investigation of crannogs has taken place (excepting initial programme of research by the author).

The result of these research strategies has been that most of the primary data from crannogs remains almost exclusively from sites in south-west Scotland. While this research has been incredibly valuable and advanced our knowledge about loch dwellings in Scotland, our overall understanding of the site-type remains geographically biased. If appropriately recognised, this would not in itself be problematic, but the geographically focused bulk of data leaves wider interpretations difficult to develop. An example of that difficulty has been the recent arguments regarding the distribution of sites in the country put forward on the basis of recorded crannog sites (Henderson, 2009: 39-42; Cavers, 2010: 26-36), which have suggested that based on their distribution, crannogs can be seen as a «characteristically western trait» (Henderson, 2009: 40). Such interpretations have not sufficiently accounted for the «lost» resource, and as the results reviewed above have demonstrated, the modern distribution of sites is skewed to the west. The greatest density of surviving sites is now in western areas of Scotland, and future research and management will have to account for this, but there is a danger that crannogs as a site-type become primarily a characteristic of western or Atlantic settlement forms to the ignorance of other regions. It is likely that other inland water archaeologies have been impacted on a similar basis, whereby historic changes in land-use have created an artefact in archaeological assessment which has not been taken into account.

Discussion of Impacts to the inland water archaeological resource

Land-use changes associated with the development of agricultural practices have impacted the inland water archaeological resource to a great extent, perhaps more than any other external factor. This work has demonstrated a connection between relatively recent land-use changes (loch drainage) and trajectories of research on inland water archaeology (crannogs). The impact of historic land-use change is not frequently highlighted as a primary factor in shaping the archaeological record of inland waters, and research of land-use changes and their impacts are usually limited to modern management strategies and programmes of monitoring (e.g. Matthiesen/Salomonsen/Sørensen, 2004; Lillie/Smith, 2007; Matthiesen, 2015). This paper has shown that past changes to the landscape have not only objectively impacted the archaeological record, but shaped research trajectories that have informed modern interpretations. There is a danger here that wider spatial patterns regarding inland water archaeologies will continue to be poorly understood, and interpretations grounded in such an understanding will remain problematic. Exceptional preservation conditions most inland waters provide compounds the problem, as where material is discovered, it is often found in large quantities. In many instances this draws in research focusing on the preservation conditions themselves and basic description of the archaeological material at the expense of larger scale analyses or interpretations (Van de Noort/O'Sullivan, 2006: 143-144). Further paleogeographical research aimed at quantifying losses to inland water environments, that includes close scrutiny of the archaeological record in these environments, can begin to address this imbalance.

Like crannogs, although less numerous, logboats are a characteristic feature of Scotland's inland water archaeology, and represent a potential case study that would shed further light on patterns of land-use change and how they have shaped the archaeological record. Logboats are perhaps more representative of the ephemeral inland water archaeological resource that is more susceptible to decomposition through desiccation, and as such, it is more difficult to quantify losses in the same way as described above regarding crannogs. However, it has been noted previously that drainage operations served to record logboats in particular regions while causing their destruction and loss in others (Mowat, 1998: 32). Mowat identifies a particular concentration of logboat finds around the Clyde estuary, while also noting a dearth of logboat finds in north-east Scotland (*ibid.*). This is a similar pattern to that identified regarding crannogs above. Com-

binning patterns of logboat discoveries, and other inland water archaeology, with the loch drainage and crannog identification work presented here will continue to develop our understanding of how historic land-use changes have shaped the archaeological record of inland waters in Scotland. Furthermore, as with crannogs, surviving examples of logboats discovered in areas where drainage occurred earlier and more intensely should not be seen as outliers, but rather as rare surviving examples speaking to a wider tradition. Care should be taken, however, to avoid suggesting that any examples are representative of that wider tradition, and the limitations of the surviving archaeological record must be acknowledged.

The methodology described here can be extended beyond Scotland as a way of understanding why the inland water archaeology resource appears where it does and what factors have influenced that pattern. This is similar in many ways to what has been achieved with submerged landscapes (e.g. Sturt/Garrow/Bradley, 2013; Clark/Mitrovica/Alder, 2014). The work presented here demonstrates the value in understanding much more recent impacts on the archaeological resource in Scotland, but Scotland is unlikely to be unique in this regard. There are other countries and localities where similar drainage histories to Scotland may have greatly shaped the archaeological record and histories of research examining those inland waters. Scotland is somewhat unique in that the Roy Map is an exceptionally early example of a map produced at such a small scale that also had broad coverage, however, potential areas for further examination in Europe include; north-east Poland's lake district and its lake-dwellings (see Pydyn, 2007) and Scania, Sweden, renowned for its wetland archaeology (see Larsson, 2007). Areas of North and South America, Australia and New Zealand also present potential opportunities, especially since the use of agricultural practices that including widespread drainage, is very tightly defined chronologically to the arrival of European colonists.

Conclusion

This paper has highlighted the benefits of a close examination of historic agricultural practices that have impacted inland water archaeology perhaps more than any other. Drainage of various wetlands, including lacustrine environments, has occurred across the world, and has impacted the spatial patterns and characteristics of the archaeological record of these environments. In at least the case of Scottish crannogs, the history of drainage associated with land-use changes has guided the history of research, and this has rendered modern research strategies and interpretations problematic as a result. It is unlikely that this phenomenon is unique to Scotland or crannogs. The methodology described here could be applied using appropriate cartographic and historic resources in other countries as well as examining other elements of Scotland's inland water archaeological resource.

Inland water archaeology is a rich resource of material, the quality of which is rarely, if ever, encountered on terrestrial sites, and this can only be emphasised in the case of lacustrine settlement archaeology. However, despite the wealth of information that can be gleaned from inland waters, there remains a pitfall if the most significant processes that formed the inland water archaeological record (i.e. historic drainage) are not carefully examined, and where possible quantified and analysed. Robert Van de Noort and Aidan O'Sullivan warned that preservation conditions in inland waters can focus archaeological inquiry on simply describing the resource at the expense of wider interpretation and understanding (2006: 143-144). Additionally, inland water archaeology needs to also understand the land-use changes that have in many cases completely shaped what we find in the archaeological record today. Where this has caused desiccation, there can be near total loss to the material that makes inland water archaeology unique. This lost resource cannot, however, simply be overlooked, and methods and analyses need to account for what has been lost.

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Two artificial anchorages off the Dead Sea north shore: a ground aid to navigation on an inland lake

Dos fondeaderos artificiales de la costa norte del mar Muerto: una ayuda terrestre para la navegación en un lago interior

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Abstract: Lake level fluctuations, loose silt bottom, lack of natural anchorages, and on-shore prevailing winds, endangered navigation on the Dead Sea and prevented the long-term planning, construction and maintenance of shore-based harbour installations. A recently discovered artificial stone mound off the northern shore of the Dead Sea is a maritime-related archaeological find exposed by the drying out of the lake. The construction of this site and another site nearby inside the lake away from its historic shore was intended to create an open-water mooring designed to overcome some of the for cited challenges. In turn they allowed the use of this economically and strategically important part of the lake by maritime traffic.

Key words: Dead Sea, navigation, anchoring/anchorage, mooring, inland lakes.

Resumen: las fluctuaciones del nivel del lago, un fondo de limos sueltos, la falta de fondeaderos naturales y los vientos predominantes en tierra, amenazaron la navegación en el mar Muerto y evitaron la planificación a largo plazo, la construcción y el mantenimiento de instalaciones portuarias en la costa. Recientemente, en la costa norte del mar Muerto, fue descubierto un montículo de piedra artificial, un hallazgo arqueológico marítimo que salió a la luz durante la desecación del lago. La construcción de este sitio y otro yacimiento cercano, en el interior del lago y a mucha distancia de su orilla histórica, tenía la intención de crear un amarre en aguas abiertas diseñado para superar algunos de los citados desafíos. A su vez, permitió la utilización de esta importante parte del lago, económica y estratégicamente, por el tráfico marítimo.

Palabras clave: mar Muerto, navegación, fondeo/fondeadero, amarre, lagos interiores.

Introduction

The Dead Sea is a hyper-saline inland desert lake located at the lowest terrestrial place on Earth (Fig. 1-A, B). Until recently knowledge of the Dead Sea's ancient maritime history relied on indirect evidence, including iconography, written accounts, and land archaeology of shoreline sites. While these sources highlighted the importance of the Dead Sea in the region's daily life, they provided little information on the technical nature of maritime activity on the lake.

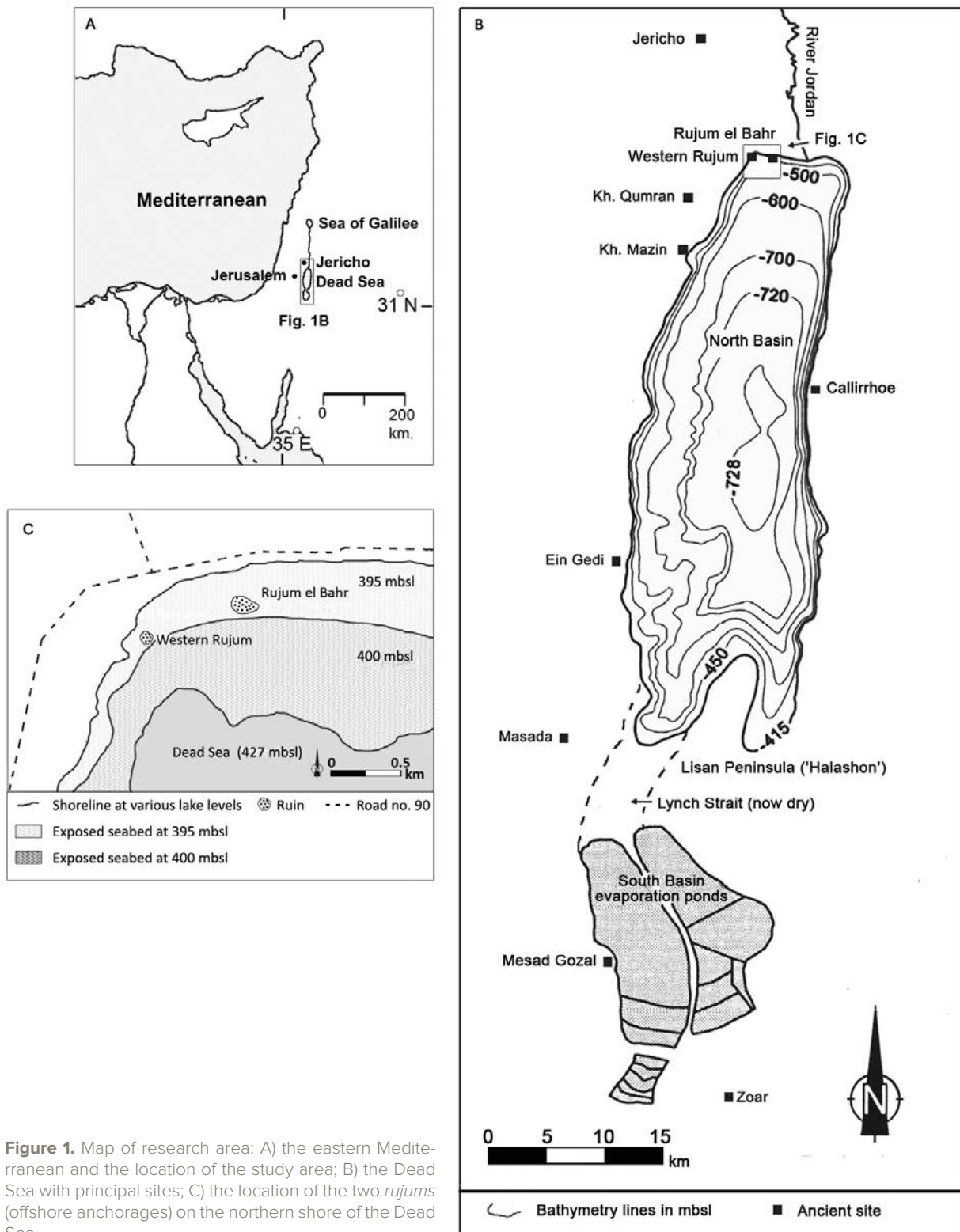
The drying out of the Dead Sea from the 1960's onward (Bookman *et alii*, 2004) and the consequent exposure of large areas of its former Lakebed is gradually adding to our knowledge by bringing to light new finds directly related to navigation on the lake.

The discovery, by the Dead Sea Coastal Survey team (DSCS), of an artificial stone mound exposed by the drop in the lake water level off its northern shore is an important addition to the corpus of maritime-related finds from the Dead Sea littoral. Its interpretation as a structure associated with maritime activity links it to Rujum el Bahr (Arabic for 'stone mound of the sea'), a massive artificial stone structure located nearby offshore (Fig. 1-C). The latter site has been known for a long time, and its possible use, as mooring or anchoring site, was previously recognised (Schneller, 1963; Schult, 1966: 139-144; Bar-Adon, 1989a: 3-14; Hirschfeld, 2006: 221-222; Hadas, 2008: 32-33; 2011: 163-166). However the reasons behind its initial design and its positioning offshore at this area of the lake were not fully explored.

The following study examines these two structures within the maritime context of the Dead Sea geophysical and climatic determinants and their affects on the seaborne traffic on the lake.

The geographical setting of the Dead Sea

The Dead Sea occupies the deepest part of the Jordan Rift Valley (Horowitz, 2001). Its water level currently stands at 427.82 m below mean sea level (mbsl) (Israel Water Authority, 2014). The River Jordan and its tributaries provide the main inflow to the lake. The river discharges into the lake at the northern shore, where it forms a shallow delta fan of limited navigability (Shatner, 1999). The lake has no outlets or links to other bodies of water. It is divided into two sub-basins by a sill at an elevation of 402 mbsl and the Lashon peninsula (Arabic: *El Lisan*) (Neev/Emery, 1967; Niemi *et alii*, 1997). The northern basin is about 300 m deep, and the shallow southern basin is only a few metres deep (it is now covered by artificial evaporation pans). The eastern



and western shores of the lake are bound by the rift valley escarpments, which tower to heights of about 1000 and 500 m respectively. The northern and southern shores are flat and open (Hall, 1997). They merge gradually with the adjacent rift valley floor, and are characterized by their straight exposed shorelines and loose fine-grained sediments (Shatner, 1999).

Lake level fluctuations - an overview

The Dead Sea is located at the terminus of one of the largest drainage basins in the Levant (43 000 km²). Variations in the precipitation and evaporation rates over this vast area, resulting from global and regional climate changes, are reflected in the lake's water level changes (Dayan/Morin, 2006; Greenbaum *et alii*, 2006). High-resolution instrumental lake level measurements from the 19th and 20th centuries show an annual fluctuation range of about 1 m, and more than 10 m over a longer time scale (Klein, 1982: 77-78; 1986; Bookman *et alii*, 2006: 166-168, fig. 5a, 5b). Studies based on sedimentary sequences, geomorphic evidence, historical records, and a few shoreline archaeological sites, coupled with radiocarbon dating, indicate that these fluctuations have also existed on a millennial scale throughout the lake's history (Klein, 1986; Frumkin, 1997; Frumkin *et alii*, 1991; Frumkin/ Elitzur, 2002; Bookman *et alii*, 2004; 2006) (Fig. 2).

Historical and archaeological sources for maritime activity on the Dead Sea

Textual and iconographic evidence (Diodorus, 19.99.1-3, 100.1-4; Wars 4.8.2-4; *Geography* 16.2.42-43; Avi-Yonah, 1954: 38-40, Pls. 2, 3; Rosen, 1986; Friedman, 1999: 104-111; 2011) augmented by archaeological investigations of shoreline sites and anchorages (Hadas, 1993b; 2008;

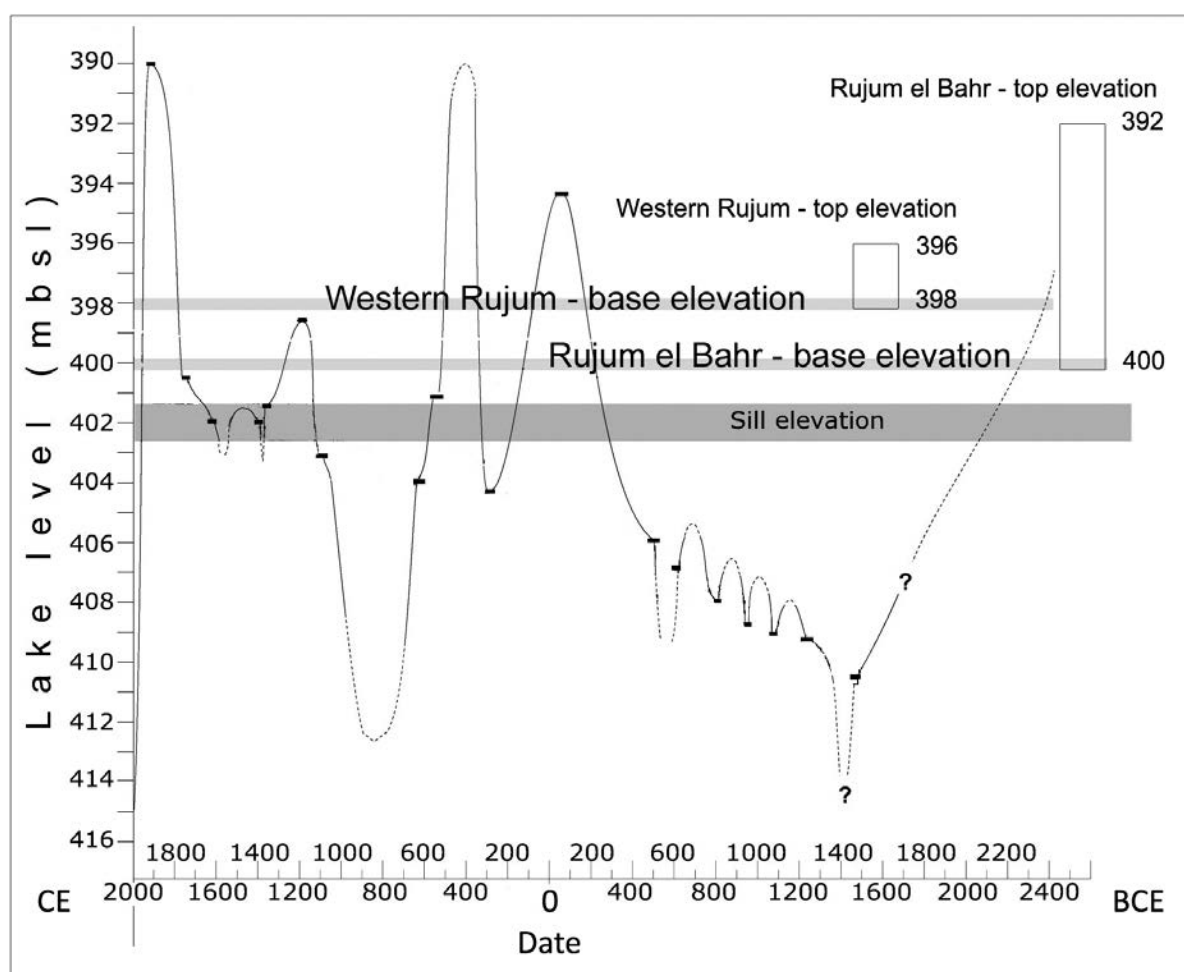


Figure 2. Dead Sea water levels from 1800 BC until the present. The mound height range indicates the water level below which the sites stood on dry land, and above which they were fully submerged (After Bookman *et al.* 2004: fig. 8, A).

2011; Hirschfeld, 2004: 214-215; Hadas/Oron, 2013) attest to the central role of the Dead Sea in the region's daily life, not only as a source of valuable minerals, but also as a passage for commerce, transport, and military action.

The overuse since the 1960's of the River Jordan and its tributaries, the lake's principal water source, led to a drop of 28 m in the water level, i.e. from 399 mbsl to 427.82 mbsl in 2014 (Klein, 1982; Bookman, *et alii*, 2006: 167-168). Vast portions of the lakebed have thus been exposed and with it a diverse array of cultural heritage material.

A systematic ongoing survey of these areas in the framework of the DSCS has revealed numerous new finds directly linked to ancient and historic maritime activity on the lake (Oron/Hadas, in press-a; in press-b). These include metal and ceramic cargo remains, anchorages, and anchors of several types spanning over two and a half millennia (Hadas, 1992; 1993a; Hadas *et alii*, 2005; Hirschfeld/Ariel, 2005; Oron *et alii*, 2008). The analysis of this survey material, much of which has been preserved in pristine condition by the highly saline water, sheds new light on the nature of maritime activity on the lake.

The drying of the lake continues today at an average rate of more than 1 m annually. It is causing a serious loss of cultural heritage remains through accelerated erosion processes, the formation of sink holes, and by exposing well-preserved marine objects to deterioration through rapid drying and human intervention.

Interactions between the physical conditions and maritime activity

Maritime activity on the Dead Sea was greatly influenced by the lake's unusual geophysical characteristics, in particular its fluctuating water level. The rise and fall of the water level resulted in a shifting shoreline and the ensuing changes in the coastal environment. The drying out of the Lynch Strait at low level stands cut off maritime traffic between the northern and southern basins, forcing the use of terrestrial transportation instead. Long-term and seasonal level fluctuations also changed the relative position of offshore navigational hazards, endangering maritime activity on the lake. Most importantly, level changes interfered with the planning, construction, and maintenance of permanent harbour installations.

The dramatic impact of water level fluctuations on maritime activity on the lake is recorded by 20th century accounts of the Palestine Potash Company fleet on the lake (Kopolevitz/Venski, 1944: 229; Erel, 2009: 29; Tal-Krispin, 2010: 212-213).

Maritime activity along the northern shore

The northern shore of the Dead Sea occupies an important place within the Dead Sea basin. Its close proximity to the region's key roads – linking it to the Mediterranean, Trans-Jordan, the fertile territories to the north (Roll, 1999; Hirschfeld, 2006: 217), and large ancient urban sites (Jericho, Jerusalem), made it an ideal transit zone to and from the lake. Its use as such was assisted by its topographic setting: unlike other parts of the lake which were mostly cliff-bound, the open landscape along this part of the lake facilitated an easy land-sea approach.

Archaeological and historical evidence attest to the use of that shore by maritime traffic from as early as the Hellenistic period (Hirschfeld, 2006: 221-226; Hadas, 2008; 2011) to the mid-20th century («Old Capitan», 1913: 392; Tamari, 2009: 25; Tal-Krispin, 2010: 211-212).

However, maritime activity along this part of the lake met with inherent difficulties. The topographic merits of the northern shore, namely its flat open landscape and ease of land access, translated into an exposed low-lying coast and shallow water. These resulted in hazardous sailing conditions and difficult navigation. The harsh maritime reality is reflected in several historic sources that describe sailing activity off this shore (Lynch, 1849: 268-270; Brokhes, 1913: 391; Erel, 2009: 28). An added risk in this area derived from the fine-grained estuarine lakebed, which offered insecure anchor hold during the prevailing moderate on-shore southerly winds. Scores of modern iron anchors and a few wrecks scattered along the northern shore (Oron/Hadas, in press-a; in press-b) testify to the magnitude of these risks in historic times.

In summary, onshore winds, the straight shoreline, fluctuating water levels and loose silt bottom, endangered watercraft activity along the lake north shore.

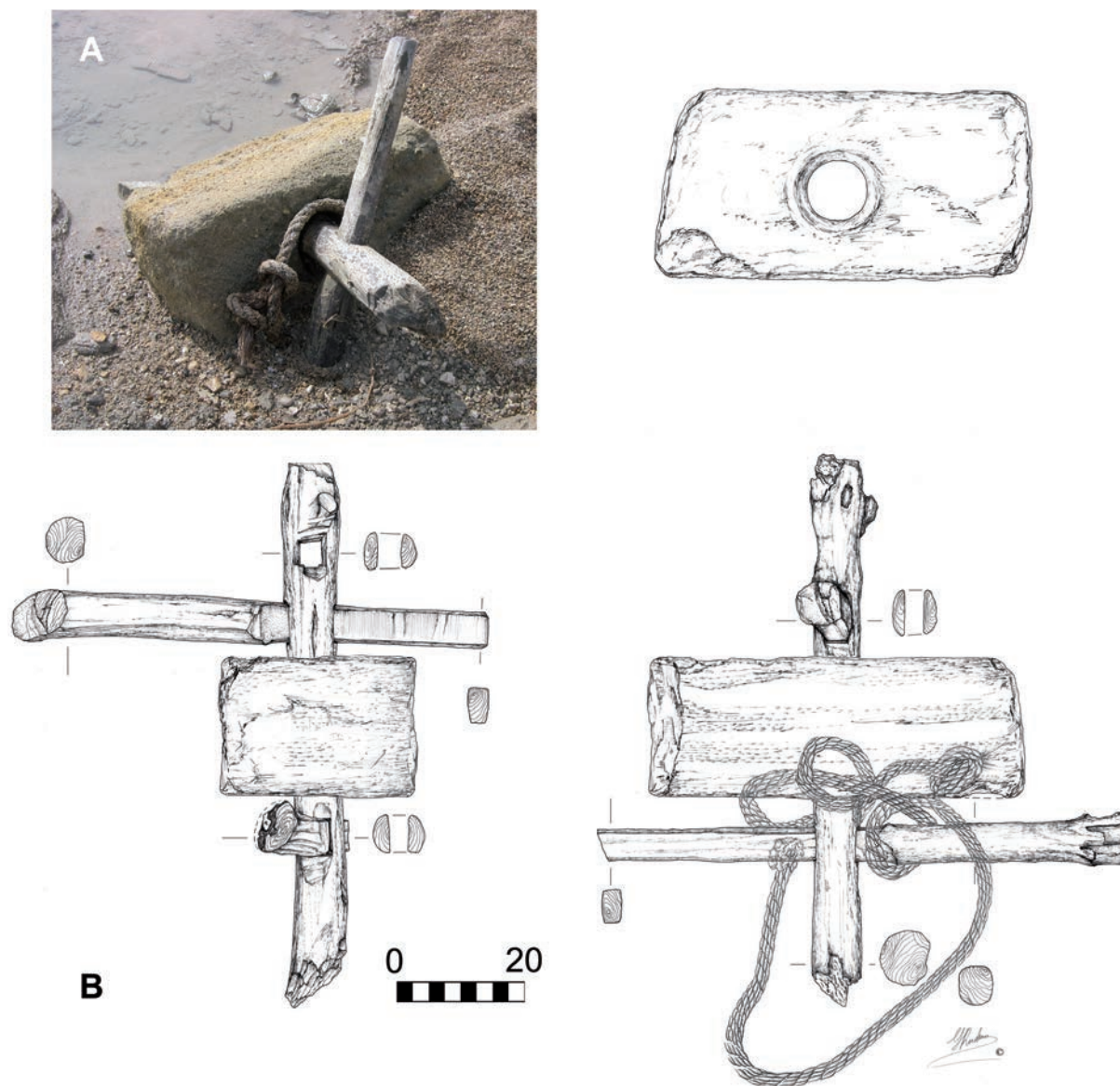


Figure 3. Dead Sea composite anchor type (Khirbet Mazin #A) dated to the 10th-11th century CE: A) Photograph of anchor *in situ* (Asaf Oron); B) Scale drawing of the anchor. (Yulia Rudman).

The unusual maritime environment of the Dead Sea influenced various aspects of human/maritime activity on the lake and its shores (Oron *et alii*, 2015). Altogether they contributed to the emergence of a maritime cultural landscape with unique local characteristics. On a small scale these are seen in the evolution of portable naval gear of local design, e.g. the unique Dead Sea composite anchor type (Oron *et alii*, 2008) (Fig. 3). On a larger scale it is proposed here that the challenges created by the Dead Sea maritime characteristics also motivated the construction of the artificial offshore anchorages discussed below.

Anchorage on the northern shore

Archaeological and historical records suggest that maritime activity off the Dead Sea's northern shore centred around three locations; a natural anchorage at the River Jordan inlet, the artificial offshore structure at Rujum el Bahr, and the recently discovered artificial offshore structure designated the Western Rujum.

River Jordan inlet

A wealth of 19th and early 20th century photographs indicates the use of the Jordan estuary as a natural anchorage at the northern shore (Hadas, 2011: 163). The shallow river channel provided a supply of fresh water, and allowed watercraft access to and from the hinterland several kilometres inland.

Rujum el Bahr

An island termed Rujum el Bahr is mentioned in this area by travellers and pilgrims from the mid-17th century onwards. It is described as a tiny island or a peninsula (Klein 1986: 17). The site was mentioned briefly by Lynch, who sailed past it in 1848 and marked it on his map as a peninsula (Lynch, 1849: 268, 270). In 1873-4 it was examined by the Survey of Western Palestine, and was said to be «...probably an artificial pier constructed at some period when boats were used on the lake» (Conder/Kitchener, 1883: 220-221).

Frequent changes in the lake water level lasting few decades at a time resulted in alternating submergence and exposure of the site (Klein, 1986: 17-20). Depending on the lake level, it alternated from being fully submerged (at water levels above 392.77 mbsl), to an island (at water levels between 392.77 mbsl and 399 mbsl), to a peninsula linked to the mainland by a low-lying isthmus (at water levels between 399 mbsl and 400 mbsl). When the lake level dropped below 400 mbsl, the site was exposed on the dry mud flat. Today it lies on land 950 m north of the present shoreline.

The complete exposure of Rujum el Bahr in the 1960's brought with it a renewed scholarly attention (Schneller, 1963; Schult, 1966: 139-144; Klein, 1982; 1986: 17-20).

Excavations and surveys at the site (Bar-Adon, 1989a: 3-14; Hirschfeld, 2006: 221-222; Hadas, 2011: 163-166) identified Iron Age II pottery (8th-7th centuries BCE), a major Hellenistic construction phase, and an early Roman presence (2nd-1st centuries BCE) (Bar-Adon, 1989a: 4; Hirschfeld, 2006: 222).

The site is a large artificial stone mound, measuring about 200 × 150 m, now onshore (Fig. 4). It is situated in an area of fine-grained estuarine sediment, and therefore cannot be a natural feature. The mound is constructed of limestone boulders measuring about 40 × 60 × 25

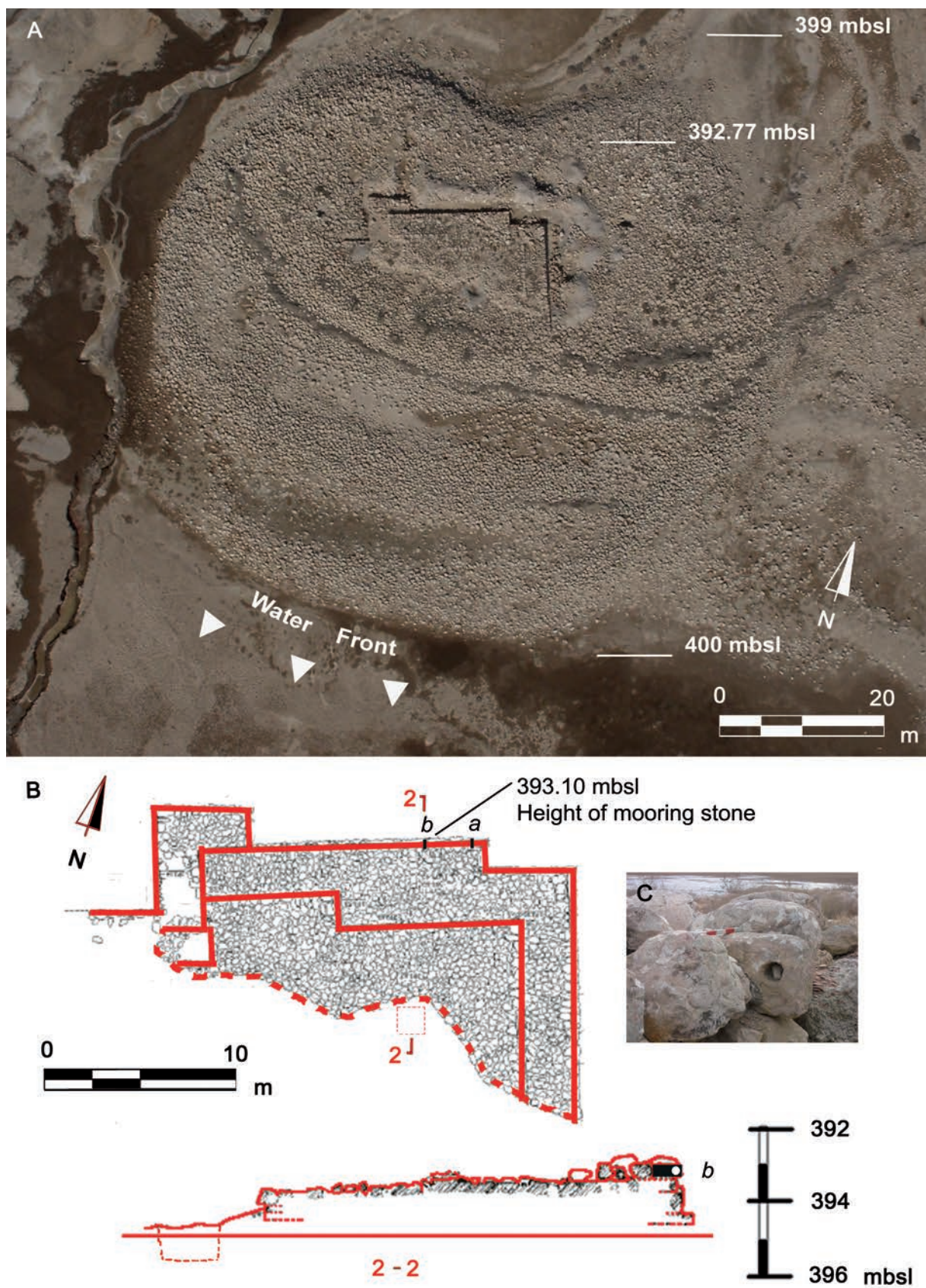


Figure 4. Rujum el Bahr: A) aerial photograph showing the stone mound, its elevation range, and the Hellenistic structure (Asaf Oron and iC Arealis); B) site plan of the Hellenistic structure showing the two embedded mooring stones *a*, *b* (modified after Bar-Adon 1989a: fig A-3 and Schult 1966: Abb. 2); C) photograph of mooring stone *b* *in situ* (Gideon Hadas).

cm. They were most probably transported from the escarpment 6 km to the west. An additional rock type –a soft sandstone of the Samra formation– was also identified in the mound (Bar-Adon, 1989a: 4-6). This local stone –found at other sites along the lake shore (Bar-Adon, 1989b: 21-22)– was often used for more refined architectural elements.

The highest point of the site is at 392.77 mbsl, and its lowest point, at the seaward south edge of the mound, is at 400 mbsl. The latter area of the mound features a series of massive boulder «bands» interpreted as jetties or breakwaters reflecting different water levels of the lake (Klein, 1986: 17; Bar-Adon, 1989a: 6). A rectangular (20 × 30 m) Hellenistic structure was built on the mound. The elevation of this structure is 395 mbsl at its shore side. Its seaward front has been eroded by the waves.

Stone anchors scattered around the site, as well as mooring stones made of pierced sandstone, two of which are still embedded in the landward face of the Hellenistic masonry (Schneller, 1963: 138; Schult, 1966: 142 abb.2 x-y, taf. 28b; Bar-Adon, 1989a: fig. 3a; Hirschfeld, 2006: 222; Hadas, 2011: 164, pl. 3b) (Fig. 4-B *a-b*, C), suggest that the site functioned as a wharf or a pier. The elevation of the fixed mooring stones (393.10 mbsl) provides a rough estimate of the water level of the lake during the Hellenistic / Early Roman periods. It shows that the Dead Sea water level was no higher than 393.10 mbsl, and that Rujum el Bahr was an island at that time. The elevation range of Rujum el Bahr places it within the lake's fluctuating water levels in the past four millennia (Fig. 2).

The new Western Rujum

In the course of the DSCS a second stone mound was located on the dry lakebed 700 m west-south-west of Rujum el Bahr.

The site resembles Rujum el Bahr in its topographic layout and position off the historic lake shore, although it is smaller (about 34 × 27 m), and lacks the former Hellenistic masonry (Fig. 5-A,B).

The site was comprehensively studied in 2013 and 2014. Its elevation and profile were recorded using differential GPS and low altitude high-resolution aerial photography coupled with 3-D modelling techniques.

It is composed of large un-hewed local limestone boulders (averaging 40 × 70 × 25 cm) most probably transported from the escarpment 5 km to the west. Additionally a few eroded blocks of Samra sandstone were also noted on the mound. The mound is located in an area of fine-grained sediments, with no local boulders or stones, and therefore must be an artificial structure rather than a natural feature.

The mound's base elevation ranges between 397 mbsl on the shoreward side and 398 mbsl on the seaward side. Its highest point is at 396.87 mbsl. This elevation range places that mound within the fluctuating water levels of the Dead Sea of the past four millennia (Fig. 2). There is no apparent order in the arrangement of stones. However, there are some fragmented linear patterns, as well as a narrow extension of the site westward in the direction of the former shoreline. These features may be remnants of man-made structures.

Interpretation and usage of the Western Rujum and Rujum el Bahr

The Western Rujum and Rujum el Bahr are the only artificial offshore structures in the Dead Sea littoral. Several questions arise regarding these sites: When where they constructed? For

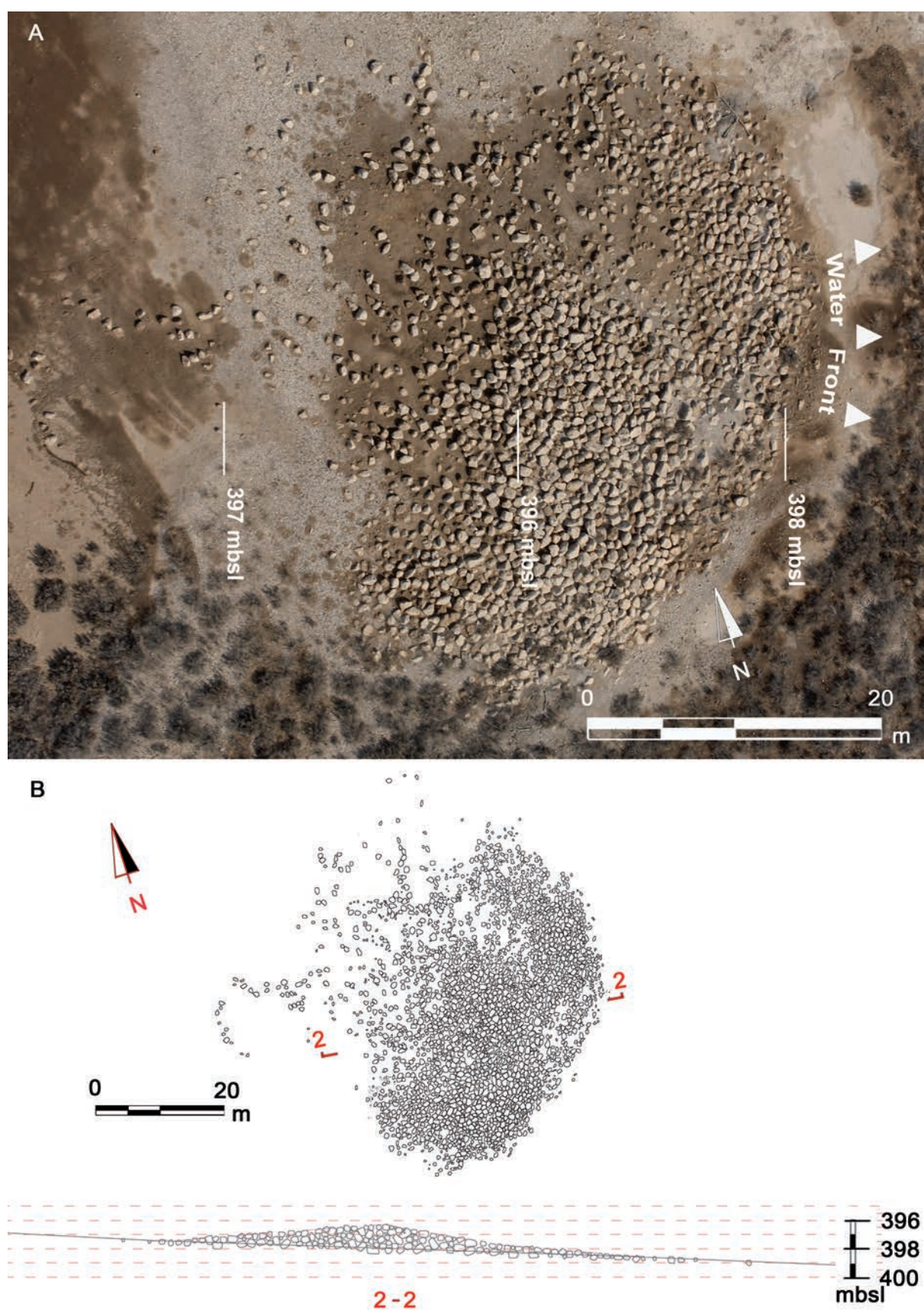


Figure 5. The Western Rujum: A) aerial photograph showing the stone mound and its elevation range (Asaf Oron and iC Aereals); B) Site plan of the Western Rujum (Asaf Oron).

what purpose? Were they built in the lake or on the shore during lake low levels, and later submerged?

Several artificial stone mounds of similar nature to the two mounds have been reported off the southern shores of the Sea of Galilee located 103 km to the north (Nadel, 1993: 1; Galili/Sharvit, 2002: 19, fig. 21; Galili *et alii*, 2002: 952). Built of local basalt pebbles and cobbles, these mounds range in size between 5 and 20 m in diameter. A significantly larger mound measuring 70 m in diameter was recently reported off the south-western shore of the Sea of Galilee, north of the prehistoric sites of Bet Yerah and adjacent to Ohalo I (Paz *et alii*, 2013). The interpretations of these structures included their use as artificial fish nurseries (Galili/Sharvit, 2002: 19; Galili *et alii*, 2002: 952; Paz *et alii*, 2013: 191), and as open-water anchorages intended to provide anchor holds in an area lacking natural anchorages and having a loose silt bottom (Galili *et alii*, 2002: 952). Given the monumental nature of the latter mound near Ohalo I it was considered also as a possible Early Bronze Age megalith (Paz *et alii*, 2013: 192).

The complete absence of fish in the Dead Sea excluded the use of the two mounds as fish nurseries. However, the maritime characteristics of that area, i.e. the straight shoreline, loose silt bottom, and strong on-shore winds resemble the maritime conditions along the southern shore of the Sea of Galilee. As such, the interpretation of the mounds at the Sea of Galilee as offshore anchorages should also be considered when discussing the role of the Dead Sea stone mounds.

The use of Rujum el Bahr for maritime activity and as an anchorage has been known since the 1960's (Schneller, 1963; Schult, 1966). However, its technical characteristics and usage as an offshore anchorage, as well as the reasons for its construction at that specific location were not fully explored. The examination of Rujum el Bahr and the Western Rujum in this study in their regional, geophysical and maritime cultural settings sheds new light on their *modus operandi* and the reasons for their construction at this part of the lake. Important shared attributes between the two sites in terms of elevation, location, and construction details suggest that both served a similar function.

The location of both sites at the northern end of the Dead Sea is of importance to their understanding and should be considered as a factor in their construction and existence. That area of the lake was as a key transit zone throughout the basin's history, linking, via maritime routes, the lake's remote and less accessible shores to important urban centres such as Jericho and Jerusalem. Also the fertile Jordan Rift Valley and the areas beyond could have been reached thus. As such, it had significant economic and strategic importance.

On the Mediterranean the existence of estuaries, river mouths and sheltered bays, coupled with the small tidal range and intensive maritime activity, simplified the construction of well-developed and long-lasting harbours (Oleson/Hohlfelder, 2011: 809-812). In contrast, unpredictable and significant seasonal and multiyear water level fluctuations on the Dead Sea shores rendered such undertakings technically complex and economically unviable. Instead, smaller scale ad hoc solutions for sheltering and anchoring were adopted. These can be divided into two main categories: a) natural anchorages in partially protected areas; and b) artificially constructed offshore anchorages in areas of high-energy exposed coastline.

Natural shelters, other than the Jordan River inlet, did not exist on the Dead Sea north shore. Watercraft approaching that part of the lake could easily have been trapped there by a moderate southerly onshore wind. Moreover, the gentle slope of the lakebed in this area amplified seasonal horizontal shifting of the coastline due to water level fluctuations. A drop of 1 m

in the water level could result in tens of metres of horizontal shift in the shoreline location. To overcome these difficulties, and to exploit the full economic and strategic potential of this part of the lake, other solutions were developed. These included the use of the River Jordan channel as a natural anchorage unaffected by lake level changes, and the construction of open-water artificial anchorages.

The River Jordan outlet anchorage provided shelter, but had some major drawbacks derived from its shallow depth (measured by Lynch as 3 feet = 1 m) and the estuarine environment, restricting its use at certain times of the year (Lynch, 1849: 268). Altogether, these constraints called for an alternative solution assuring a safe landing at the north shore of the lake. Such an haven had to provide a hold by anchor or a mooring line, cope with seasonal and multi-year lake level fluctuations and allow use by watercraft of all sizes in strong on-shore winds. These requirements were best met by the construction of open water offshore anchorages, such as the two artificial mounds. These structures offered a solution with several advantages. The location at a distance from the shore enabled the anchoring of small and large watercraft under varying wind directions (Fig. 6-A). The massive underwater stone mounds provided the anchor hold so crucial in this area loose silt bottom. Unlike shore-based mooring installations, which would easily have been rendered unusable by water level fluctuations, these open-water installations remained usable both when fully submerged and when partially exposed as small islands. At low water levels the exposed stone mound provided a leeward wind and wave shelter, and allowed simple mooring by tying up directly to the structure (Fig. 6-B). At high water levels the submerged stone pile provided a firm anchor grip or a fixed mooring line hold (Fig. 6-C).

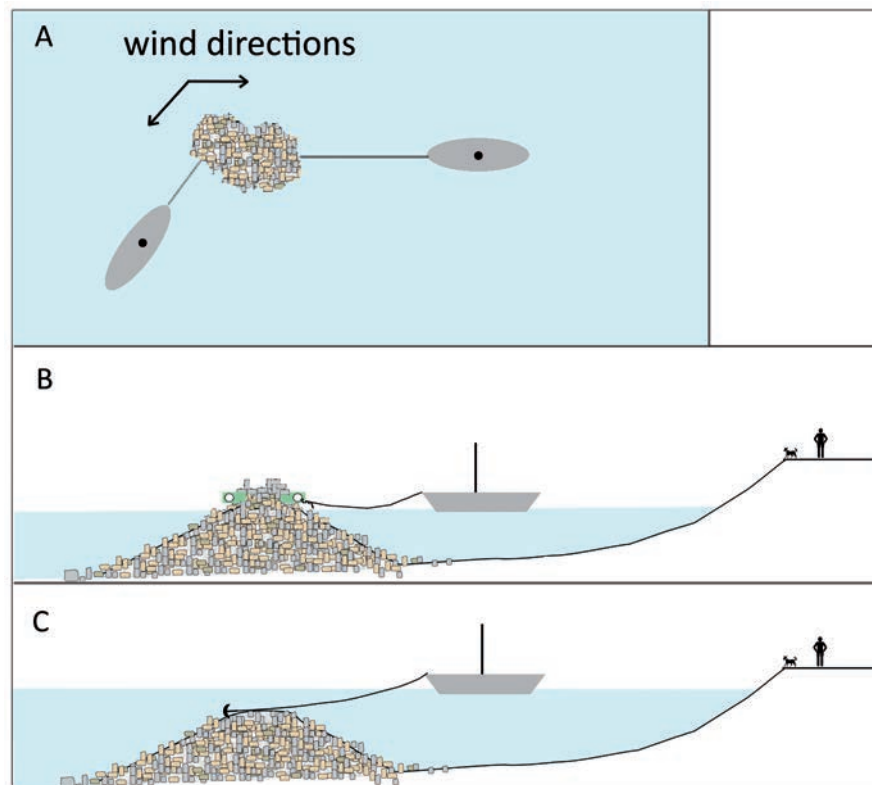


Figure 6. Proposed use of an offshore anchorage: A) mooring positions at different wind directions; B) mooring on the artificial anchorage at low water level stands; C) anchoring on the artificial anchorage at high water level stands. (Asaf Oron and Ehud Galili).

The presence of a Hellenistic superstructure at Rujum el Bahr is an indication that at low lake level stands, the underwater anchor holds could have been used as a foundation for further construction of architectural elements. These in turn could have fulfilled additional maritime functions, such as navigational aids, temporary storage, regional control, and maintenance of watercraft (Hirschfeld, 2006: 221-222, fig. 9).

Who may have built the Western Rujum and Rujum el Bahr

Both the archaeological evidence and consideration of lake levels provide clues as to the period of construction and use of Rujum el Bahr and the Western Rujum.

The volume of stones required for the Western Rujum is estimated at *c.* 1380 m³ and about 3000 tones. Rujum el Bahr is estimated at *c.* 80000 m³ weighing *c.* 200000 tones. Moving such large quantities of stones off shore could have been accomplished by using watercraft and drop-piling them at a predetermined location. The effort invested in the construction of these structures is indicative of a complex society, with economic ability and planning skills. It also indicates the prevalence of lake transport and the importance of the north shore as major maritime gateway.

The lake-level graph during historical periods (the past 5000 years) indicates three time periods when water levels were high enough to allow both the construction and the use of these mounds: the Early Bronze Age (*c.* 2nd-3rd mil. BCE), the Hellenistic-Early Roman period (4th century BCE-2nd century CE) and the Byzantine period (4th-7th centuries CE). High lake levels during the Early Bronze Age would have theoretically allowed the construction of these structures off shore. However, Early Bronze Age watercrafts used on the Dead Sea were most probably local, small reed boats, like those reported on the lake in the late 4th century BCE (Diodorus, *History*, 19.100.1-4; Oron *et alii*, 2015). These boats could have easily been hauled ashore and did not require the construction of artificial offshore anchorages. Therefore, it is most likely that these structures were built in later periods, and to accommodate larger watercraft. Based on the lake-level curve, the mound of Rujum el Bahr could have been constructed about the end of the 3rd century BCE when water levels rose above 400 mbsl. The superstructure could have been built on the artificial island between the end of the 2nd and the beginning of the 1st century BCE when water levels approached 395 mbsl. The presence of Iron Age II pottery at the site is intriguing because at that time lake level was very low and the area was dry land. A recent re-examination of the Iron Age material reported by Bar-Adon showed that only two of the sherds are clearly of Iron Age date (pers. comm. Uri Davidovich). The presence of only two isolated Iron Age II sherds and the absence of a related Iron Age stratigraphy suggest that these ceramic fragments are intrusive. They may have been transported with materials used in constructing of the mound and its various installations—for example earth floors—during the Hellenistic period. Such earth floors are reported in the excavation report at the north-east area of the mound (Bar-Adon, 1989a: 6).

Conclusions

The location of the two sites, along the lake's northern shore, and their similar architecture is not coincidental. It reflects the economic and strategic importance of this area of the lake and its adverse maritime characteristics. Using offshore artificial structures provided a secure anchor-hold in the loose silt bottom and a permanent anchorage where it did not exist naturally. More importantly, the sites location, away from the shore, ensured their functioning regardless of the lake-level fluctuations and changing wind directions. In essence, these structures represent an important feature of the lake's ancient maritime cultural landscape. They show that this maritime cultural

landscape incorporated a broader and more complex range of components than indicated by items of ships' gear, such as Dead Sea anchor types, previously recognized. Finally, the geographical proximity between the Dead Sea and the Sea of Galilee and some similarities between their maritime characteristics corroborate the interpretation of stone mounds found off the latter's shore as artificial anchorages. As such, this may indicate some shared ancient maritime cultural traits between two adjacent but otherwise uniquely different inland lakes within the Jordan Rift Valley.

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During the course of preparing this paper for publication we were informed of the tragic death of our friend and colleague archaeologist Yuval Peleg. Yuval provided invaluable research and logistic support throughout our work along the Dead Sea shores without which much of this study would not be possible. We deeply regret that he will not be able to see the fruits of our shared effort.

The Dead Sea Coastal Survey project was launched in 2005 following the chance discovery of several ancient anchors along the receding water line of the lake. The project is aimed at locating, recording, retrieving, and studying newly exposed finds on the Dead Sea former Lakebed along the northern basin's western and northern shores. The survey is carried out annually on foot following the ongoing drop in the lake water level at a rate of over a meter each year.

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MARPASE: un modelo geoespacial para calibrar la afección del patrimonio arqueológico subacuático en embalses

MARPASE: A geo-spatial model for the assessment of risks in underwater archaeological heritage in reservoirs

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Resumen: en la segunda mitad del siglo xx se reestructuró la cuenca del Tajo extremeño, embalsándolo en su totalidad. La falta de planificación respecto al impacto de los embalses sobre el patrimonio cultural llevó a realizar actuaciones puntuales sobre construcciones de época romana, pero no una documentación sistemática del conjunto de bienes afectados. Ello supone hoy un problema de primer orden a la hora de proteger estos sitios de las agresiones que provocan continuamente los embalses. Hasta la fecha no existen en España iniciativas enfocadas a evaluar estos daños. Hemos modelado las variables causantes del deterioro de los sitios arqueológicos en un entorno SIG con vistas a poder predecir sus posibilidades de preservación. El ámbito de aplicación de este modelo es el área de Alconétar. Los resultados obtenidos tienen implicaciones tanto para la gestión de este patrimonio como para la planificación de proyectos arqueológicos, cada día más frecuentes en entornos de embalses.

Palabras clave: Patrimonio subacuático, aguas continentales, Cuenca del Tajo (España), calibración de afecciones, SIG.

Abstract: The Tagus River basin in Extremadura region (Spain) was re-structured during the second half of 20th century, flooding a vast extension of the drainage. The lack of a global planning for assessing the impact of reservoir on cultural heritage forced to develop a specific action on roman buildings, although not a systematic recording of the affected cultural heritage goods. This can be considered today as a first order issue when protecting the sites from the

damage that the reservoirs cause. Up to the date there are not initiatives in Spain focused on the assessment of these damages. We have modelled in a GIS environment the variables that deteriorate archaeological sites with the aim of predicting their possibilities for preservation. The study case is the Alconétar area. The obtained results are useful for the management of cultural heritage and the planning of archaeological projects, increasingly frequent in areas of reservoirs.

Key words: Subaquatic heritage, continental waters, Tagus River basin (Spain), assessment of damages, GIS.

MARPASE: un modelo geo-espacial para calibrar la afección del patrimonio arqueológico subacuático en embalses

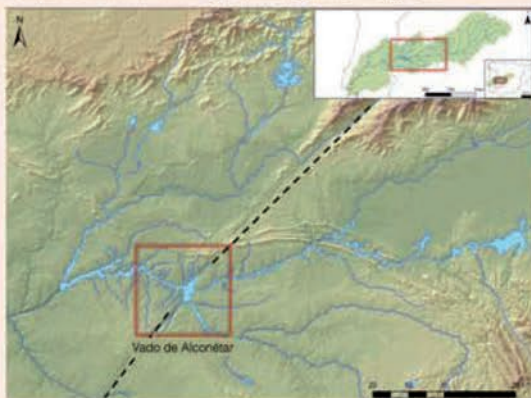
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Durante el periodo 1945-1975 se proyectaron obras hidro-eléctricas que supusieron la construcción de numerosos embalses y la inundación de un inestimable número de elementos patrimoniales. Cuantificar el número de afecciones y determinarlas es hoy en día una tarea compleja. Por un lado, se tiene constancia de sitios arqueológicos puntuales que ya eran conocidos antes de la inundación, pero por otro, los yacimientos van aflorando a medida que la acción de los embalses ha retirado la capa de sedimentos que los protegían. Hay que tener en cuenta que el entorno agresivo en el que se encuentran estos sitios puede llegar a provocar su desaparición, por lo que la estimación de las afecciones se convierte en una prioridad.



En este poster presentamos una propuesta de evaluación de las afecciones basada en el análisis de las variables que pueden acelerar o retardar el deterioro de los sitios. El marco de trabajo es el embalse de Alcántara y en concreto el área de del vado de Alconétar (Cáceres), con un elevado número de sitios arqueológicos sumergidos.

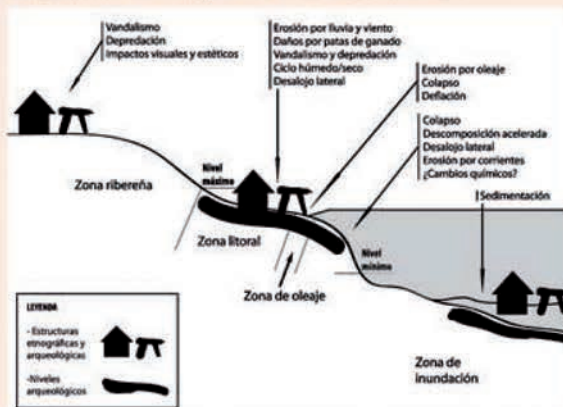


Con este propósito, hemos recurrido a las Tecnologías de Información Geográfica (TIG) para:

1. Crear un Modelo Digital del Terreno (MDT) con la topografía anterior a la inundación del embalse
2. Calcular sobre él un grado teórico de afección a partir de distintas variables.

El MDT fue creado a partir de la restitución fotogramétrica de fotografías del llamado "vuelo americano" (1956-1957), con ello hemos recuperado la topografía y situado algunos de los sitios arqueológicos conocidos, bien mediante foto-interpretación, bien mediante prospección superficial en tiempo de sequía. Este MDT es lo suficientemente preciso (10 m/píxel) como para reflejar las entidades topográficas originales.

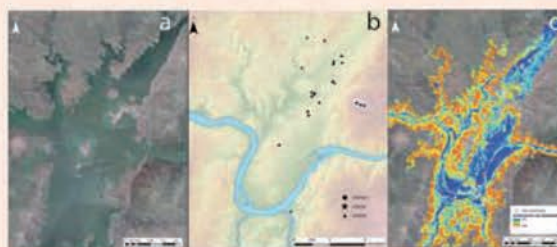
MARPASE (Modelo de Afección y Riesgo del Patrimonio Arqueológico Subacuático en Embalses) es una propuesta para evaluar la afección de la acción del embalse sobre la preservación de los sitios. Para ello tenemos en cuenta las propuestas Waechter y Mikesell, quienes trabajan sobre este mismo aspecto en embalses americanos.



Tipología de afecciones en función de la situación topográfica de los sitios (modificado a partir de Waechter y Mikesell 1994)

MARPASE está basado en el análisis multicriterio y emplea las siguientes variables:

1. La cota del nivel del agua (series históricas diarias desde 1970 a 2012) y el número de días que los sitios han permanecido inundados. Calculado sobre el MDT.
2. El mapa de pendientes obtenido sobre el MDT del "vuelo americano"
3. Un índice topográfico, TOPIDX, que modeliza el flujo del sedimento.



a) Orto foto actual del área de estudio, b) MDT obtenido a partir de la restitución fotogramétrica y sitios detectados, c) MARPASE con categorías de los distintos grados de afección.

Mediante MARPASE, se aborda una primera estimación definida en función de cuatro categorías: poca estabilidad, estabilidad moderada, estable y muy estable. La mayor parte de los sitios documentados en Alconétar se localizan en una zona de inundación permanente, lo que en principio les confiere unas condiciones de preservación «muy estables».

Si comparamos estos datos con las categorías que hemos propuesto en nuestro modelo, parece que la mayor parte de los sitios están en condiciones de relativa estabilidad, sin embargo son pocos los que se localizan en áreas de estabilidad moderada o poca estabilidad. Por ahora, no podemos calibrar si estas zonas más frágiles, han albergado yacimientos y si éstos, se encuentran ya desaparecidos.

Navegación en las aguas continentales de Piamonte: las piraguas monóxilas del Museo di Antichità di Torino

Navigation in inland waters of Piedmont: the dugout pirogues of the Museo di Antichità di Torino

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Resumen: en esta breve intervención, lo que los autores pretenden es poner el foco de atención sobre tres piezas de crucial importancia para ver con qu medios se efectuaban los intercambios en aguas interiores del Piamonte. Se trata de tres piraguas monóxilas, conservadas en la actualidad en el Museo de la Antigüedad de Torino, en un diorama de nueva realización que hace más fácil su comprensión y entendimiento. Gracias a estos trabajos de modernización de la exposición, fue posible retomar los estudios sobre estas piezas, ejecutar nuevos análisis sobre las esencias y la fecha de los mismos, pero lamentablemente las muestras no han aportado nuevas informaciones debido a la reelaboración gráfica que exalta las particularidades de estas tres piraguas.

Palabras clave: Piamonte (Italia), piraguas, navegación, aguas interiores, diorama.

Abstract: In this poster the authors would take stock of the situation about three crucial pieces to understand how commercial and cultural exchanges were led across the inland water of the region of Piedmont during a large period of our history. These three pirogues are actually hosted in a renewed diorama in the Museo di Antichità di Torino and finally are exposed to the public in a way that enhances their understanding. Thanks to the recent renovation works in the museum and this new out-fitting for the pirogues, it was possible to make again wood and 14C analysis, but unfortunately samples were too much contaminated by the wood treatments made during the '80. In this poster some constructional details are easy to appreciate thanks to HD PhotoShooting.

Key words: Piedmont (Italia), pirogues, ancient navigation, inland waters, diorama.

Navegación en las aguas continentales de Piemonte: Las piraguas monóxilas del Museo di Antichità di Torino

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MOTTA DI COSTIGLIOLE (Asti)

TIPO DE MADERA: Quercus
robur



LARGO TOTAL: 514 CM
SECCIÓN MAESTRA:
76 CM DE ANCHO - 48 CM DE LARGO

DATAción DIRECTA: ¹⁴C imposible debido
a un problema de contaminación de las muestras.

DATAción INDIRECTA: Edad Media.

PEROSINI DI ANTIGNANO (Asti)

TIPO DE MADERA: Quercus
robur



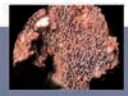
LARGO TOTAL: 354 CM
SECCIÓN MAESTRA:
52 CM DE ANCHO - 42 CM DE LARGO

DATAción DIRECTA: ¹⁴C imposible debido
a un problema de contaminación de las muestras.

DATAción INDIRECTA: Edad Media.

BERTIGNANO (Biella)

TIPO DE MADERA:
Populus sp.



LARGO TOTAL: 358 CM
SECCIÓN MAESTRA:
65 CM DE ANCHO - 40 CM DE LARGO

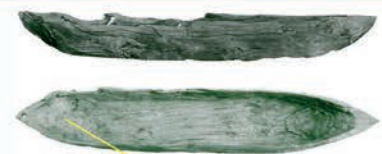
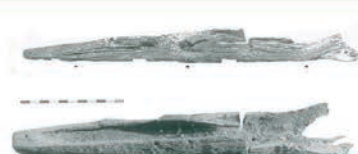
DATAción DIRECTA: ¹⁴C 2300-1300 a.C. (obtenido en el 1989).
Hoy no es posible repetir los análisis a causa de la alta
concentración de consolidante utilizado durante la restauración.



FOTO DEL 1989



FOTO DEL 2014



La piragua de Costigliole d'Asti, de la zona de la Plana, fue descubierta en el 1989 durante una excavación de la zona del lago de la Plana. La zona está rodeada por una zona de cultivo de arroz.

El tipo de madera fue identificado como Quercus robur, lo que indica que se trata de un tipo de madera de roble.

La piragua es monóxila, es decir, está hecha de una sola pieza de madera. La longitud total es de 514 cm, la sección maestra mide 76 cm de ancho y 48 cm de largo.

La datación directa por ¹⁴C no fue posible debido a un problema de contaminación de las muestras.

La datación indirecta indica una edad medieval.

El tipo de madera fue identificado como Quercus robur, lo que indica que se trata de un tipo de madera de roble. La longitud total es de 354 cm, la sección maestra mide 52 cm de ancho y 42 cm de largo.

La datación directa por ¹⁴C no fue posible debido a un problema de contaminación de las muestras.

La datación indirecta indica una edad medieval.

La piragua es monóxila, es decir, está hecha de una sola pieza de madera.

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El tipo de madera fue identificado como Populus sp., lo que indica que se trata de un tipo de madera de sauce. La longitud total es de 358 cm, la sección maestra mide 65 cm de ancho y 40 cm de largo.

La datación directa por ¹⁴C no fue posible debido a un problema de contaminación de las muestras.

La datación indirecta indica una edad medieval.

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En el septiembre 2014 ha sido preparada una nueva sección del Museo di Antichità di Turin dedicada a las piraguas monóxilas descubiertas en Piemonte, gracias a la financiación de la Compagnia di San Paolo di Turin. En la amplia vitrina, dotada de un mecanismo que mantiene el aire húmedo, envueltas en un ambiente escénico se exponen los tres elementos que aquí presentamos, procedentes de la zona lacustre oriental del "Lago di Bertignano" (Biella) y de las riberas del río Tánaro (Asti), que con ocasión de la nueva instalación, se han vuelto a estudiar con investigaciones a través de encuestas y análisis diagnósticos. El espacio subyacente la vitrina ha sido proyectado para consentir el almacenaje ideal y para guardar las maderas procedentes de las zonas húmedas, en particular de las aldeas palafíticas del lago de Viverone y de las zonas ricas de turba, halladas durante las campañas de excavación sistemáticas efectuadas en los últimos treinta años.

G.P.



**PERIODOS PREHISTÓRICO
Y PROTOHISTÓRICO**

**PREHISTORIC & PROTOHISTORIC
PERIODS**

Constructing maritime worlds through objects

La construcción de mundos marítimos a través de objetos

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Abstract: This paper examines the use of similar boat models and imagery that were created in two different locations: the Cycladic Islands during the Bronze Age (EC II) and the Naqada II period of Predynastic Egypt. Through their recontextualisation back into their societies, it can be suggested that the models and images probably represented very different things to the people who created them and chose to include them in burials, revealing clearly divergent attitudes to nautical life in these two societies. This is a preliminary investigation from a new project that is using the collections of the Ashmolean museum at the University of Oxford. It aims to investigate the use of such «maritime» objects within world societies and to understand how people engaged with the sea through the evocative things that they created.

Key words: Boat imagery, objects, Bronze Age Aegean, Predynastic Egypt.

Resumen: este artículo examina el uso de modelos de imágenes de barcos similares que fueron creados en dos lugares diferentes: las islas Cícladas durante la Edad del Bronce (EC II) y el periodo de Naqada II del Egipto predinástico. A través de su recontextualización en sus sociedades, puede sugerirse que los modelos e imágenes probablemente representaban cosas muy diferentes para las personas que los crearon y decidieron incluirlos en los enterramientos, revelando las actitudes claramente divergentes sobre la vida náutica en estas dos sociedades. Esta es una investigación preliminar de un nuevo proyecto que está utilizando las colecciones del Museo Ashmolean de la Universidad de Oxford. Su objetivo es investigar el uso de tales objetos «marítimos» dentro de las sociedades del mundo y comprender cómo las personas se involucraron con el mar a través de las cosas evocadoras que crearon.

Palabras clave: imágenes de barcos, objetos, Edad de Bronce del mar Egeo, Egipto predinástico.

Introduction

The choice to decorate pottery with maritime motifs or to build boat models and deposit them in graves are specific acts of people deliberately engaging with lakes, rivers or seas and life upon them. Such creative use of a maritime «vocabulary» within the object world of a culture may speak from the hearts of their ideals, representing concepts and thoughts in a material way. Yet across the *longue durée* of maritime history not all maritime peoples have chosen to create a maritime object world and while the seas may create conduits of communication and exchange, cultures at opposite ends of trading routes can represent their engagement with the sea in very different ways. Today the United Kingdom is perhaps more reliant upon the sea than ever for the material basis of our daily lives with as much as ninety per cent of everything being brought by container ship (George, 2014; Levinson, 2008; Stopford, 2008). Despite such reliance upon the sea and to shipping, references to it are scarcely followed though in to our daily object-based lives, yet just a century ago this was not the case and in the everyday material world –from the cigarettes that people smoked, the matches they struck them with, to the names of the pubs in which they drank– objects replete with imagery of the sea and seafarers were a stronger presence in their lives (e.g. Massie, 2007). Our reliance on the sea has not changed –if anything it has increased– what has changed is the level of our engagement with it as an agent within our daily lives.

«Constructing Maritime Worlds» is a new project that draws upon the rich repertoire of motifs of the sea and seafaring peoples in the collections of the Ashmolean museum at the University of Oxford and uses the collections as a way in to thinking about the extent and forms of maritime engagement of the diverse groups of people who made them. The Ashmolean houses over 1 000 objects that may be related to the maritime world, ranging from model boats in lead from 4th millennium BC, to English Tudor models, from 18th century Persian boat-shaped begging bowls, to a 19th century clove-boat model from Indonesia. Images of boats are found on a wide range of objects – pottery, terracotta and metal, particularly Greek, Roman and Medieval coins, as well as woven fabrics, Delft tiles, 19th century fine china and a range of paintings and prints from across the world.

Rather than study the objects and their nautical imagery simply from a technological and trading perspective, «Constructing Maritime Worlds» will attempt to understand the material and its place within the particular cultures and communities that created them. The project will also investigate the gap between the use and avoidance of imagery in the creation of maritime identities in world societies.

In this paper what we want to do is to simply start to consider the relationship of people to the maritime objects that they create through looking at two small groups of prehistoric objects from different parts of the Mediterranean and consider what they, when properly contextualised, can tell us about the different societies that created them and how they chose to engage with the maritime world around them.

Case study 1: Naqada II Period pottery

Our first case study comes from Predynastic Egypt, from which the Ashmolean possesses an important collection of boat models, particularly from the Naqada II period, a time when the culture of the south of Egypt spread northwards, a precursor to ultimate state formation (Wengrow, 2006: 72-126; Midant-Reynes, 2000: 169-186). The Nile provided a highway along which Egyptian culture and politics were spread. River craft are prominent on the pottery from the Naqada II period, where a variety of boats are shown. Some images suggest multi-oared craft,

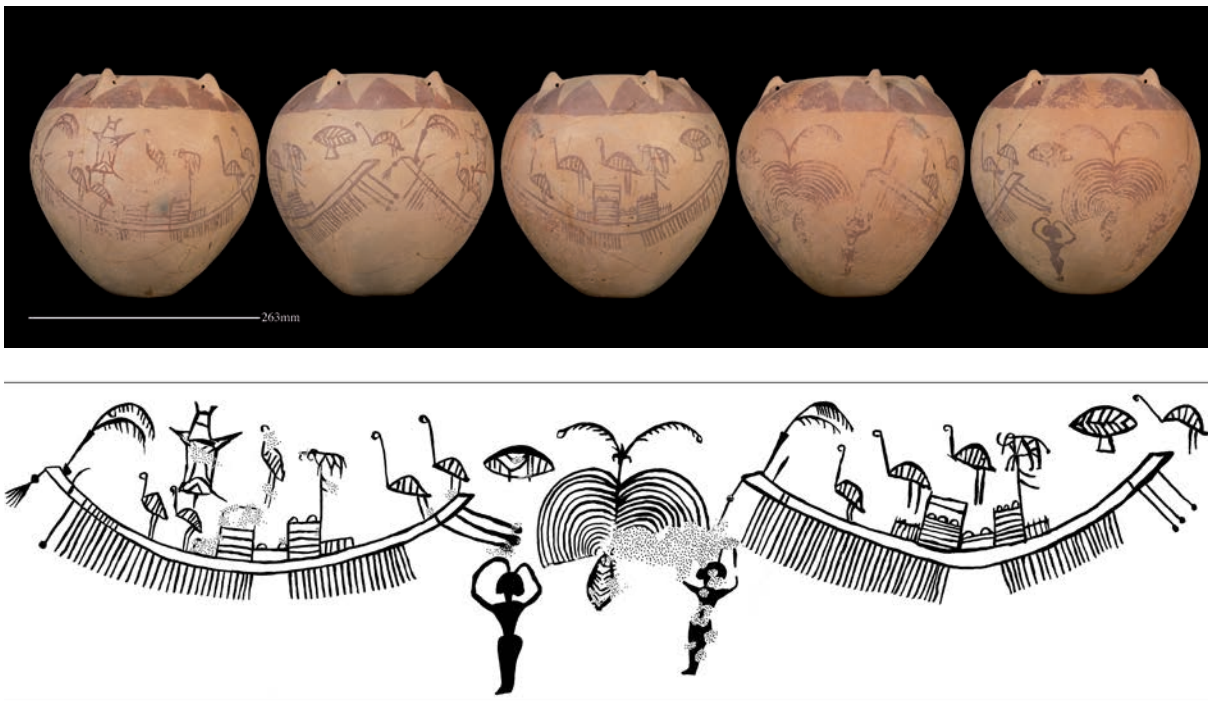


Figure 1. D-ware jar from Naqada grave 454. AN 1895_584, height 25 cm, diameter 26.3 cm.

suggesting a disciplined and coordinated crew operating within a socially stratified society (Fig. 1). The stratification that these boats suggest are discernible in the material culture as a whole, which shows in the burial record the definition of elites through their access to prestige goods. The sudden arrival of the images of boats on the pottery of this period has suggested to authors that they were a key enabling technology in the opening up of Egypt via the Nile and that they were significant in transforming the pace of life.

Consequently, these boat images are at the heart of discussions about a fundamental change in Egyptian society and while we do not want to denigrate the importance of the boat, we do question the idea of their sudden importance at this time. This Naqada II imagery is almost universally familiar in any study of Egyptian watercraft. Yet, this high archaeological visibility is essentially an artefact of both the selection policy of looters and archaeologists and a research agenda that tends to focus on the development of boat technology.

Firstly, the Naqada II period pottery in the Ashmolean is not a true representation of that placed into graves of this period. It has been shown that coarse wares constitute more than half of the ceramic repertoire of any given Naqada II period burial, yet when we look at what is in the museum there are 66 plain vessels in D-Ware, compared to 156 painted examples (Crowfoot Payne, 1993). Aesthetically, painted wares are much more exciting and collectable than coarse wares and so rather than a parity in the ratio between painted and plain, more than twice as many painted wares made their way into the museum.

While this is perhaps understandable, it has resulted in the foregrounding of this type of pottery and its imagery: boats suddenly appear in the archaeological record and in great numbers. Yet the evidence elsewhere in the material culture from the earlier Predynastic period indicates that boats were already well established and used for travel, transport and fishing on the river, and perhaps even for limited short-haul trading and voyaging away from Egypt: they were always there in the background of Predynastic society (Wengrove, 2006: 76; Midant-Reynes,



Figure 2. D-ware jar from Naqada grave 173. AN 1895_606, height: 8.9 cm, diameter 6.6 cm.

2000: 169-186). Consequently, what we are seeing in the Naqada II period is a time when the depiction of a boat became a culturally acceptable icon to be painted on pots in great numbers. Although it should be noted that boats do appear on Naqada I bowls, for example, on an example from Mahasna (Petrie, 1920: pl. XV), although with less frequency. Why then do watercraft suddenly become important enough in the material world of the Naqada period burial culture to be depicted?

In order to come to some understanding of this we can return to the collection from the Ashmolean. Quantitatively, watercraft do not appear that often within the imagery of D-ware pottery, with only 14% of the painted pots in the collection having them. Images of animals, hunting and landscapes with people in them are rather more common (27%) and indeed, where boats are depicted they are often done so in combination with animals and hunting scenes (Crowfoot Payne, 1993). It seems clear from this, that the relationship being depicted is that where the boat is part of a hunt. Figure 2, for example, appears to show armed men with a large horned animal, possibly an antelope, alongside the boats. As such the iconography of this relationship between river craft and hunting needs to be investigated further.

Similar associations between boat images and hunting have also recently been suggested as reasons behind the use of such imagery in the Eastern Desert of Egypt. Although it is difficult to be sure of the dating, it would appear that much of the rock art of the desert from this period was associated with ritual hunting expeditions into the desert that took place as part of elite burial practices (Lankester, 2013). This firmly embeds the boat into the ritual practises of the Predynastic period and illustrates that the river craft that we see in the archaeological record are part of an elite-centred cult of the dead and not necessarily those of everyday life on the river.

Our boat models are also similarly firmly embedded in the symbolic realm. In this particular case, the boat is placed within the world of Egyptian mythology. Figure 3 is of a stone model of a flat-bottomed craft from the temple enclosure at Hierakonpolis, now in the Ashmolean, which perhaps rests upon serpents. A couple of potential interpretations of this spring to mind, the first refers to the pre-creation universe which is composed of just an infinite body of water –Nun– the entwined female side of which –Naunet– was represented by a snake. So here we could have a boat on the primeval waters, order over chaos, which is a familiar trope in Egyptian mythology and is also picked up in the second interpretation, which is that the snake could represent Apophis –the forces of disorder– who had to be repelled from the sun god Re's solar barque in order to ensure sunrise and stability in the world (Cf. Shaw, 2014: Nun, 19-21 and Apophis, 37). The use of the boat as a metaphor for safety and stability in the watery world of the Nile and in the context of its flood is easily understood.

Similarly, Figure 4 is of a ceramic box from Hierakonpolis which includes a drawing of a boat on one face, presented alongside an image of a hippo, a building and a decorative element or net. Hunting images were also painted on the flanks of ceramic hippo models. Hippo hunting became a powerful religious metaphor in Pharaonic culture: the hippopotamus was connected to Ra but also was seen as an evil agent of the god Seth, so a hunt was a way of restoring order, as well as proving hunting skills – a key theme in later elite art. For example, the tomb of Antef, the great herald of the king during the reign of Hatshepsut and Tuthmosis III, has a scene in which Antef and his family spear a hippopotamus (Prisse d'Avennes, 2000: 68). Perhaps here we are also returning to the theme of ritual hunting that were seen on the Naqada II period D-ware pottery and scratched on to the rock surfaces of the Eastern Desert?



Figure 3. Limestone boat model from the temple enclosure at Hierakonpolis. AN 1896-1908 E.119, length 27.4 cm, width 9.5 cm, height 3 cm.

Overall, this first case study demonstrates the importance of the boat to the symbolic culture of early Egypt. Tellingly, there is little hint of other aspects of this society, such as trade or the economy in which river craft would have undoubtedly played a meaningful role. This would suggest that boats were not depicted in the Predynastic period simply because they were familiar, everyday items: they were depicted because they had something meaningful to say to the world of the time. Predynastic era images of boats emphasise the growth in inequality between elites and non-elites, perhaps with reference to the ability to control people, for which boat crews are a clear metaphor. The use of river craft also refers to the responsibility and func-

tion of these developing elites to hold at bay the waters of chaos in an uncertain time of social and political change. Within such a world, the boat had a highly charged symbolic function in the creation and maintenance of Egyptian society.

Case study 2: Cycladic Boat Models

Our second case study, deals with material from the Cyclades in EC II, and raises the issue about the level of a culture's engagement with the sea as viewed in their material record and the importance that we place upon objects to exemplify it.

Figure 5 is a model of a boat from Naxos made from lead and is one of the prized maritime objects on display in the galleries of the Ashmolean and illustrations of it appear with almost monotonous regularity in discussions of Bronze Age seafaring in the Aegean. The boat was first published by Renfrew (1967: 5, 18 Cat Nos. 12-14, Pl. 1 and 3) and has since appeared in many publications (e.g. Wachsmann, 1998: 69-72). The model is of a type of longboat that is seen as being of crucial importance in trading, particularly the acquisition of metal ores and status objects that were required for the development of social hierarchies and complexity in the Cycladic region. To propel these boats would have taken teams of rowers, the training of whom would have required man-hours and the ability to summon them implies a complexity not obvious from the relatively undifferentiated small scale settlements on the islands at the time (Broodbank, 1989: 320-321; 2002).

Clearly then from its visibility in the literature of seafaring and Aegean archaeology we should perhaps expect boat models to be a relatively common item in the material world of Naxos, or the Cyclades, in a similar way to the boat models of the ancient Egyptians of the Middle Kingdom: objects that by their numerical ubiquity and contextual association provide clear insights into how this particular society viewed their relationship to the water and travel upon it. Yet when we dig a little deeper in the records of the collection and their wider context it would appear there are only four such models from Naxos –three of which are in Oxford– and that they all come from the same grave (Renfrew, 1967: 5). With this exception, boat models do not appear



Figure 4. Ceramic box from el-Amra grave a 41. AN 1901 E.2816, length 19 cm, width 12.8 cm, height 14.7 cm.



Figure 5. Lead boat model from Naxos. AN 1929_26, length 40 cm, height 3.5 cm.

to be part of the funerary traditions and practises for the greater majority of Naxian society. Neither do they appear to have had much currency in the Cyclades as no other boat models from the Early Bronze Age are recorded in Michael Wedde's catalogue of ship imagery. Indeed, only five other models exist from this period in the Aegean, with four coming from Crete and one from Spetses. These models come from both burial and settlement contexts and on Crete from different sites (Wedde, 2009).

By its high visibility in the archaeological literature, does this well-preserved boat model actually distort or misrepresent the relationships of the people of Naxos to the sea? With such a paucity of evidence are we correct in thinking that the inhabitants of the Cyclades were maritime peoples? Clearly, they used the sea: but Cyprian Broodbank, for example, suggests that the boats themselves would have required all of the available free manpower of an island to propel them during the very limited times in which they were not required for agricultural activities (Broodbank, 2002). Consequently the sea was simply a relatively minor part of island life for the majority of its population, which is perhaps actively reflected in the material record.

Such a view can be nuanced, however, with reference to another maritime object from the Ashmolean's collection: the so-called Cycladic frying pan in Figure 6, although in this particular case its provenance, as well as its function, is unknown. Here a pattern of spirals predominates alongside a long boat similar to the Naxos boats. Not every Cycladic frying pan had a nautical motif, but where they are depicted there are longboats, fish, sun/star symbols and abstract «sea-spirals» that may represent billowing waves and cumulatively hint at practises of celestial navigation (Coleman, 1985: 198-199, 207-208; Broodbank, 2000: 249-53). It should also be

emphasised that those with boat imagery and a secure provenance come from just one site: Chalandriani, a centre «intrinsically linked to longboat activity» (Broodbank, 1989: 331-332). Here the inclusion of such objects in burial contexts would, perhaps, suggest a more direct engagement with the boats and the sea in the ritual life of this particular community than is common throughout the remainder of the Cyclades in the Early Bronze Age. Although here it must also be noted that there were other non-maritime symbolic objects from this site, suggesting that a more complex set of ritual practises was in operation and that there was an active choice to be made to include a «maritime» frying pan into a grave or not.

Intriguingly, it has been recently suggested by Thomas Tartaron that these objects may represent the material expression of the maritime *habitus* of a particular seafaring sub-culture within the wider community (Tartaron, 2013: 125-126, 129). Perhaps then, the choice to bury someone with these maritime objects, as opposed to the wider variety of other decorative motifs on frying pans or other pieces of ritually significant material culture, could signify membership of this specialised seafaring sub-culture? Although, of course, we have to be cautious and while specialised seafaring knowledge for the construction of longboats and the ability to successfully crew and navigate them on journeys beyond their immediate locality undoubtedly existed in the Cycladic islands during the Bronze Age, simply suggesting that the occupant of the grave with the lead boats or a nautical frying pan was a master shipwright or navigator is, of course, pure speculation. Nevertheless, it does open up the discussion and provide an alternative to the simple association of longboat motifs with wealth, status and power (Renfrew, 1972: 375; Broodbank, 1989: 335). Instead, through their comparative exclusivity in the totality of the material culture, the very choice of an object with a maritime motif *could* have been imbued with active symbolism up to and including membership of a maritime sub-culture.



Figure 6. Ceramic frying pan. AN 1971_842, height 1.6 cm, diameter 19.1 cm, with handle 21.4 cm.

Concluding thoughts

What this pilot study shows –and this is not a new idea– is that there is no necessary relationship between the economic significance of maritime activity and the intensity of symbolic engagement with maritime imagery. Just as there are many different reasons for an individual or group to put to sea, there are equally many different reasons why an individual or group may choose to include maritime objects or motifs in their material worlds. The comparison between the Egyptian and Cycladic imagery of essentially the same types of vessels –paddled boats– clearly denotes that while the depiction of a boat may be a symbol of power and a motif for the development of social hierarchies in some societies, the same image can also be more nuanced than this and have different associated meanings in others.

The example of Predynastic Egypt would suggest that the inclusion of boat imagery was concerned with expressing ideas pertaining to the emergence of an elite –perhaps based upon the ability to control a body of men who formed a crew– and the role of the boat in rituals associated with death. The use of the boat –perhaps even different ones to those illustrated on the pottery– in the burgeoning trading links of the time was of little interest to the artisans who created the models and painted the pottery. Nevertheless, this appears to be a relatively unified statement of ritual intent utilised throughout the expanding region of Naqada-influenced material culture and clearly, therefore, the boat would have been symbolically significant to a large proportion of the population – as we might very well expect from people who lived on the Nile.

This can be compared to the situation in the Aegean, where the use of boat imagery and models appears to be extremely limited in the Early Bronze Age and restricted to particular sites or even to particular graves within them. While there were certainly burgeoning social hierarchies and maritime trading and raiding taking place across the waters of the Aegean, the long-boat was not an image with universal currency and far from being a ubiquitous element in the visual vocabulary of the islands. A widespread engagement with the maritime world through objects is largely missing from the Cyclades and as such, it is this very scarcity of maritime motifs that is perhaps more significant. Rather than being simply deployed, as in Egypt, as part of an everyday discourse of developing power and ritual, the Cycladic examples may say something more about possible group membership and being part of specific maritime sub-sets of the population for whom such images would have resonated at a more personal level.

The examination of the boats from the *Egypt at its Origins* and the *Aegean World* galleries of the Ashmolean museum have offered us the opportunity to rephotograph and illustrate these important objects. It has also enabled us to reconsider the ways in which these very similar sets of boat models and images were deployed within two different societies, and further objects from the remainder of the museum offer us the potential to expand this still further. Through a systematic examination of all of the maritime objects within the collections –starting with the boat models– and their recontextualisation back in to the their communities, we aim to provide a narrative for the production and use of maritime objects across time and space. In this way *Constructing Maritime Worlds* will eventually write a comparative history of people's engagement with the sea through the evocative objects that they created.

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Reconstructing the Maritime Cultural Landscape: the case study of the coastal landscape of Larnaca on the island of Cyprus in the Late Bronze Age

Reconstruyendo el paisaje cultural marítimo: el ejemplo del estudio del paisaje costero de Larnaca, en la isla de Chipre en la Edad del Bronce

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Abstract: The coast is a difficult environment for being studied by archaeologists, because changes in sea level and other natural phenomena cause changes in its nature and this can affect on the maritime activities developed in this area. The case of the coast of Larnaca is an example of coastal changes, as it has been drastically changed from the Late Bronze Age period to the present. However, it still constitutes a storehouse of data, as plenty of archaeological sites can be identified within its extent. If all these sites are taken into account along with underwater remains of human activity and their examination is combined with the study of geological and topographical data, a complete picture of human utilization of this coast during the Late Bronze Age period and the maritime cultures that developed in its littoral area will be reconstructed. This is mainly the aim of the present paper.

Key words: Cyprus, Larnaca, Late Bronze Age, coast, maritime cultural landscape.

Resumen: la costa es un ambiente difícil de estudiar para los arqueólogos ya que las alteraciones en el nivel del mar y otros fenómenos naturales producen cambios en su naturaleza que pueden afectar a las actividades marítimas desarrolladas en esta área. El ejemplo de la costa de Larnaca es un perfecto reflejo de los cambios costeros, pues ha cambiado radicalmente desde la Edad del Bronce final hasta la actualidad. Aun así, conforma un silo de datos, puesto que se pueden identificar varios sitios arqueológicos a lo largo de su extensión geográfica. Si tenemos

en cuenta todos estos sitios junto a los restos submarinos de actividad humana y, su examen se combina con el estudio de datos geológicos y topográficos, tendremos una reconstrucción completa de esta costa durante la Edad del Bronce final y de las culturas marítimas que se desarrollaron en el área litoral. Éste es principalmente el objetivo del presente artículo.

Palabras clave: Chipre, Larnaca, Edad del Bronce final, costa, paisaje cultural marítimo.

Introduction

This paper presents the reconstruction of the «maritime cultural landscape» of the coast of Larnaca on the island of Cyprus during the Late Bronze Age (1600-1050 B.C.). The primary aim of the present paper is to simultaneously examine both the terrestrial and underwater archaeological record of the coastal area of Larnaca, from Cape Pyla to the mouth of the Vasilikos River (Fig. 1). Consequently, the paper shall attempt to combine them with the area's geological and topographical data, in order to understand what is defined as the coastal landscape of this area and to present a reconstruction of its «maritime cultural landscape» during the aforementioned chronological period.

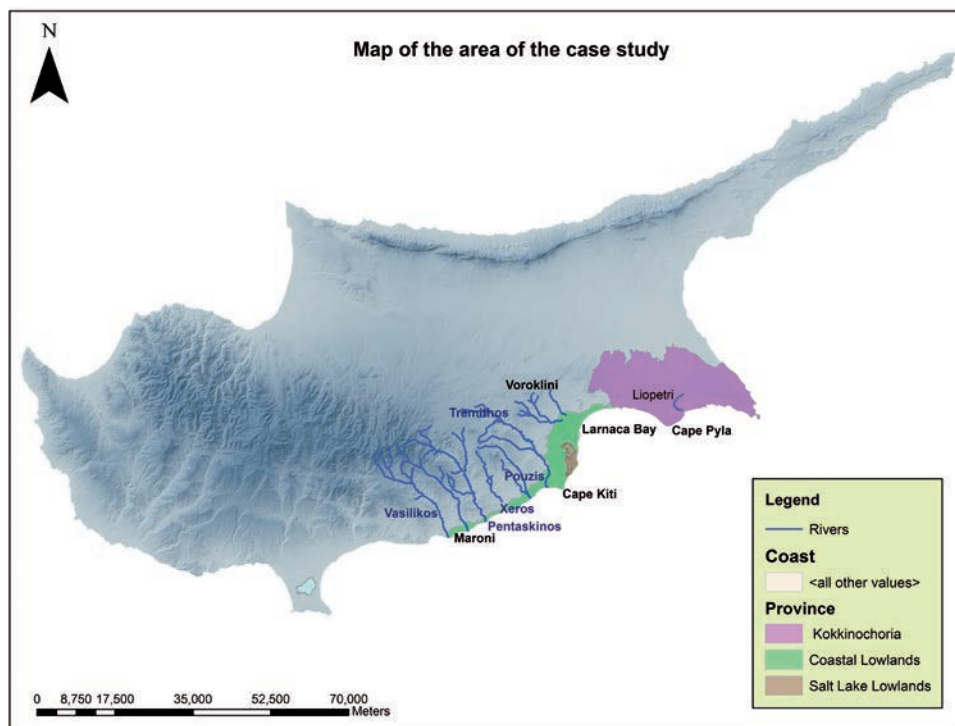


Figure 1. Map of the area of the case study. Drawing by Maria Michael, 2014. (Digital Geological Data from the Department of Cyprus Geological Survey).

«Coast» and «Maritime Cultural Landscape»: The Theoretical Concept

Prior to discussing the specific case study of the coastal landscape of Larnaca, it is essential to clarify what is theoretically meant by the terms «coast» and «maritime cultural landscape», in order to examine if this theoretical background can apply on the specific case study.

Although it is difficult to precisely define the term «coast», this can be generally defined as the part of the land adjoining or near the sea where marine processes such as erosion, depo-

sition and storm surge influence terrestrial processes and vice versa (Ford, 2011a: 764; Μπαμπινιώτη, 2002: 111). The understanding of the formation processes and geoarchaeology of coasts is one of the essential difficulties of its study, as it causes changes to the nature of the coast (Ford, 2011a: 765- 766). Furthermore, the anthropogenic alterations must be taken into consideration, as activities including quarrying, farming and filling can drastically change the quality of the shore, creating new embayments while obliterating old ones.

Although the coasts are a challenge for archaeologists in terms of research and preservation, coasts are involved in maritime activities since ancient times. Consequently, their archaeological records are formed by inland sites, which must be taken into account along with harbours and shipwrecks, so as to be able to reconstruct a complete picture of human utilization of the coast (Ford, 2011a: 768).

The term «maritime cultural landscape» was first introduced by Westerdahl (1992: 6; 2011a) and comprises «the whole network of sailing routes with ports and harbours along the coast, and its related constructions and remains of human activity, underwater as well as terrestrial». All of these features are interpreted within the landscape so as to explore how people perceived and understood the sea and used this knowledge and understanding to order and constitute the societies and culture that they create and live in (Ford, 2011b: 6; Rönnby, 2007: 66). Furthermore, a holistic picture of «maritime cultural landscape» will only be achieved across the boundaries of various disciplines, including geology, geomorphology, history, archaeology, ethnology and language (Westerdahl, 2011b: 340).

Having explained the terms that are used to be in this paper, the examination of the specific case study shall follow.

The case study of the coast of Larnaca: Evidence and Discussion

As it has already been mentioned, this paper aims to examine if the theoretical concept of «maritime cultural landscape» can be applied in the coastal area of Larnaca on the island of Cyprus in the Late Bronze Age (1600-1050 B.C.).

The chronological context of the case study is widely recognised as a time when significant social, economic and political changes defined a largely new framework on the island, as internal processes and external relations with the wider area of the East Mediterranean led to the «urbanisation», the intensification of metallurgical production, the development of trade and changes in burial practices and settlement patterns (Keswani, 2004; Knapp, 2008). Furthermore, its topographical context is specifically comprised of the bay of Larnaca, which occupies the area from Cape Pyla to Cape Kiti, and the coastal lowlands of Larnaca (Fig. 1).

The coasts from the Cape Pyla peninsula to Dhekelia are mostly bare, very rocky with just a few tiny and poor sandy patches (Yaacov, 1993: 23). The area from Dhekelia to the mouth of the Vasilikos River comprises the Larnaca Lowlands.

The Larnaca Lowlands are a gently seaward-dipping platform (Harrison *et alii*, 2013: 563). In this region muddy, poorly sorted alluvium was deposited during the end of Pleistocene period and early Holocene period (Poole/Robertson, 1991: 918). During the end of Pleistocene period, some sea level change was the dominant control on the erosive and sedimentary features in south Cyprus, although limited uplift may have taken place (Poole/Robertson, 1991: 919). During the Holocene period, high sediment supply has led to the progradation of coastlines and a metamorphosis of the simultaneous palaeo-environments from rocky coasts to del-

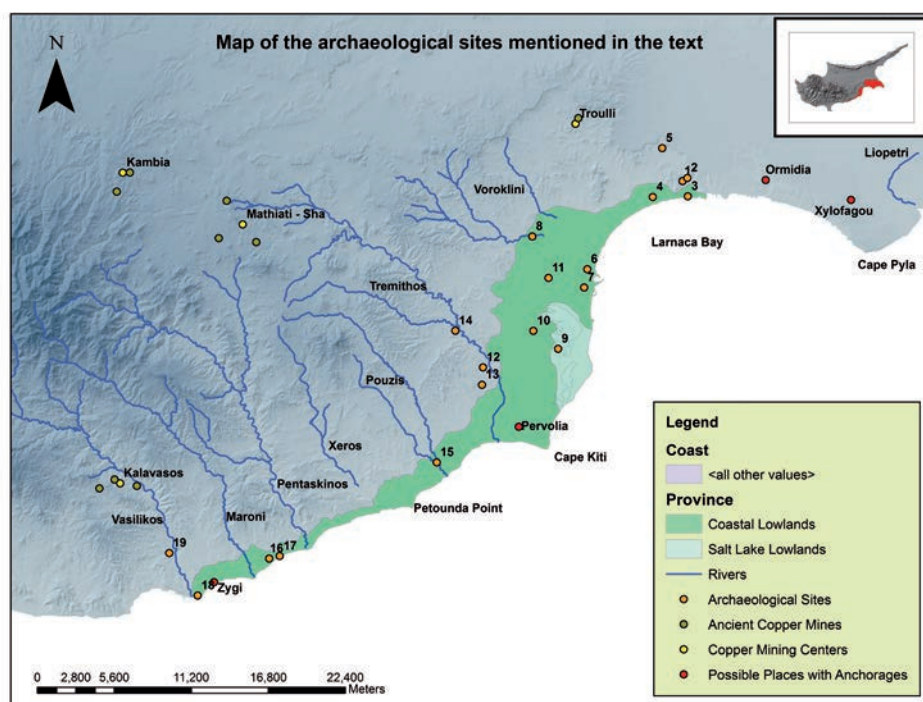


Figure 2. Map of the archaeological sites mentioned in the text. Archaeological Sites: 1. Pyla - Kokkinokremos, 2. Pyla - Steno, 3. Pyla - Koukoufouthkia, 4. Pyla - Verghi, 5. Pyla - Stavros, 6. Kition - Kathari, 7. Kition - Bamboula, 8. Aradippou - Kophinarga, 9. Dromolaxia - Vyzakia (Hala Sultan Tekke), 10. Dromolaxia - Trypes, 11. Laxia tou Riou, 12. Tersefanou - Arpera - Chiftlik, 13. Tersefanou - Arpera - Mosfilos, 14. Klavdia - Tremithos, 15. Kivisili - Yippos, 16. Maroni - Vournes, 17. Maroni - Tsaroukkas, 18. Tochni - Lakkia, 19. Kalavassos - Agios Dimitrios. Drawing by Maria Michael, 2014. (Digital Geological Data from the Department of Cyprus Geological Survey).

taic or lagoonal environments, which were exploited as harbours (Marriner/Morhange/Goiran, 2010: 21). Towards the end of the second millennium B.C. siltation of a number harbours, occurred due to increased rates of alluvation, as a result they were abandoned (Blue, 1995: 256). Nowadays, marine terraces, dunes and salt lakes underlie the coastal plain. The beaches in this area are narrow, and in most cases composed of small quantities of sand and some pebbles (Yaacov, 1993: 26). Six main rivers, the sources of which are at the Troodos main Massif, are reaching these shores (Figs. 1-2) (Bagnal, 1960: 13). These rivers introduce to the beaches high percentage of pebbles, while they create a number of river valleys along the south coast of Cyprus (Yaacov, 1993: 26).

Despite the geomorphological aspect of this area, Larnaca additionally has an archaeological aspect, as in its wide coastal area many archaeological remains have been discovered during this period (Fig. 2). In this paper, I will concentrate on coastal sites, but I will also mention some inland sites that help to the better interpretation of the coastal landscape.

To begin with the first area to be examined is this of Pyla (Fig. 2), whose name means a gate, as it is an easy passage from the inland of the island to its coast and vice versa. In this area, five sites are dated to the Late Bronze Age period (Fig. 2) (Caraher, 2014: 271-273; Catling, 1962: 168; Masson, 1966: 3). However, in this paper, I will concentrate to Pyla-Kokkinokremos (Caraher/Nakassis/Pettegrew, 2014: 26-31).

The Pyla-Kokkinokremmos (the red cliff) is a rocky plateau and rises steeply from the plain permitting excellent views of the surrounding land and sea, dominating not only the plain, but also Larnaca Bay and allowing for excellent defence of the site. On the east of the coastal

plain and ridges, the fertile red soils of the Kokkinochoria lie. This must have brought the same agricultural prosperity to the region in the past as they do nowadays.

Surveys that were carried out at the site have revealed that the whole plateau was occupied. Remains of houses, fortification walls and streets of a substantial, short-lived fortified settlement have been identified (Karageorghis/Demas, 1984: 6-24). A high standard of material culture with implications of wide-ranging external contacts is implied at the site by the wealth of bronze, silver and gold remains that have been recovered (Karageorghis/Demas, 1984: 29). There is also evidence of metallurgical activity at the site, as on the north-west of the site the copper mines of Troulli area lie (Fig. 2) (Catling, 1962: 144).

Furthermore, the plateau is surrounded by low-lying, marshy land, which is believed to have formed an almost enclosed harbour in antiquity, which was used for the development of the maritime activities of the specific settlement or other local, inland settlements (Dikaïos 1971: 896; Karageorghis/Demas, 1984: 5). During the course of a geomorphological survey, Noller has identified this lowland as having the definitive characteristics of a prehistoric to historic harbour (Caraher *et alii*, 2005: 246; Caraher/Nakassis/Pettegrew, 2014: 25-26, 43-46). A shore-parallel beach ridge, the remnant of an earlier high stand of sea level during the high stand of sea level in the Pleistocene period, would have been well-hardened against waves and formed a protected bay of more than 40 hectares in surface area. It was perhaps during the two most recent millennia that the embayment was finally filled with sediments shed from Pyla area watershed (Caraher *et alii*, 2005: 248).

However, there is also a possibility for the anchorage of this site to be located at the area of Ormidia, a word which most probably derives from the Greek word Ormos that means 'bay' (Fig. 2). The topographical location of this area and the existence of a small fishing boat shelter nowadays support this viewpoint. However, much more research must be applied before accepting this possibility.

The next site that can help with the reconstruction of the «maritime cultural landscape» of Larnaca is this of Kition (Fig. 2). The archaeological area of Kition chiefly consists of two sites, Bamboula and Kathari (Karageorghis/Demas, 1985; Karageorghis, 2005). The earliest phases of human habitation in Kition are found at the site of Kathari dated from the end of the 13th to the end of the 11th century B.C. It is the sacred area, as five freestanding structures were identified as public cult buildings (Karageorghis/Demas, 1985; Webb, 1999: 37; Yon, 2006: 37). Moreover, two *temene*, two workshop areas for the smelting of copper and a street system were located in this area (Webb, 1999: 64-84).

According to historical research and the geological surveys carried out, in order to understand the coastal changes that happened in this area, it is obvious that there was a harbour opened to the sea during ancient times. According to Nicolaou, who wrote about the historical topography of Kition, the harbour of Kition lay to the north-east of the city, where the sea penetrated inland to reach the foot of the hill that became the Acropolis of Kition, and as far south as the area of the Larnaca District Archaeological Museum (Nicolaou, 1976: 71). The sea also penetrated inland to reach the city-wall at the area of Kathari, while a small bay seems to be formed at this area in the last phase of the Pleistocene period (Nicolaou, 1976: 73-74). In historical times, the coastline was changed. The small bay at the area of Kathari became a marshland and only a closed bay, which interacted with the sea via a narrow inlet (channel), was shaped at the area of Bamboula. This closed bay probably was the closed, military harbour of Bamboula (Yon, 2006: 129-131).

Furthermore, the corehole samples taken by Gifford in the 1970's reveal a lagoonal environment present in the area of marsh that lies to the north and north-east of the site of Kathari

until at least the Hellenistic period (Gifford, 1978: 58-63, 163; Gifford, 1985a: 47; Gifford, 1985b: 384-385). This bay gradually silted up until the end of the Late Bronze Age when only a small inlet to the sea survived.

Morhange also suggests a hypothesis regarding the coastal palaeogeography and the harbour of Kition (Morhange *et alii*, 2000). He applied sedimentological and paleontological analysis and ¹⁴C dating of 17 cores that had been obtained in the vicinity of the Phoenician military harbour of Bamboula (Morhange *et alii*, 2000: 205). The results of this study for the period, which corresponds to a chronological period from approximately 2040 B.C. (Early Bronze Age) to 260 A.D. (Roman Period), present a calm and protected marine back-bay behind a *posidonia* layer (Morhange *et alii*, 2000: 221, 224-226). Furthermore, a growing coastal spit probably progressed quickly toward the north-east, progressively isolating a lagoon from the sea, approximately in 350 B.C. (Classical Period).

Based on the aforementioned data, it is obvious that Kition was a major harbour town of Late Bronze Age Cyprus, situated in the sheltered marine embayment of Larnaca. The trading character of Kition was also apparent from a wealth of imported material that has been recovered from this area (Webb, 1999: 42-43, 69, 71-83). In addition, it seems that the commercial and industrial activities of the inhabitants of this site were associated with their ritual activity, as the several sanctuaries of the site associated with metallurgical workshops and smelting kilns. For instance, within the northern workshop, copper smelting was associated with burnt bones, masks and anchors (Webb, 1999: 74-76). Furthermore, the twenty-one ship graffiti that are carved on stone blocks of Temple 1 and Temple 4 probably indicate a special relationship between cult and trade at Kition (Basch/Artzy, 1985: 322-336; Michail, 2015); as a result, it seems that the creation of monumental sacred areas during this period and their association with metallurgy and harbours probably proved that the ritual authority had under of its province a part of the commercial activity and the production of copper.

Around the middle of the 11th century B.C. collapsed structures at Kition imply a natural disaster, possibly an earthquake, which hastened the end of the period (Gifford, 1978: 17; Karageorghis, 1976: 92).

On the south-east side of the site of Kition, the main focus of Late Bronze Age occupation on the coast was at the site of Dromolaxia-Vyzakia, otherwise known as Hala Sultan Tekke (Fig. 2). This site is situated on the southwest of the main Larnaca Salt Lake, as there are five Salt Lakes in this area (Bagnall, 1960: 62).

According to the geoarchaeological survey that was carried out by Gifford, this site was built on a Late Pleistocene or Early Holocene alluvial deposit of the Tremithos River (Gifford, 1978: 2, 87). Furthermore, the results of the geoarchaeological surveys prove that the Larnaca Salt Lakes were an inlet directly open to the sea, which must have formed a lagoon or a marine embayment used as a natural, safe harbour between c. 1600-1175 B.C. (Devillers/Brown/Morhange, 2015; Gifford, 1978).

During the late second millennium B.C., the westward transgression of the sea caused by the rising sea level was reduced, and a net aggradation of the coastline seaward was caused. Northerly deposition of longshore drift sediments probably choked the one or more channels connecting the embayment with the open sea and eventually cutting it off from the sea (Devillers/Brown/Morhange, 2015: 75-79; Gifford, 1978: 35; Gifford, 1985b: 384). Consequently, this was the main reason for the isolation and abandonment of the harbour, which appears to correlate with the subsequent abandonment settlement at Dromolaxia-Vyzakia (Hala Sultan Tekke) during the 12th century B.C. (Devillers/Brown/Morhange, 2015: 79; Gifford, 1978: 168; Nicolaou, 1976: 12).

However, during the excavations by the Swedish Expedition in 2012 (Fischer/Bürge, 2013: 62-63), evidence of a catastrophic event was found and it proved that the city was partly destroyed in the 14th or the 13th century B.C. It possibly was caused by a *tsunami*, which was caused by an earthquake in the sea south-east of the shore of Cyprus (Fischer/Bürge, 2013: 63). Furthermore, there is a 2 m wide wall running roughly parallel with the sea, overlooking the ancient harbour (Fischer, 2012: 1). It was probably constructed in order to stop a tsunami wave. The possible *tsunami* may have been one of the reasons for the abandonment of the site, as the site ceased to exist shortly after 1200 B.C. This assumption about the tsunami can be supported by the GIS-based assessment of tsunami hazard on Cyprus, because the geological records indicate that every part of the Cypriot coast has been inundated by *tsunamis* (Noller/Zomeni/Panayides, 2011: 57). However, an intensive field study involving drilling of coastal sediments and considering the archaeological and historical records must be applied, in order to date and characterise the phenomenon of *tsunamis*.

According to the aforementioned data, the site of Dromolaxia-Vyzakia (Hala Sultan Tekke) was most likely one of the most important ancient harbours of the island certainly during the Late Bronze Age. The maritime character of the site is also obvious from the results of excavations at this site, as extensive foreign imports were revealed. The imported finds include Mycenaean pottery, Egyptian and Levantine objects of alabaster and glass, Cannanite jars, Cretan vase and stirrup jars of oatmeal fabric, cylinder seals, carved pieces of elephant tusks and faience from the Near East and lapis lazuli from Badakshan (Åström, 1986: 8, 15).

Furthermore, evidence of copper workshops has also been identified at the site. Copper ore and hundreds of kilograms of copper slag were noted (Fischer, 2011: 84). The copper slag and lead also point to the production of metal objects and weapons (Åström, 1986: 12; Fischer, 2011: 84). Numerous *tuyères* (clay pipes), which were used to blow air into the furnace in order to raise the temperature of the copper ore and in turn to extract the copper, were also found (Åström, 1986: 12).

Moreover, evidence of stone working and fishing hooks is apparent in this site (Åström, 1986: 14-15; Blue, 1995: 129). The murex shells, in connection with finds associated with the production of textiles, such as spindle whorls and loom weights (Fischer, 2011: 91-92; Fischer/Bürge, 2013: 55), point to the manufacturing of one of the most expensive products in the Bronze Age: purple dyed textiles (Åström, 1986: 11, 15).

Based on the aforementioned data, it is obvious that the inhabitants of this site have been involved in industrial and commercial activities, as the trade was one of their important activities and part of its social life.

Following, Late Bronze Age sites abound all over the area of Salt Lakes, but particularly nearer their west side (Fig. 2). These sites (Klavdia-Tremithos: inland settlement and necropole, Tersefanou-Arpera-Chiftlik: inland settlement and necropole and Tersefanou-Arpera-Mosfilos: inland necropole) are located within the river valley of the rivers Tremithos and Pouzis (Catling, 1962: 142-146, 161, 164, 166; Nicolaou, 1976: 11). It appears that their inhabitants were involved in both agriculture and trade. According to Gifford, the Tremithos River Valley was the main water source for the inhabitants and the crop irrigation in the Larnaca Lowlands (Gifford, 1978: 140-152). Furthermore, the numerous *pithos* sherds, which were found at the site of Klavdia-Tremithos, show that the site was able to store agricultural products, while the two stone moulds, four knives and some slag, which were found at the same site, indicate that manufacturing of bronze items took place at the site (Malmgren, 2003: 58-59, 120). Additionally, extensive foreign imports were revealed in these sites (Malmgren, 2003: 120), as a result, it seems that the trade was one of the important activities of their inhabitants.

According to Nicolaou, in these sites, which grouped in an intermediate position between the mining settlements of the eastern Troodos range and the coast, the inhabitants used the harbour of Dromolaxia-Vyzakia (Hala Sultan Tekke), in order to carry out their trading activities (Nicolaou, 1976: 10-12). Although there is the possibility that this large harbour functioned as their outlet for their products to the Mediterranean, there is also a possibility that an anchorage or a smaller Proto-harbour at Cape Kiti served for their maritime activities.

In accordance to the results of the underwater archaeological surveys carried out at the Cape Kiti area, the eastern side of Cape Kiti is probably an ancient anchorage of considerable importance (Åström *et alii*, 1977: 7; Engvig/Åström, 1975: 7-24; Hult/McCalsin, 1978: 97-157). The high concentration of anchors and other findings could be explained by the hypothesis that ships sought shelter here from the difficult winds and currents off Cape Kiti, and sometimes found themselves caught in the north-eastern winds, which suddenly arose (Fig. 3). Moreover, the results of the underwater survey that was undertaken in 1977 show that Cape Kiti was a convenient water stop in the Late Bronze Age and later periods (Hult/McCaslin, 1978: 130).

The assumption that the anchorage of Cape Kiti was useful for the trading activities of these sites can be further supported by the results of my research and the Larnaca Hinterland Project (Leonard, 1999; Leonard, 2000). According to the observations of the local topography suggested that it was very unlikely that the agricultural and metal products passed through these sites, in order to arrive at the large harbour of Dromolaxia-Vyzakia (Hala Sultan Tekke), which was located at the area of Salt Lakes. The topography of the area strongly suggests that an anchorage or a harbour must be somewhere on the coast of Kiti or Pervolia, in order to serve their trading activities (Fig. 2-3). Consequently, the possible anchorage at the Cape Kiti is a potential place.

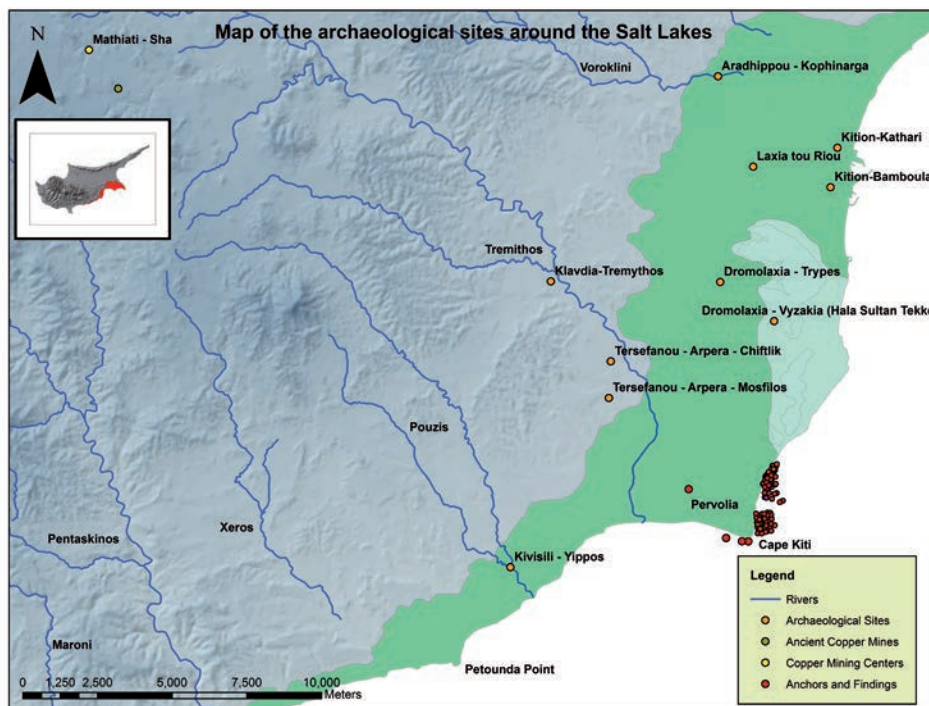


Figure 3. Map of the archaeological sites around the Salt Lakes. The map shows the high concentration of anchors and findings in the eastern side of Cape Kiti. Drawing by Maria Michael, 2014. (Digital Geological Data from the Department of Cyprus Geological Survey).

Furthermore, it seems that there is an easier way for these sites to conduct their trading activities. As it has already mentioned, these sites are located within the Tremithos River Valley. It is easier for someone, who travels down the Tremithos drainage toward the coast, at the point where the two upper branches of that river join near the site of Klavdia-Tremithos, to turn westward along the northern flanks of the Metsouvouno toward the Pouzis River drainage and then down that valley past Kivisili and on the sea, rather to cross to the east (Fig. 2-3). According to the observations of the natural topography, a harbour or an anchorage was located in this area (Leonard, 2000: 135-137). The settlement that probably controlled this harbour or anchorage is the settlement that is located at the site of Kivisili-Yippos (coastal settlement and necropole), which is located at the mouth of the Pouzis River.

Furthermore, there is the possibility that the trading activities of these or other inland sites can be conducted via a harbour or an anchorage, which was located at the area of Petounda Point (Fig. 2-3). The natural reefs that have been identified offshore of Petounda Point appear to provide shelter to a natural harbour, while a great deal of pottery and anchors have identified underwater in this area (Blue, 1995: 162-163). However, much more research must be applied before concluding.

Except for the river valleys of the Pouzis and Tremithos rivers, a number of river valleys along the south coast of Cyprus exist, such as the Maroni and Vasilikos Valleys, where many archaeological sites are located (Fig. 2). In this paper, the most well published sites from this area will be mainly mentioned.

The low hillock site of Maroni-Vournes is situated on the east bank of the River Agiou Mina or Maroni. The site encompasses an administrative centre, with an ashlar building, together with associated oil production, processing textiles and metallurgical areas (Cadogan, 1989). Quantities of Egyptian and Syropalestinian artefacts, together with Late Minoan pottery and an increased number of Mycenaean imported pottery, imply extended contacts with these regions (Blue, 1995: 163).

The aforementioned evidence supports that Maroni-Vournes was possibly a Bronze Age riverine anchorage, acting as an outlet for copper distribution and inlet for trade items, and served by the anchorage of Maroni Tsaroukkas, located along the shore to the south-east of the site (Blue, 1995: 163). However, Cadogan supports that the relationship between the site of Maroni-Vournes and the site of Maroni-Tsaroukkas is not certain (Cadogan, 2011: 398). This opinion can be supported by the results of the recent geophysical investigations, which did not provide any evidence for the grid system or the axial roads of the area of Maroni (Manning *et alli*, 2014: 24). Although the aforementioned data, there is the perception that at least one main route from the site Maroni - Vournes towards the area at Maroni-Tsaroukkas existed (Manning *et alli*, 2014: 24). This can be partly supported by the topographical features of this area.

The site of Maroni-Tsaroukkas has been identified along the coast, slightly east of the present mouth of the River Agiou Mina or Maroni (Fig. 2). The evidence from this site reveals the presence of a major Late Bronze Age centre in the area of Maroni (Manning *et alli*, 1994: 83-89). Late Bronze Age building remains have been found along the shore, with storage areas and evidence for production in the form of weaving, olive oil production and possibly metal working, together with an area of tombs in the cliff above the site (Manning/Monks, 1998: 298). Two terracotta boat models were found in these tombs (Manning/Sewell/Herscher, 2002: 109-110; Westerberg, 1983: 13-14); as a result, their presence along with many imported goods in these tombs that were located on a low bluff overlooking the sea seemed to emphasize the links between the society of the site with the maritime activities and the sea in general.

Offshore to the eastern end of the site, a high concentration of anchors of the Late Bronze Age type have been recovered with ceramic findings (Fig. 4) as a result, this area is suitable for a sheltered anchorage. According to Bell, who has taken some cores from the site, it appears that some meters of coastline, including a Late Bronze Age anchorage area has very likely been lost to a combination of minor sea level change, local tectonic movements and erosion (Manning/Sewell/Herscher, 2002: 111-113; Manning *et alii*, 2014: 23). Combining these data with the distribution of the anchors that lie directly off the excavated area at Maroni-Tsaroukkas, a hypothetical reconstruction of the coastline in this area was given (Manning/Sewell/Herscher, 2002: 113).

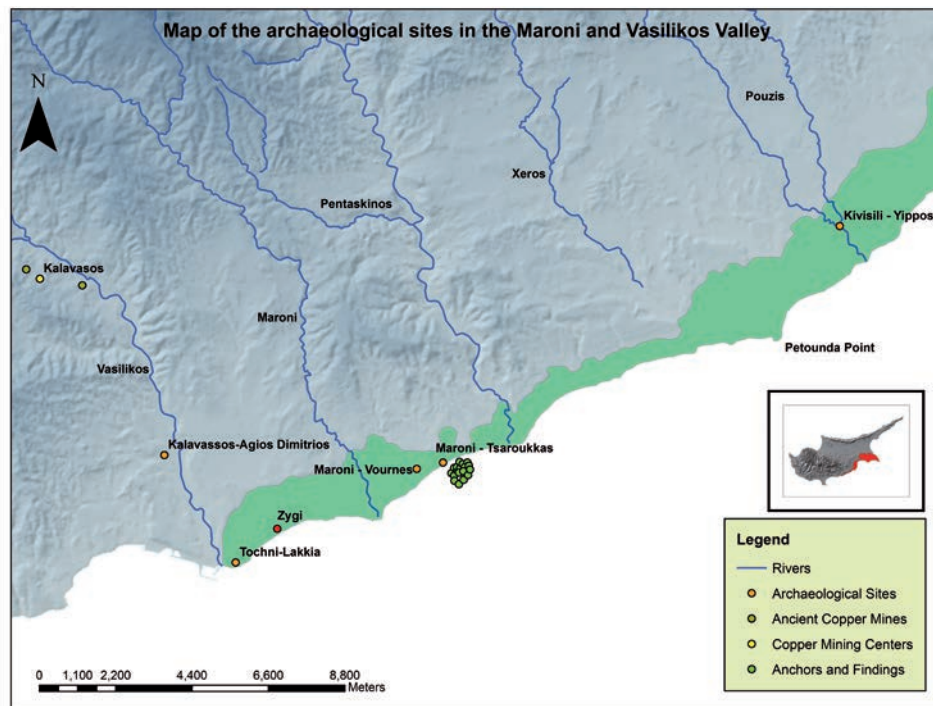


Figure 4. A map of the archaeological sites in the Maroni and Vasilikos Valleys. The map shows the high concentration of anchors and findings in the area of the site Maroni – Tsaroukkas. Drawing by Maria Michael, 2014. (Digital Geological Data from the Department of Cyprus Geological Survey).

Finally, a number of second millennium sites have been identified in the Vasilikos Valley, many of which were probably agricultural villages, farms and processing or storage facilities (South, 2002; Todd, 2004; Todd, 2013). The site of Kalavassos-Ayios Dhimitrios, which is certainly the biggest Late Bronze Age settlement in the Vasilikos Valley and can be characterised as a fully urbanised site (South, 2002), is situated inland from the Bay of Vasilikos (Fig. 2 and Fig. 4). It lies south of the area of the copper mines, while metallurgical activities are attested at the site by evidence of the remains of a smelting furnace, copper slag and metal objects, including fragments of oxhide ingots (Todd, 2013: 94). However, it should be clearly understood that no actual proof of Bronze Age use of the mines has been retrieved, as a result it is not clear if the copper slag is local (Todd, 2013: 96).

Moreover, amongst the finds recovered from this site, the most outstanding architectural complex is the ashlar building X, the west side of which was devoted to a pillared storage hall, as it contained massive *pithoi* that chiefly stored local olive oil or wine (South, 1989: 321; South, 2002: 61). Furthermore, the quantity of imports recovered at the site clearly indicates that trade was a part of the life in the society (South, 1989: 320).

According to Blue, it is feasible that the site was a riverine anchorage served by the reasonably sheltered bay at Zygi, where Bronze Age material has been recovered (Figs. 2-4) (Blue, 1995: 131). An alternative possibility is that the site was served by Vasilikos Bay since it is eastern from the site and the topography shows that it is easier to transfer products to a nearest anchorage rather than to the area of Zygi. Furthermore, the presence of a metalled road and a mining railway that run the length of the Vasilikos Valley from Kalavassos down to the coast probably shows that a same way may have been used too during the Late Bronze Age, in order to transfer products and copper from the inland sites and mines to the coast (Todd, 2004: 15-16; Todd, 2013: 93). However, the industrial development of Vasilikos and the presence of a small factory and port in this area have certainly destroyed any features that existed in the area from the Late Bronze Age. These are also the main reasons that no underwater survey has been carried out adjacent to the mouth of the Vasilikos (South, 2002: 63).

On the other hand, the coastal site Tochni-Lakkia, which is situated on the east of the valley mouth, can function as a coastal settlement that managed an anchorage or harbor from where copper and other local products dispersed to the Mediterranean (Figs. 2-4). According to the results of the survey conducted by the Vasilikos Valley Project, the site consisted of Late Bronze and Archaic period remains with a scatter of latter period pottery as well (Todd, 2004: 133-134). Based on the results of the Tochni-Lakkia Maritime Survey Project, the most obvious evidence of the site is the eroding coastal cliff, which consists of multiple buildings that are chiefly dated in Late Bronze Age (Sewell, 2013: 3). A notable number of artefacts, *pithoi* installations, stone tools and other features suggest that this site is a settlement, which may have gathered agricultural production and/or functioned as a transshipment site for the site of Kalavassos-Ayios Dimitrios and other sites further up the Vasilikos (Sewell, 2013: 3). The presence of a possible pottery kiln and enigmatic pits also supports the possibility of pottery making in this site (Sewell, 2013: 3).

Furthermore, a number of sherds recovered during the underwater survey at the area of Tochni-Lakkia (Sewell, 2013: 7). Most of these sherds were of Late Bronze Age date, while they chiefly were of storage jars, *pithoi* and utilitarian wares (Sewell, 2013: 7). Consequently, based on the aforementioned data, the coastal site Tochni-Lakkia could act as an outlet for copper distribution and inlet for trade items and served the site of Kalavassos-Ayios Dimitrios or other sites within the Vasilikos Valley. However, further research would be needed to help clarify if this was its role, while protective actions must be taken, in order to protect the archaeological remains and the coast from the rapid erosion.

Conclusions

Overall, it is obvious that a number of evidence, which proves the existence of harbours and anchorages, and supporting archaeological records are located within the area of the case study. Their gathering and their study with the geological and topographical data can hypothetically reconstruct «the whole network of sailing routes with harbours and anchorages along the coast, and its related constructions and remains of human activity, underwater as well as terrestrial» (Fig. 5). Their study can also provide a general view of how did the natural rhythms of the coast structure people's lives or how did people value and interact with the littoral environment. For example, the isolation of a harbour from the sea, as happened to the harbour of Dromolaxia-Vyzakia (Hala Sultan Tekke), can lead to the abandonment of the settlement.

The «maritime cultural landscape», however, is difficult to fully reconstruct, due both to a lack of data and to the wealth of information that must be considered (Ford, 2011b: 3).

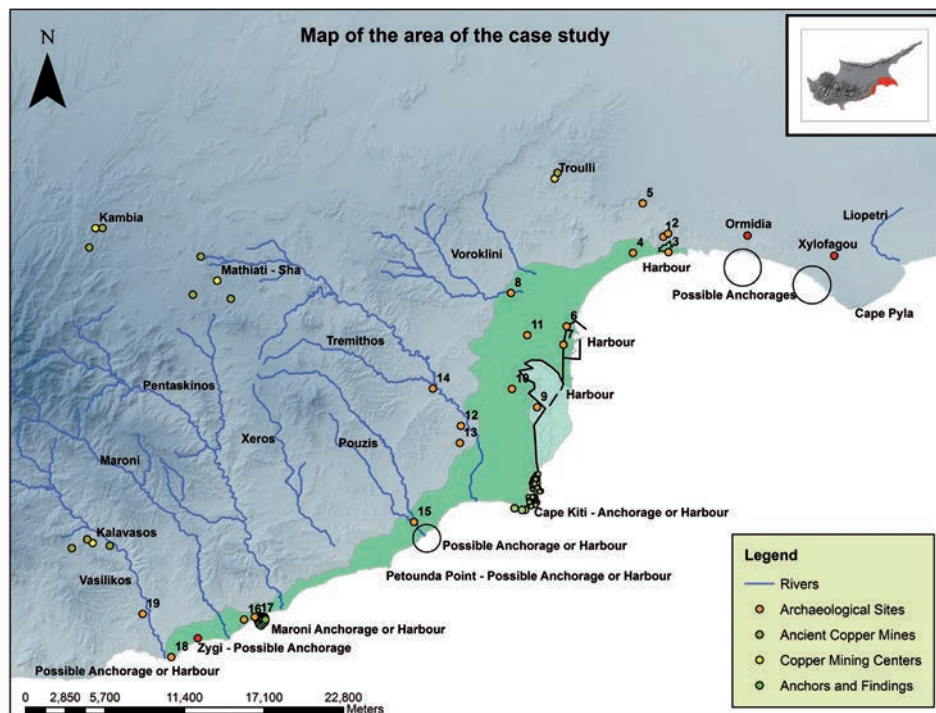


Figure 5. A possible reconstruction of the coast and places of harbours or anchorages during the Late Bronze Age (1600-1050 B.C.). Archaeological Sites: 1. Pyla - Kokkinokremos, 2. Pyla - Steno, 3. Pyla - Koukoufouthkia, 4. Pyla - Verghi, 5. Pyla - Stavros, 6. Kition - Kathari, 7. Kition - Bamboula, 8. Aradippou - Kophinarga, 9. Dromolaxia - Vyzakia (Hala Sultan Tekke), 10. Dromolaxia - Trypes, 11. Laxia tou Riou, 12. Tersefanou - Arpera - Chiftlik, 13. Tersefanou - Arpera - Mosfilos, 14. Klavdia - Tremithos, 15. Kivisili - Yippos, 16. Maroni - Vournes, 17. Maroni - Tsaroukkas, 18. Tochni - Lakkia, 19. Kalavassos - Agios Dimitrios. Drawing by Maria Michael, 2014. (Digital Geological Data from the Department of Cyprus Geological Survey).

For instance, no archaeological records are located at the area of the Cape Pyla. This phenomenon probably depends on the geomorphological context of the area, which is too rocky, or on the limited research that has been conducted in this area. However, it seems that there is quarrying activity (Φιλοχύπρου, 1998: 144-145), while some anchors have been found underwater at the area of Xylofagou (Fig. 5). According to this evidence, it seems that there is human activity in this area, but much more research should be conducted, in order to understand if there was an anchorage that served the quarry or a settlement in this area.

Additionally, the comprehensive reconstruction of the «maritime cultural landscape» of the coast of Larnaca is a difficult task, because its coast has been drastically changed from the Late Bronze Age period to the present, as many of its natural bays and lagoon environments that served as harbours or anchorages during this period were silted up or were eroded. As a result, many of the sites, such as Pyla-Kokkinokremos, Kition and Dromolaxia-Vyzakia (Hala Sultan Tekke), turned from harbour or anchorages to coastal sites that are located some meters far away from the sea, while some sites, such as Tochni-Lakkia, lost into the sea. The activity of quarrying, which is observed in this area (Φιλοχύπρου, 1998), can also contribute to change the quality of the shore or to demolish any archaeological evidence. Moreover, the result of the inconsiderate construction of large tourist facilities (hotels, marinas etc) has been dramatic on landscape of this area. Consequently, it is necessary to establish a detailed inventory of the archaeological evidence of this area and to develop policies for their protection, preservation and management. A closer incorporation of antiquities in the coastal management legal system must be also applied and a large scale survey assessment of the coast must be launched, in order to protect the cultural heritage of the coast.

Furthermore, it is difficult to provide a complete picture of the harbour facilities located in this coastal area, because no harbor works have yet been found on the Eastern Mediterranean which dated in the second millennium B.C. (Blackman, 1982: 90; Oleson/Hohlfelder, 2011: 809-812). However, the existence of the evidence of these harbours or anchorages on this part of the southern coast of Cyprus can give reason to understand that this coastal area has been the favoured safe anchorage for seafarers and had been involved in the Late Bronze Age trade. The appearance of imported objects and pottery, the stone and metal working and the production of textiles, tools, olive oil and wine almost in every Late Bronze Age site prove that the industrial, commercial and agricultural activities were part of their inhabitants' lives. Additionally, the appearance of boat models and ship graffiti within their ritual and burial environments supports that their inhabitants were involved in maritime activities and corroborates the maritime character of these sites.

In conclusion, it is obvious that the attempt to understand and reconstruct the «maritime cultural landscape» of the coast of Larnaca during the Late Bronze Age, creates numerous questions, which are difficult to answer. Although the evidence of harbours and anchorages sets in their geographical, economic and cultural context, it is complicated to distinguish how a harbour related with their hinterland or with other harbours. Furthermore, the position of sites such as Kalavassos-Ayios Dimitrios, Maroni and Pyla and their large share of foreign imports raise questions regarding the role of the other harbours or anchorages that were located in the area of Larnaca, for example, if they were secondary or if the harbours of Kition and Dromolaxia-Vyzakia (Hala Sultan Tekke) were the principal harbours of Larnaca Bay during the Late Bronze Age. Furthermore, the absence of settlements in areas, where there were harbours or anchorages, increases questions such as how some harbours developed without relating with a city or a settlement. For instance, it is not clear if the potential evidence of the anchorages at the area of Petounda Point, the area of Zygi or the area of Ormidia related with a coastal settlement or with a specific inland site.

In order to answer these questions, much more interdisciplinary research must be conducted. However, at the moment it is clear that there is not a systematic protection and research of the whole coastal area of Larnaca. Consequently, there are generally more questions than answers about this field of study in Cyprus.

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Interaction, production and exchange in Late Bronze Cyprus: The case of Tochni Lakkia

Interacción, producción e intercambio en el Bronce final en Chipre: el caso de Tochni Lakkia

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Abstract: Tochni Lakkia is a Late Bronze Age and Iron Age site located near the mouth of the Vasilikos River on the south central coast of Cyprus. In recent years, erosion to the site has exposed a series of features including multi-period walls, floors, and installations for pottery production. These components suggest that this settlement was one in a series of local anchorages along the south central coast in the Late Bronze Age linking Cyprus to the Eastern Mediterranean international trade. In 2013-2014, the underwater survey was conducted to examine the eroding site of Tochni Lakkia and its proximal offshore environment. The intent of the survey was to seek physical evidence of the maritime role of Tochni Lakkia and understand its broader economic and socio-political integration with other contemporaneous Vasilikos valley sites. The findings from the underwater survey attest to the large degree of coastal erosion that has impacted the site.

Key words: Underwater survey, Cyprus, Bronze Age, anchors, trade.

Resumen: Tochni Lakkia es un yacimiento del final de la Edad del Bronce o inicio de la Edad del Hierro situado cerca de la desembocadura del río Vasilikos en la costa centro-sur de Chipre. En los últimos años, la erosión ha dejado expuestos varios elementos como paredes de varios periodos, los pisos y las instalaciones para la producción de cerámica. Estos componentes sugieren que este asentamiento fue uno de una serie de fondeaderos locales a lo largo de la costa

centro-sur que unían Chipre con el comercio internacional en la Edad de Bronce. En 2013-2014, la campaña subacuática se realizó para examinar la erosión en el yacimiento y su entorno marino próximo. La intención era encontrar pruebas físicas del papel marítimo de Tochni Lakkia y comprender su integración económica y socio-política con otros sitios del valle. Los resultados de la campaña subacuática atestiguan el alto grado de erosión costera que ha afectado al sitio.

Palabras clave: prospección subacuática, Chipre, Edad del Bronce, anclas, comercio.

Introduction

During the Late Bronze Age, material evidence indicates that Cyprus became connected to the wider Eastern Mediterranean world, causing significant changes in political and economic spheres on the island (Knapp, 2013: 416-451). Together with these changes in the Late Bronze Age trade networks, archaeological results indicate that there were also increases in visible coastal settlements in the southern river valleys (Keswani, 1996: 217-220; Knapp, 2013: 353-359). For example, along the south central coastline of Cyprus in the Vasilikos Valley, the Late Bronze Age settlement of Kalavassos *Ayios Dhimitrios* has an organized street plan and an impressive monumental building with a large-scale hall that had huge *pithoi* for storing organic materials (South, 1996). Given the storage capacity of the building, it is possible that any surplus would have been exported (South, 1995: 192-195). However, Kalavassos *Ayios Dhimitrios* is located about 3.5 kilometers inland, thus raising the question of which port was used for importing and exporting goods (Knapp, 1997: 156-157).

In looking for patterns between anchorages and coastal settlements, the site of Maroni Tsaroukkas approximately eight kilometers away in the neighboring Maroni river valley offers a parallel (Fig. 1). The area of Maroni Tsaroukkas consists of a complex of large late Cypriot buildings and



Figure 1. Map of the south central coastline of Cyprus showing the location of the Late Bronze Age and Iron Age site of Tochni Lakkia, in relation to the Late Bronze Age sites of Kalavassos Ayios Dhimitrios and Maroni Tsaroukkas.

tombs, the extent of which is still being determined (Manning/Monks, 1998; Manning *et alii*, 2014). Maritime activity off of Maroni Tsaroukkas has been confirmed by underwater surveys in 1993-1996 in which fifty anchors were located within 300 meters of the current coastline (Manning/Sewell/Herscher, 2002). This grouping of anchors is evidence for the maritime activity that occurred in conjunction with the site of Maroni Tsaroukkas and likely served as a gateway for importing and exporting goods to and from the other sites in the Maroni Valley, which have been identified in the Maroni Valley Archaeological Survey Project (Manning/Conwell, 1992; Manning *et alii*, 1994).

One hypothesis is that a similar situation occurred for the Vasilikos Valley in which a settlement would be situated near the mouth of a river to serve as a gateway into the valley. The Vasilikos Valley has been the subject of intensive survey, within which the site of Tochni Lakkia was identified to the east of the mouth of the Vasilikos River (Todd, 2004: 133-134). Given the location of Tochni Lakkia, it seemed likely that the site could fulfill this role. Since its discovery in the 1970s, the continued erosion of the coastline at Tochni Lakkia has exposed more features and artifacts, such as walls, floors, and ceramics dating to the Late Bronze Age and Early Iron Age (see the article by Andreou in the current volume). Today, the site of Tochni Lakkia now exhibits a four-meter scarp along the coastline that is increasingly being scoured away. On land, the site is marked by actively farmed land and the British East Mediterranean Relay Station, with the land inside neither being ploughed or farmed. Recent recording of the exposed features along the coastline has been undertaken by Andreou and Sewell since 2011, and the discovery of a kiln and tanks for settling clay suggests that the site was involved in pottery production. Given this level of storage and production at the site, it seems possible that Tochni Lakkia would have functioned to help facilitate trade and movement of goods overseas. Consequently, in order to determine whether Tochni Lakkia was used as a port or whether the waters offshore were used as an anchorage, we conducted an extensive underwater survey in June 2013 and June 2014 immediately offshore.

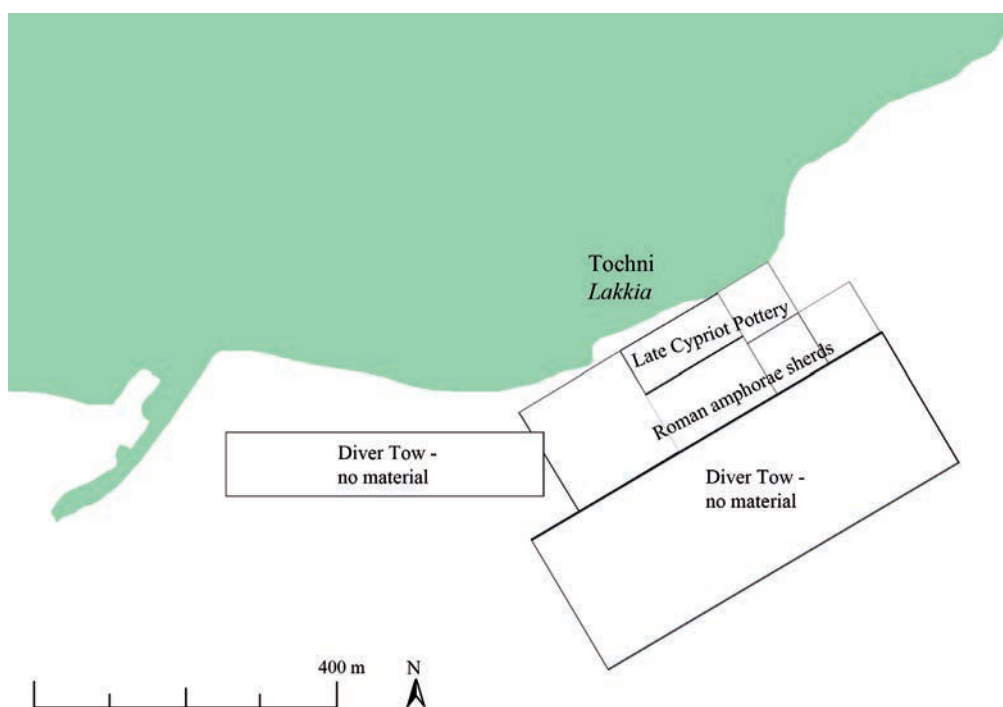


Figure 2. Areas surveyed in 2013. The GPS tracks were within the eight regions marked on the map covered by a team of three divers swimming a transect, except for the two areas with towed divers. There was a general division in the location of the remains; sherds from Roman transport amphorae were discovered approximately 150-300 meters from the current coastline, whereas remains from Late Bronze Age pottery were discovered approximately 50 meters from the current coastline. The ceramic remains from the 2013 and 2014 surveys were identified by Sturt Manning.

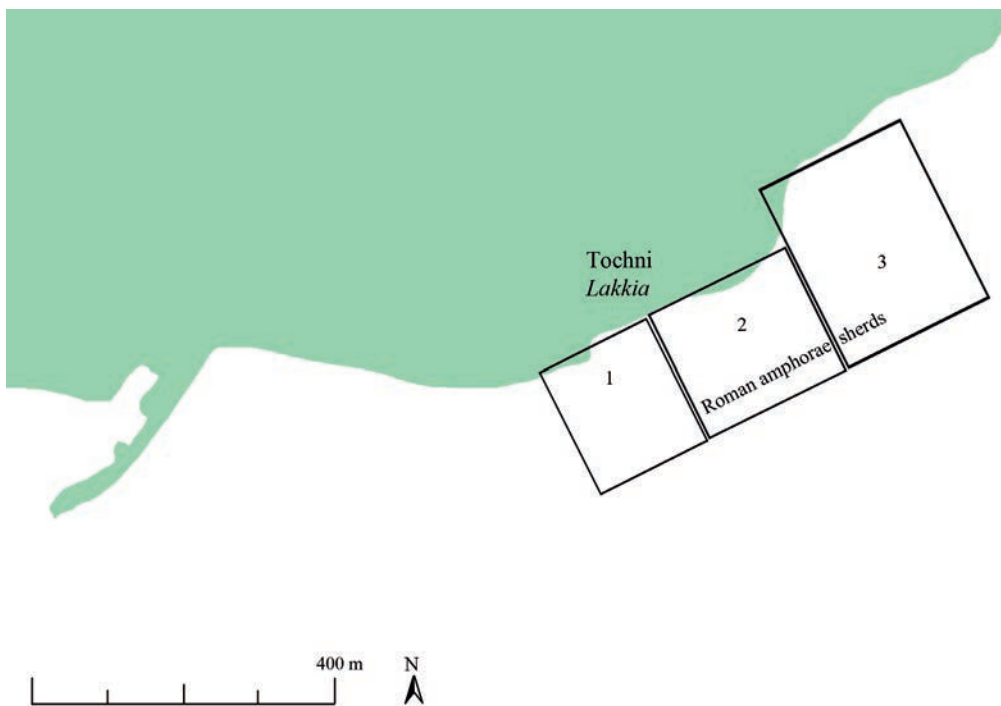


Figure 3. Areas surveyed in 2014. The GPS tracks were within regions 2 and 3 marked on the map covered by a team of three to four divers swimming a transect. Only six sherds of Roman transport amphorae were discovered.

Survey methodology

In the first season of survey in June 2013, we conducted a series of transects and towed surveys within the waters directly off of Tochni Lakkia, covering out to approximately 500 meters off-shore (Fig. 2). To cover the area effectively we combined methodologies of snorkeling transects for shallow waters, diving transects, and towed surveys further off shore. For the snorkeling and diving transects, survey activity was generally conducted by a three-person team swimming across a 15 meter swathe along a bearing. In order to ensure complete coverage, the area off Tochni Lakkia was divided into eight regions with deployed buoys to demarcate certain search areas. The placement of the buoys was directed from shore, generally along a compass bearing of due south. The positions of the deployed buoys were then fixed by GPS as a mark or encompassed within the track log record of the GPS unit. The track of the team was recorded by a GPS unit that had been attached to a dive float and towed by the person in the center of the team. All GPS coordinates were taken on a GARMIN GPSmap 78SC using WGS84 datum in hddd° mm.mmm' format with an accuracy of ± 3 meters. For the towed diver survey, the GPS unit was stored on the boat and the diver would indicate whether he or she noticed anything of interest, which would then be marked.

Due to the heavy amount of coastal erosion and high degree of turbidity in the nearshore region, the team returned in June 2014 to survey off Tochni Lakkia. The 2014 program was meant to assess whether material culture associated with maritime activity, rather than coastal erosion, had been exposed in the intervening twelve-month period. In 2014 the underwater site was subdivided into three areas to reflect our knowledge of the marine environment acquired during the previous season (Fig. 3). Working from our acquired knowledge that erosion, currents, and wave action moved material along the coast in an easterly manner, the two areas designated to the east of the main site were required to be resurveyed out to 400 meters and along the coast

for 600 meters. These targeted sections were the most likely to show any material that had been recently scoured out from the substratum or scarp as well as include any material transported eastward from the main site. As in 2013, the divers swam a transect with a towed GPS unit to record the tracks. For both seasons, any ceramic evidence was collected for identification and documentation and then returned to the sea.

Evidence of material remains

Within this survey area in both 2013 and 2014, we did not observe any remains of anchors or other structures indicative of direct maritime interaction with Tochni Lakkia. However, over one hundred pottery sherds were collected for identification that signified evidence for both maritime activity directly offshore and also a high degree of coastal erosion from the site. The ceramic remains included 69 sherds of Late Cypriot pottery in the nearshore region within approximately 50 meters from the coastline and 42 sherds of late Roman transport amphorae located starting at approximately 150 meters offshore (Figs. 2 and 3). There were 29 undiagnostic sherds.

Most of the Late Cypriot sherds were discovered within the subtidal region, either wedged between or beneath rocks. The majority were coarsewares that had been heavily abraded by the souring and churning action associated with a nearshore, high-energy environment. One cluster of large *pithoi* fragments indicates the presence of large storage jars at the site. A sherd of Late Cypriot I white slip was discovered very close to the shore with little evidence of wear, indicating perhaps it had been recently eroded from the scarp. Additionally, a pot scatter was discovered 6 meters from shore. In this scatter, most of a medium sized globular flask or jug had been preserved, protruding 10 to 15 centimeters above the seabed with the rest of the pot buried in sediment. Once rocks and gravel had been cleared from around the pot, a second storage vessel was uncovered that was half preserved as well as a number of other sherds. It is possible that this deposit was originally in a pit or similar feature below the main occupation levels, thereby preserving it in an area in which there is a substantial amount of erosion due to wave action.

While the Late Cypriot ceramics were discovered in the nearshore region, Roman amphorae body sherds were located farthest out, perhaps indicative of debris from a trading route. These remains were located from approximately 150 meters to 300 meters offshore. In 2013, two sherds were identified that had become concreted into the rocks and reef system, indicative of their prolonged presence in the area with little environmental interference from wave action. In 2014, only six sherds were located no further than 150 meters offshore from Tochni Lakkia. Because these remains are all Late Roman and highly abraded, it is possible that they were once ceramic vessels that had been jettisoned from Roman ships. Alternatively, based on prevailing currents, the sherds could have eroded from a coastal site further to the west.

Environmental considerations

Offshore from Tochni Lakkia, the depth profiles can be divided into four regions: a subtidal zone up to two meters and approximately 50 meters offshore, two to four meters deep at 50-150 meters offshore, up to eight meters deep at 150-250 meters offshore, and sloping past ten meters approximately 250-600 meters offshore (Fig. 4). For the corresponding substratum, the subtidal zone near the relay station was inundated with modern cultural material that had been dumped off the point. There were a few larger rocks resting on a sandy sediment bottom. Further east, however, the subtidal was comprised of rounded rocks and smaller algal covered boulders. Rocks in this region had clearly been moved and rolled around in the wave action as evidenced by their position on top of pottery. In the substrate across the region corresponding to the ap-

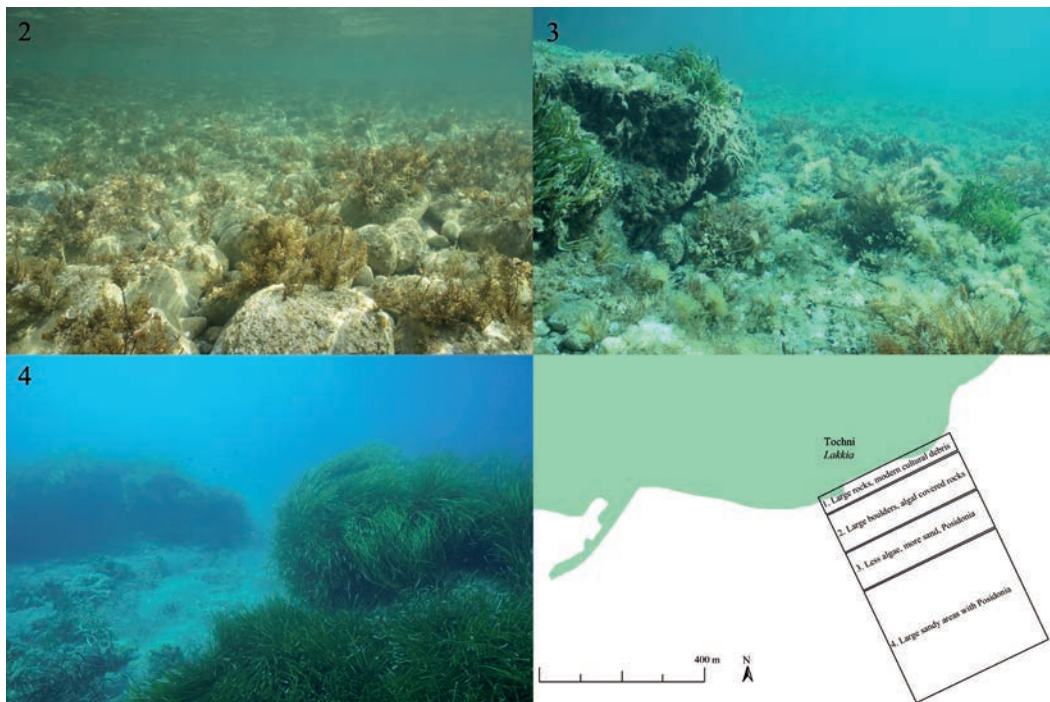


Figure 4. The nearshore marine environment can be divided into four separate types based on substratum. This environment with mechanical action and modern debris likely heavily influenced the preservation of the cultural materials.

proximate depth of two to four meters, rocks were concreted into a reef system and were covered with seaweed, thus hindering visibility of the bottom. Within this area, there were also remains of Pleistocene riverbeds as shown by stacks of stones. A similar substrate was found within the 150-250 meters range but with the addition of larger mounds often covered in *Posidonia* grass beds. Beyond 250 meters, sand seemed to be the predominate substratum punctuated by large sea grass beds, especially at the farthest and deepest extent of the survey.

Within the nearshore area, efforts were made to establish the depth of overburden to the limestone bedrock. Excavation conducted by hand fanning resulted in locating modern synthetic material that was next to the bedrock of limestone. Much of the material was trapped under several large rocks with loose sand. The depth to the bedrock was typically no more than 0.4 to 0.5 meters. This shallow amount of overburden meant that there was little sand and soft sediment in which artifacts would be buried or protected.

The makeup of the seafloor is significant because it can help interpret the results of the survey. A high degree of turbulence was evident from regions where the seaweed and grasses were unable to grow. Also, some smaller boulders in the nearshore region rested on top of Late Cypriot sherds that were in turn on top of modern cultural material. This sequence indicates that material discovered in this region was likely not in its primary context, unless buried deep in the substratum such as the pot scatter. In the deeper waters, some late Roman sherds had been concreted into the reef system, indicating both that this location was more stable but also that biological activity could obscure detection of the remains. The prevailing longshore currents, aided by the prevailing winds, were sweeping material to the east, thus shifting not only cobbles, boulders, and gravels to the east but also likely moving any eroded cultural material as well.

Similar to the reported finds from the 2013 survey, the subtidal zone as observed in June 2014 remained inundated with modern cultural material that had been dumped off the point,

especially near the relay station. Rocks in this region had clearly been moved and rolled around by wave action. Due to the heavy storms in the intervening winter months between the 2013 and 2014 survey, a light covering of *Posidonia* had been deposited along the coastline. Tochni Lakkia was possibly sheltered slightly by the shape of the coastline since nearly a meter of *Posidonia* had been deposited at Maroni Tsaroukkas. There was also additional erosion of the coastal scarp between the two seasons. The storm activity that preceded the 2014 survey, however, did not reveal any new cultural material in the area of Tochni Lakkia.

Discussion

The Late Bronze Age and Iron Age site of Tochni Lakkia is rapidly eroding into the sea. In a visit to the site in 1990 as part of the Vasilikos Valley Project, Ian Todd noted that the beach is continually changing due to the erosion, but in some places the beach rose gently up to the adjacent field (Todd, 2004: 133). The present condition of Tochni Lakkia is remarkable in that the beach no longer gently slopes to the level of the adjacent field at any point. Instead, there is a two to four meter scarp along the entire coastal zone, with more of the site significantly being eroded each year. The two seasons of extensive underwater survey in 2013 and 2014 off of the main site of Tochni Lakkia identified the remains of Late Bronze Age pottery that had been exposed from the eroding beach scarp. It seems that some pieces, such as the intact pot assemblage, may have been evidence for the extent of the site and the degree to which the site had eroded. Additionally, some pottery, such as the Late Cypriot white slip sherd, had only recently eroded into the sea given its sharp and preserved edges, unlike other pieces which were highly abraded from years of maritime action.

While no cultural material could be directly associated with maritime activity of a likely Late Bronze Age date, we were able to attribute a possible reason for the absence of remains to the environmental erosion at the site, which was likely exacerbated by the modern industrial activities directly to the west of the site. Sea grasses and soft corals are not well established in the area directly offshore from Tochni Lakkia and, if present, they are typically small. This lack of organic life is indicative of a highly mobile environment with mechanical abrasion prevalent. Indeed, the site is exposed to seasonal, predominant southerly or southeasterly winds. Moreover, while Tochni Lakkia is immediately bordered by the British East Mediterranean Relay Station, which likely is even built on top of the site, there are other industrial facilities with recent activity that have significantly altered the coastline to the west of Tochni Lakkia, with devastating implications for the site. These facilities include the Vasilikos cement factory with its large port structure and the construction of the maritime terminal for tankers to export natural gas from the Vasilikos energy center. Actions associated with the use of these structures have likely facilitated underwater destruction and ultimately exacerbated the coastal processes of erosion.

While it seems highly plausible that Tochni Lakkia would have been a point of maritime trade in the Late Bronze Age due to its proximal relationship both with the Vasilikos river and sea, no archaeological evidence has been uncovered that substantiates direct maritime activity. Natural and cultural processes in the intervening years have likely negatively impacted the underwater record and the most obvious location to continue investigation is at the mouth of the Vasilikos River. Unfortunately, this location is not safely or practically accessible given modern activities and any materials have likely since been destroyed. With the absence of remains, the relationship between Tochni Lakkia and nearby areas is still unclear; either Tochni Lakkia had not been used as a harboring area in the Late Bronze Age, or, as is more likely, evidence for maritime activity at Tochni Lakkia has been lost due to industrial and environmental processes.

In order to further contextualize and interpret the results of the underwater survey, land-based investigation of the site is continuing to determine the components of the site before they

are completely lost due to coastal erosion. With a lack of material in the underwater environment, the results from land excavation and survey are critical to proving any maritime connections, such as looking towards imported objects or grave goods. Additionally, future maritime work will include surveying to the east of the site in order to fully survey the areas both to the east of Tochni Lakkia towards Maroni Tsaroukkas as well as to the west of Tochni Lakkia to better clarify our view of the Bronze Age maritime landscape.

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Late prehistoric submerged settlements and their cultural and environmental landscape

Asentamientos sumergidos del periodo tardío prehistórico y sus paisajes cultural y ambiental

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Abstract: The Early Iron Age settlement in Powidz was discovered in the 90's of the 20th century. From 2000 to 2002 underwater archaeological excavations were conducted on the site. The surveyed area of 5000 square metres brought to light wooden piles, quern-stones and pottery sherds. The settlement was studied by a number of researchers however its aquatic landscape, both cultural and environmental, request detailed exploration. Elements of the landscape coexist and influence each other. Changes within the ecosystem cause reaction in human behaviour whereas decisions undertaken by people may lead to unstoppable changes within environment. That struggle with harshness of waterish conditions, in order to gain food and protection from enemies, is reflected in the everyday actions of lake dwellers and is well documented. Similarly to the structure of the landscape often the cooperation within science is required. Therefore for a better understanding of archaeological case studies the help of botanical and ethnographical analyses is essential.

Key words: Iron Age, environmental archaeology, Poland.

Abstract: el asentamiento de Powidz (Primera Edad del Hierro) fue descubierto en la década de 1990 y excavado entre el 2000 y el 2002. En el área de trabajo, de 5000 metros cuadrados, se descubrieron postes de madera, piedras de molino y cerámica. El asentamiento fue estudiado por varios investigadores, sin embargo, su paisaje acuático, cultural y medioambiental necesita una investigación detallada. Los elementos del paisaje coexisten y se influyen mutuamente. Los cambios de los ecosistemas influyen en el comportamiento humano y las actuaciones humanas pueden llevar a cambios medioambientales imparables. Esa lucha contra la hostilidad de las condiciones acuáticas, a fin de obtener alimentos y protección frente a los enemigos, está bien documentada y se refleja en las acciones cotidianas de los habitantes del lago. Al igual que en el paisaje, en la ciencia se requiere a menudo cooperación. Para una mejor comprensión de los estudios arqueológicos es esencial la ayuda de análisis botánicos y etnográficos.

Palabras clave: Edad del Hierro, arqueología medioambiental, Polonia.

LATE PREHISTORIC SUBMERGED SETTLEMENTS AND THEIR CULTURAL AND ENVIRONMENTAL LANDSCAPE

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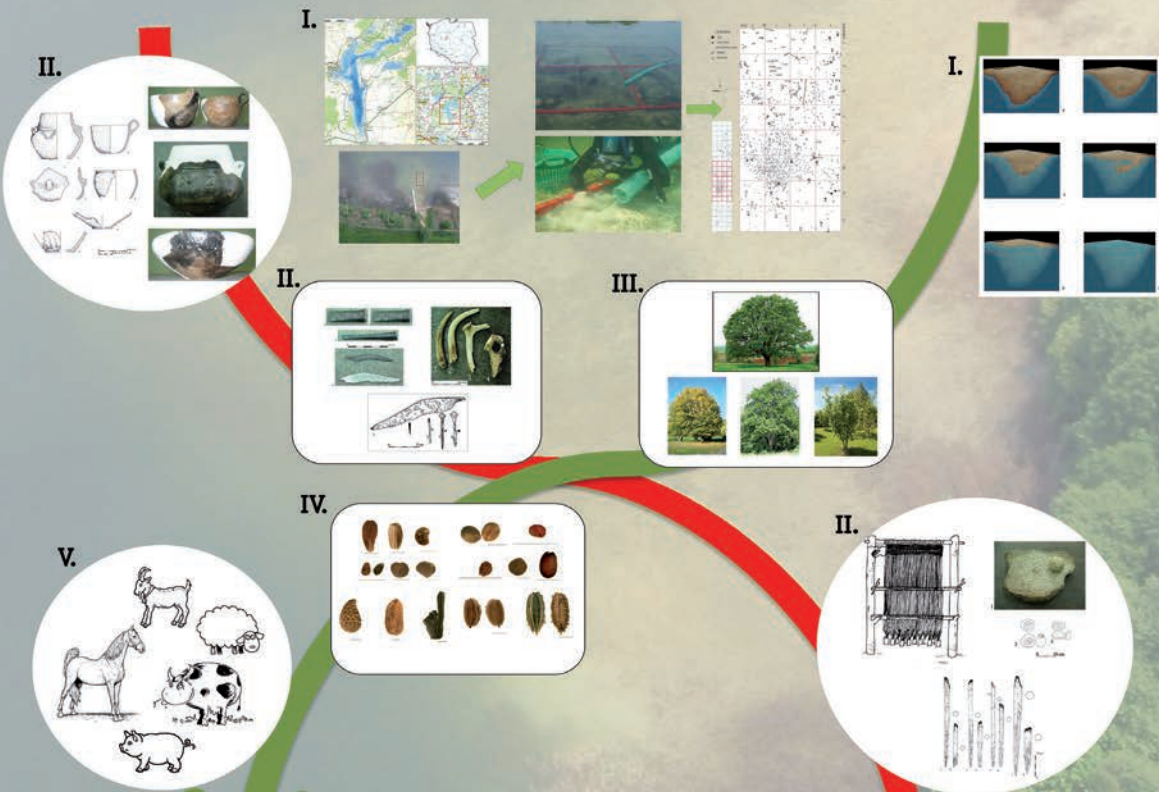
I. Lake Powiśle is of 1175 ha size and is the biggest reservoir of the Great Poland region. It is also one of the deepest lakes in mentioned part of Poland (46 m) of the average depth of 11.5 m. The primary shape is given by 2 long ribbons with a very basically developed coastal line. The lake is situated 26 km to the southern – east from Golezno and 28 km to the northern – west from Kozin (Pydyś 2010: 15). Underwater archaeological survey of the coastal zone of Lake Powiśle began in 2000. The remains of long-term settlements and short-time human activity from the Early Iron Age, Early and Late Medieval periods as well as modern time were found for the following eight years of work. At this point more than 50% of the lake's shore was surveyed. As a result of the work, two important archaeological settlements and 14 other sites with traces of the human activity were discovered. One may easily notice that during the prehistoric and medieval times human occupations of coastal area focused in the western part of the lake (Pydyś 2010: 13).

II. The Early Iron Age settlement in Powiśle was discovered by the owner of a local guest-house Roman Morawski, who found more than 450 fragments of pottery vessels, tools made from antler, stone and iron. As a result of the development of tourism in this region, a significant part of the site was destroyed. On the surveyed area of 5000 square metres a large quantity of wood piles (6–12 cm in diameter), quern stones and almost 900 pottery sherds date to the Early Iron Age was found. A significant frequency of semi-circular and spherical forms of vessel, together with a large quantity of jugs and cups can suggest that the pottery should be related to the Late Lusitanian ceramic style. Also the so-called ornamentation of fir tree, hung triangles, finger holes and pseudo-cord as well as the presence of the pottery with underlip holes is characteristic of 3rd phase of the Lusitanian Unfield Culture known from the eastern part of Great Poland and Cuiavia, in the Hallstatt D Period (Riemann 2000b: 75).

III. Classical methods of pollen analysis and analysis of macrofossils have been used to determine the age and character of sediments in the area of the underwater archaeological site (Powiśle Lake, Golezno Lake). Moreover, these methods were to answer a question if there are any original culture layers related to the Lusitanian Unfield Culture settlement preserved in this site. The results indicate that in the area of the site bottom sediments are strongly disturbed due to lake level changes. Both pollen and macrofossil samples do not contain any direct indicators of settlement activity. The lower part of the sediments is of the late glacial age and is covered by a much younger sequence deposited after the decline of the Lusitanian Unfield Culture settlement activity. In the final conclusion we suggest that new coring point for palaeoecological investigation should be placed in more distance from the littoral zone of the lake (Świątek-Muzykiewicz et al. 2010: 175).

IV. The botanical content of two vessels found in the Lusitanian Unfield Culture settlement has been examined. More than 6000 specimens representing 137 taxa including 120 species have been determined. The character of the subfossil flora extracted from both objects is very similar in respect to species composition and quantitative relations between the main constituents. Apart from the remains of some useful plants (*Camellia sativa*, *Papaver somniferum*, *Panicum millicum*, *Linum usitatissimum*, *Triticum spelta*) and common weeds, some rare and interesting species appeared, list of all *Primula* taxa and *Saxifraga aizoides* granulate. The occurrence of these species in both vessels suggests intentional collecting and use for special purposes. In our opinion the botanical content of both vessels confirm the preliminary suggestion made by the archaeologists that these objects were a part of a foundation offerings (Latawiec, Pufalska 2010: 155).

V. The aim of this study is archaeological analysis of small assemblages from the Lusitanian Unfield Culture settlements in Polanowo (site 12) and Powiśle (site 16). The former consists mainly of domestic mammals' remains, the latter of domestic and wild mammals of Cervidae family in fairly equal numbers. Cattle and sheep/goat bones form the majority of the remains while deer skeletal elements are the most frequent ones in the latter category. Economy of the inhabitants of the area was based on husbandry and hunting which provided meat and bones for craft processing. The cattle were represented by *Bos taurus* breeds: sheep in small- and large-size varieties. Among pigs there were both a small-sized variety and a big one, wild boar-like.



LAKE POWIDZ LANDSCAPE

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IKUWA V

PERIODO CLÁSICO

CLASSIC PERIOD

Un complejo portuario romano descubierto en las albuferas narbonenses

A roman harbour complex discovered in Narbonne's lagoons

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Resumen: en IKUWA III (Londres, 2008), se presentaron los resultados de las prospecciones geofísicas realizadas en las albuferas narbonenses con el fin de detectar la topografía portuaria de la antigua Narbonne. Las excavaciones realizadas posteriormente han suministrado datos esenciales sobre el desarrollo de la desembocadura del río. Con un ancho de cincuenta metros y una profundidad de aproximadamente 3,50 m, el curso de agua está flanqueado por dos muelles de casi veinte metros de ancho, construidos durante el siglo I d.C. Es sobre este sistema de muelles donde se organiza la descarga de embarcaciones de calado y la transferencia de mercancías hacia la ciudad. A partir del siglo IV de nuestra era, fue necesario acometer nuevos trabajos al objeto de consolidar esta desembocadura. Las reparaciones de la Antigüedad tardía son monumentales, utilizando tanto el aporte de numerosos bloques que provenían de los principales edificios urbanos como los restos de una embarcación usada para elevar y reforzar los muelles.

Palabras clave: puerto antiguo, Narbonne, muelle, desembocadura, pecio.

Abstract: We presented the results of geophysical surveys in Narbonne lagoons aimed at identifying the topography of the port of ancient Narbonne at the IKUWA III symposium held in London in 2008. Since then, further excavations have provided crucial data that reveal the development of the river mouth, which was fifty meters wide and approximately 3.50 m deep. The river was flanked by two fifteen-meter wide jetties built during the first century AD a system of quays was installed for unloading deep-draught vessels and the subsequent transfer of goods to the city. From the fourth century A.D on, further works were required to consolidate the river mouth. Huge scale repairs were undertaken in the Late Antiquity including the transfer of a large number of stone blocks from major urban buildings, and the use of a wreck to raise and consolidate the quays.

Key words: Ancient harbours, Narbonne, quay, mouth river, shipwreck.

La creación de Narbonne y de su puerto, en la Antigüedad, representó un acontecimiento notable que provocó una modificación profunda de los paisajes a escala local. Para comprender estas transformaciones, las investigaciones sobre los puertos antiguos de Narbonne reunieron a un equipo interdisciplinario con la voluntad de poner en relación las excavaciones arqueológicas y el estudio del paleoentorno. Este proyecto colectivo de investigación es el resultado de una colaboración entre la Región Languedoc-Roussillon, el Centro Nacional de Investigación Científica y el Ministerio de Cultura¹.

Narbonne, considerado como uno de los grandes puertos del Mediterráneo occidental, constituía, en época antigua, el punto de encuentro de grandes ejes terrestres, como la vía Domitiana y la de Aquitania, y fluvial, la desembocadura del valle del río Aude en el Mediterráneo. Aquel valle ponía en contacto el Atlántico con el mar Mediterráneo, siendo ruta de tránsito, entre otros productos, del estaño de las Islas Británicas (Diodoro Sículo, *Bibliotheca historica*, V, 38).

Aunque su actividad económica hoy sea conocida cada vez mejor por la iconografía, por los textos literarios o la epigrafía anfórica, el emplazamiento y la topografía del puerto quedaron ocultos, y por tanto desconocidos para las diferentes generaciones de investigadores que se sucedieron desde el fin del siglo XIX (Rouzaud, 1914).

Las investigaciones

La complejidad de las investigaciones está vinculada, en primer lugar y sobre todo, a la movilidad del curso del río Aude, teniendo en cuenta que, en la Antigüedad, desembocaba en el *Rubresus*, la actual albufera de Bages, y hoy día discurre por el norte de Narbonne (Fig. 1). En segundo lugar la complejidad está estrechamente relacionada con la evolución de la dinámica litoral marina: hace 2500 años tuvo lugar el inicio del cordón litoral. Finalmente, las sucesivas deposiciones aluviales del río Aude cambiaron la configuración interna de la laguna.

Las investigaciones arqueológicas se concentraron sobre cuatro zonas geográficas (Fig. 1):

- La isla Sainte-Lucie (Port-la-Nouvelle) y sus canteras.
- La isla Saint-Martin (Gruissan) donde se excava actualmente un gran complejo susceptible de haber jugado un papel de control del acceso de los navíos a la albufera.
- Port-la-Nautique y el Lac de Capelles (Narbonne) en el norte de la laguna.
- Finalmente los sectores de Castélou y de Mandirac (Narbonne), que desarrollaremos a continuación.

Al principio de las investigaciones, solamente se conocía la presencia de un muelle en Port-la-Nautique, tan solo en activo durante un siglo antes de ser abandonado alrededor de los años 60 de nuestra era (Falguéra/Bernard/Jézégou, 2003).

En Port-la-Nautique, nuestras investigaciones pudieron evidenciar la presencia de un gran vivero (de 67 m de diámetro) que permite suponer la existencia de una gran villa marítima en las cercanías: datos recabados por medio de fotografía aérea antigua, prospecciones geofísicas, hallazgos arqueológicos y reconstitución. Así como la existencia de una zona artesanal constituida de alfares adosados a grandes almacenes de *dolia* situados en las proximidades de la orilla (Ginouvez *et alii*, 2010).

¹ Este trabajo también gozó del apoyo de Labex ARCHIMEDE en nombre del programa «Investissement d'Avenir» ANR-11-LABX-0032-01.



Figura 1. Laguna de Narbonne (Francia): mapa de los principales yacimientos (C. Sanchez).

El yacimiento del Castélou y de Mandirac

La desembocadura antigua del río

Al sureste, los sectores de Castélou y de Mandirac corresponden a la construcción de una zona portuaria con la instalación de edificios administrativos y de almacenamiento que transformaron la topografía de la desembocadura del río Aude en la Antigüedad. La presencia de un brazo del río canalizado se sospechaba ya desde mediados del siglo xx por la interpretación de fotografías aéreas (Falguéra *et alii*, 2000). La Universidad de La Rochelle llevó a cabo prospecciones electromagnéticas de un centenar de hectáreas bajo la dirección de Vivien Mathé. Aquellas prospecciones fueron realizadas por medio de dos aparatos según la profundidad de lectura deseada: EM 31 entre 3 y 6 m y EM 38 entre 1 y 2 m (Jézégou *et alii*, 2008).

Estos trabajos permitieron precisar el trazado del río y descubrir, al este, una obra de protección del meandro del río, frente al oleaje y temporales procedentes del este. Dicha obra presentaba una longitud de 800 metros. Hasta el momento se ha recuperado un trazado de aproximadamente

2 km de dos muelles construidos en paralelo en el agua. Entre estos muelles, de una anchura próxima a los 20 metros, corría un canal de 50 m de ancho en la zona del Castélou. Más al norte, en el sector de Mandirac, los muelles se alejan uno del otro. Esta configuración asegura además un aumento de corriente evitando, por tanto, la acumulación de aportes fluviales. Mandirac se convierte pues en una zona de embudo, aumentando el riesgo en los casos de crecidas (Fig. 2).

El muelle derecho del río está acondicionado como vía de circulación conectada a la ciudad. De hecho se han detectado huellas de ruedas de carros en varios tramos de este muelle que se presenta como un firme ancho pudiendo ser utilizado además de como muelle, como vía de transporte y como espacio utilitario. Un edificio de 18 m de longitud y 7,60 m de anchura pudo servir de almacén o de edificio administrativo para el control de las mercancías. Un mástil con un sistema de polea para manipular cargas y numerosos hallazgos: vajillas, ánforas, materia prima de vidrio y metal, dan testimonio de intercambios comerciales con todo el Mediterráneo desde el siglo I al siglo V y atestiguan una actividad de trasvase de mercancías (Sanchez *et alii*, 2011). Es posible restituir, en este espacio, una zona de actividad intensa con numerosas embarcaciones de fondo plano cuya función era la descarga de los navíos de gran tonelaje, asegurando un enlace con la ciudad.

La profundidad del río de 3,5 m ha sido constatada por las extracciones de testigos sedimentarios. Ambos márgenes fueron consolidados con un importante fondo de roca estabilizado con una red de estacas. Las zonas húmedas han permitido la conservación de materias orgánicas y particularmente de las estacas utilizadas para la cimentación de los firmes y para las empalizadas que mantienen los terraplenes de los muelles (Fig. 3). Los estudios sedimentarios realizados bajo el muelle derecho mostraron que las construcciones antiguas reposan a veces sobre los niveles de arena natural del seno de la laguna. El río desembocaba entonces en una albufera poco profunda que permitía que esta edificación se apoyase en los niveles naturales reforzándola con pilotes. A continuación, se levantaron palés verticales rellenos de rocas que constituyeron la base de los muelles.

Construida en el año 42 de nuestra era (datación dendrocronológica sobre estacas), el muelle derecho se mantiene sin interrupción a lo largo de los siglos. En el curso del siglo IV o del V, la reparación de los muelles se beneficia de la demolición de los monumentos de Narbonne. Los arcones fueron reforzados con sillares de piedra caliza.

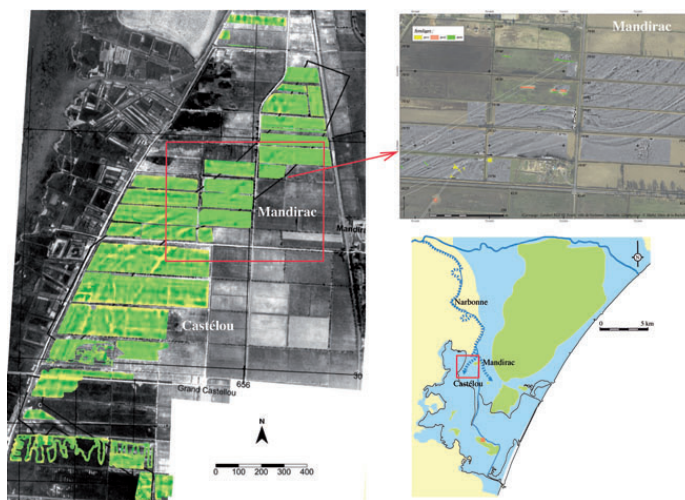


Figura 2. La albufera antigua del río Aude al sur de Narbonne (Castélou y Mandirac): prospecciones geofísicas (V. Mathé, C. Sanchez).



Figura 3. Empalizada para mantener los terraplenes (muelle derecho) (C. Sanchez).



Figura 4. Mandirac 2013, Narbonne. El muelle izquierdo con bloques recuperados de los monumentos narbonenses. Al primer plano, la embarcación utilizada para la reconstrucción tardía del muelle (C. Sanchez).

reconstrucción parcial. Este se elevó con la ayuda de bloques de gran tamaño recuperados de los monumentos narbonenses de la época imperial (Fig. 4). Esta reconstrucción parece haber tenido lugar a consecuencia de un acontecimiento climático brutal que desestructuró el muelle hasta el punto de crear una brecha. Los restos de una embarcación de una decena de metros de eslora también dañada en este episodio fueron utilizados en la reparación de esta brecha. Una parte del cargamento probablemente roto no fue recuperado, abandonándolo en el interior del barco. Este episodio está datado por el cargamento (ánforas de Lusitania, de la Bética y de África del Norte) al principio del siglo v.

El pecio ha sido excavado este año y los resultados se encuentran en fase de estudio. Las primeras observaciones mostraron que probablemente se trataba de una embarcación ligera, un barco destinado a descargar las grandes naves de alta mar y a asegurar el trasvase de mercancías a la ciudad.

Conclusiones

Las investigaciones de este proyecto han puesto en evidencia, en el norte del estanque, en Port-la-Nautique, una rica residencia colindante a una importante zona artesanal/industrial y de almacenes en directa relación con un muelle en uso a partir del año 40 antes de nuestra era y hasta el principio de la época flavia. Poco antes del abandono de este muelle, se acondicionaron importantes infraestructuras al este de la albufera, en Mandirac y en Castélou. Un brazo del río fue canalizado con cerca de dos kilómetros de longitud y 50 m de anchura. Este canal permitió el acceso de los navíos procedentes del mar y el trasvase de mercancías sobre barcos fluviales. Luego, un camino de sirga facilitó el vínculo con almacenes urbanos que empezamos a ver en la ciudad gracias a las operaciones de arqueología preventiva recientes (Ginouvez *et alii*, 2013).

Los muelles parecen ser entonces ensanchados y prolongados hacia el sur, cada vez más lejos de la desembocadura con el fin de luchar contra la colmatación provocada por los sedimentos aportados por el río Aude y depositados en su desembocadura. En este sector meridional, las prospecciones electromagnéticas no pudieron realizarse debido a la presencia de ciénagas permanentes. En 2011, se efectuó una campaña de prospección con penetrador, definiendo así los límites meridionales de los muelles. Se pudo observar que la desembocadura presentaba la misma configuración que la que presenta el Aude en la actualidad siendo el muelle izquierdo unos 50 m más largo.

La reconstrucción tardía de la orilla izquierda

En el norte, mientras que el muelle derecho se conserva como vía transitable, el muelle izquierdo sufre presiones a causa de la curva y del estrechamiento del canal. En este sector, las prospecciones magnéticas cubrieron 20 hectáreas. Pusieron en evidencia el curso del río por los depósitos de sus sedimentos. Durante la Antigüedad tardía, el muelle izquierdo sufrió daños importantes que provocaron su posterior

Tales estructuras, su creación y su mantenimiento, al menos durante cuatro siglos, no pudieron depender más que de una decisión política fuerte con vistas a desarrollar y a mantener un mayor papel del centro económico y comercial más importante entre el Mediterráneo y el Atlántico, y al mismo tiempo entre la Galia y las provincias hispánicas o africanas y entre la Galia y Roma.

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Carthago Nova: topografía y urbanística de una urbe mediterránea privilegiada. El Proyecto Arqueotopos

Carthago Nova: Topography and urban planning of a privileged Mediterranean metropolis. The Arquetopos Project

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Resumen: el objetivo de este trabajo es la presentación de un proyecto de investigación multidisciplinar, a medio y largo plazo, cuya propuesta última es la restitución de la paleotopografía de la ciudad de *Carthago Nova* y de su entorno económico y socioideológico. Parte de la necesidad de caracterizar geotectónica, geomorfológica y paleoecológicamente el medio primigenio comprometido, los cambios en su evolución holocena y los efectos de una antropización ligada a la interacción de las diversas poblaciones de la urbe con dicho medio. Presenta las bases metodológicas del estudio y la discusión cuyos referentes científicos son la arqueología, la geoarqueología, la paleoecología, la geomática y la arqueología portuaria; su conjugación transversal está propiciando interesantes y renovadores resultados en torno a una escenografía ambiental sustentada sobre una base esencialmente literaria, de los que se avanzan algunos resultados en curso.

Palabras clave: *Kart-badast*, *Carthago Nova*, paleotopografía, paleoambiente, geoarqueología.

Abstract: The aim of this work is the presentation of a multidisciplinary research project, in the medium and in the long term, whose last proposal is the restoration of the palaeotopography of the city *Carthago Nova* and its economic and socio-ideological environment. The need of the characterisation of the committed primitive environment, the changes in the Holocene evolution and the effects of an «anthropisation» linked to the interaction of diverse populations in the city with the environment is the starting point of this project. It presents the methodological basis of the study and the discussion with the archeology, geoarchaeology, paleoecology, geomatics and port archeology as scientific references. The cross conjugation of these subjects shows interesting and encouraging results about an environmental scenery based on an essentially literary basis, of which some results are advanced in progress.

Key words: *Kart-badast*, *Carthago Nova*, paleotopography, paleoenvironment, geoarchaeology.

Consideraciones previas a modo de introducción

En las últimas tres décadas la investigación sobre el desarrollo histórico de *Carthago Nova* se ha visto potenciada por el impulso que han supuesto diversos proyectos de investigación del Plan Nacional de I+D+i, llevados a cabo en colaboración con otras universidades españolas y extranjeras, el Museo Arqueológico Municipal y el Museo del Teatro Romano (BHA2002-04508-C03-01; HUM2005-04903-C03-03/HIST; HAR2008-06115, entre otros); en ellos se han abordado perspectivas de análisis relacionadas sobre todo con la arquitectura y la urbanística, enfatizadas en aspectos fundamentalmente materiales, evolutivos e ideológicos, transformadores del paisaje urbano y social de la ciudad en determinados momentos de su historia.

La ampliación del conocimiento sobre el amplio conjunto de edificaciones públicas y domésticas sacadas a la luz, asociadas a un trazado viario ahora mejor percibido, junto con el incremento de las evidencias sobre instalaciones artesanales y portuarias en diversos puntos de la urbe y sus inmediaciones, así como tramos de la muralla que la cercaba o diversas áreas funerarias *intra-* y *extramoenia*, etc., ha modificado sustancialmente la imagen tradicional de la colonia romana. A su vez, ha confirmado el importante papel desempeñado como foco de romanización en todo el ámbito del cuadrante suoriental de la península ibérica; teatro, curia, sede colegial de los augustales, espacios religiosos y varias *domus* son ejemplos elocuentes que permiten perfilar hoy día, con bastante claridad, el desarrollo monumental de la ciudad entre los siglos I y II d.C., completando el marco iniciado con la inserción de los primeros restos de la ciudad romana excavados por P. San Martín en las décadas 1960-1970 del pasado siglo (anfiteatro, vías porticadas...), proporcionando una imagen mucho más coherente de su peculiar relieve (Ramallo, 2011).

Es esa específica orografía sobre la que aparentemente se asienta la ciudad el aspecto que más ha llamado la atención de todos aquellos que a lo largo de su historia la han visitado; desde escritores greco-latinos hasta viajeros del siglo XIX, son múltiples las citas que resaltan aspectos de su distintiva topografía como la profunda bahía, al fondo de la cual se sitúa el promontorio sobre el que se levanta la ciudad, bordeada desde época púnica de un cerco defensivo que refuerza el flanco oriental en el tramo rocoso que la pone en comunicación con otras alturas colindantes; también el amplio estero situado al norte, que duplica la superficie del área habitada y constriñe el desarrollo urbano por ese sector, o el seno marino que cierra el área emergida por el oeste y que debió albergar las instalaciones portuarias más importantes, etc. Los trabajos más rigurosos se vinculan a la interpretación de las fuentes escritas y sobre todo a los textos de la conquista por parte de Escipión en el año 209 a.C.; se trata de las ilustraciones aportadas por J. L. Strachan Davidson (1888), H. H. Scullard (1930: 290) y F. W. Walbank (1967: 206, Fig. 1) en sus ediciones de Polibio, que presentan sustanciales errores, tanto en la extensión y los límites de la laguna como en el contorno del núcleo urbano. Otras propuestas, que han gozado de un cierto favor entre los investigadores y eruditos, han sido las de Fernández-Villamarzo (1907), A. Beltrán (1948), J. Mas (1971) y más recientemente Martínez Andreu (2004), que cierra el elenco de estudios que, con una mayor o menor profundidad han intentado restituir las líneas maestras de la topografía de la ciudad antigua, y como esta ha condicionado su desarrollo y evolución a lo largo de su historia.

No obstante, y aun considerando los avances realizados en los últimos años por la intervención arqueológica sobre áreas de la ciudad en proceso de renovación constructiva, es preciso hacer una reflexión crítica, en tanto que ha supuesto una renovada visión de la configuración ideológica de la misma en torno a un modelo urbanístico que se ha venido recreando en razón a dos circunstancias; en primer lugar, por el imaginario transmitido por las fuentes literarias re-

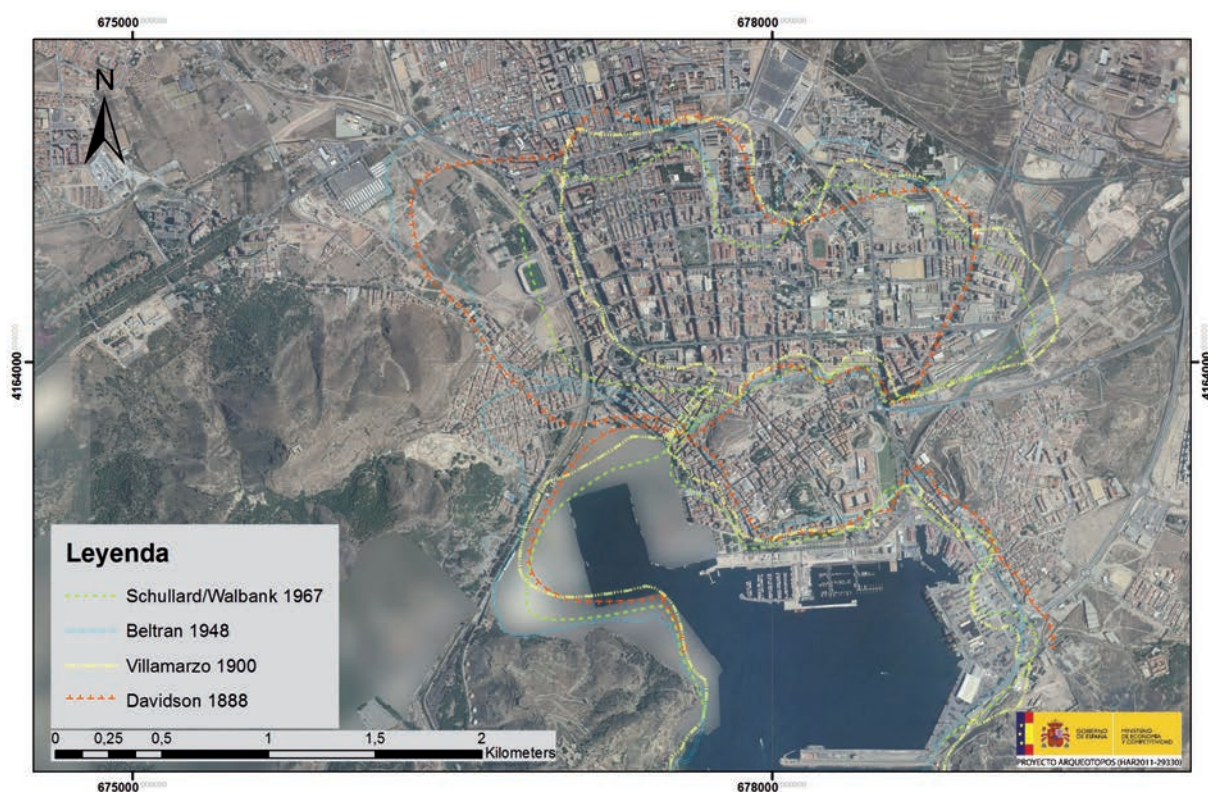


Figura 1. Superposición georreferenciada sobre la fotografía aérea actual de distintas propuestas de restitución de la paleotopografía de Cartagena en época púnico-romana.

lacionadas con su conquista por parte de Roma; en segundo, por una indistinta, incierta y equívoca consideración primigenia u originaria del suelo ocupado por la población de la urbe en sus distintas fases históricas, cuando en realidad estamos ante *ciudades* cuyos espacios construidos, abandonados o transformados son resultado de la propia evolución continuada, aunque también diferenciada, de la historia de su poblamiento; se olvida así que esa historia estuvo mediatizada por una *historia ecológica* a cuyas contingencias estuvo supeditado tanto el propio solar urbano como el medio interactuado por sus sucesivas poblaciones, con derivaciones y consecuencias que han marcado el devenir de la ciudad y su población en el tiempo.

En este sentido, hasta el momento había quedado ausente el estudio de la paleotopografía de la ciudad y de su entorno relacionado, desde el enfoque científico que aporta la geoarqueología, entre otras disciplinas; una perspectiva de análisis que ayudaría a entender su proceso formativo en relación a los cambios paleoecológicos que se han ido fraguando a lo largo del Holoceno, tanto en razón de episodios naturales como de actividades antrópicas materializadas a lo largo de la Historia, tal y como se acaba de indicar. Una carencia necesaria de paliar, tanto más cuando pocos ejemplos como el de Cartagena resultan tan aleccionadores para comprender la mutua interacción ejercida entre el hombre y la naturaleza. Los drásticos cambios que el paisaje urbano de Cartagena y su entorno continental y marino han experimentado en los últimos tres mil años, suponen para la Arqueología y las ciencias que la complementan un sugerente reto de cara a la investigación; reto que ha de ser abordado desde la multidisciplinariedad científica, y resuelto en el ámbito de una interpretación interdisciplinar; parece obvio que la historia que se oculta bajo el suelo de una ciudad es la de las relaciones con el medio en el que se insertaron no solo su espacio urbano, sino también y sobre todo, su tejido social y productivo, de manera que cabe una reflexión en el sentido de que el éxito de aquellas sociedades no radicó solo en la adaptación al medio, sino en el aprovechamiento de sus bondades y la necesidad de superar sus efectos negativos.

Desde estas premisas, el proyecto de investigación «Carthago Nova: topografía y urbanística de una urbe mediterránea privilegiada» (Mineco-HAR2011-29330, parcialmente subvencionado con fondos FEDER) objetiva la restitución, sobre bases científicas, de la paleotopografía sobre la que se asentó la ciudad púnico-romana de *Carthago Nova*, imprescindible hoy para la prosecución de la línea investigadora que sobre esta lleva a cabo el equipo de trabajo que sustenta el proyecto. El discurso histórico generado por los sucesivos trabajos arqueológicos realizados en las últimas décadas sobre la actual ciudad, ha reproducido hasta ahora una topografía construida desde fuentes literarias. Como acabamos de avanzar, a ello se ha sumado, en primer lugar, una percepción visual actual debido al enmascaramiento que la sucesión de «ciudades» ha ido construyendo sobre los restos previos; en segundo, la ausencia de un proyecto de trabajo que, aún utilizando en buena medida los contextos arqueológicos constructivamente más complejos y bien caracterizados de los últimos grandes hallazgos realizados en la ciudad, fuera más allá del ámbito estrictamente arqueológico, incorporando disciplinas propias de la arqueología y la geoarqueología desde las que acometer el estudio fiable de la primigenia topografía urbana y periurbana de la urbe hispana. Contribuir, pues, a paliar esta importante laguna constituye la finalidad del proyecto que aquí se presenta, centrado en la restitución de la paleotopografía primitiva y sucesiva de la península elegida por púnicos y romanos para levantar su más estratégica ciudad de Hispania, y en el análisis y determinación de los componentes naturales y antrópicos que en su dinámica cambiante la condicionaron.

Objetivos de un proyecto a largo plazo

Resulta obvio que la orogenia del solar en que se asentó Carthago Nova ciñó y, en ciertos casos, restringió su urbanística interna, amén de obligar a diversificar sus áreas portuarias y a circuns-

cribir el espacio para el desarrollo de sectores periféricos y suburbanos donde se ubicarían instalaciones de carácter artesanal e industrial. A esta limitación tampoco escaparon los espacios ideológicos y de representación social; e incluso determinó los ejes viarios que comunicaban la ciudad con su *ager*. Igualmente es cierto que, progresivamente, iría condicionando los sucesivos asentamientos urbanos y la relación de estos con su entorno interactuado al que acabaron por transformar. Pero también lo es que determinados elementos morfogenéticos coadyuvaban a configurar paisajes cambiantes constituidos en escenarios del proceso histórico y, sobre todo, soportes necesarios de las actividades económicas, sociales e ideológicas referidas tanto en la propia urbe como en su *territorium*. En este sentido, el proyecto se ha centrado en restituir el medio primigenio y en ver qué factores paleoambientales, cuándo y cómo, acompañaron y mediatizaron el desarrollo de la ciudad en los tiempos acotados. Para ello precisamos conocer los procesos geomorfológicos asociados al paleoclima, junto con la litología de suelos y la amplia red hidrológica que funcionó como gran colector aportando sedimentos y aguas de las sierras cercanas, drenantes al vertedero natural constituido por un sector subsidente al norte de la ciudad; sobre ellos actuó una activa neotectónica, en determinados casos reciente, que pudiera haber comprometido un hipotético espacio lagunar-marino en dicho sector subsidente. Sin embargo, se carece de estudios anclados en estas esferas de análisis y otras relacionadas con el comportamiento del medio marino franco, referentes a las posibles áreas portuarias de las ciudades previas, coetáneas y posteriores al contexto *Carthago Nova*.

Sobre esta realidad, planean determinadas variables a la hipótesis planteada por la misma realidad de la investigación arqueológica hasta ahora realizada en el subsuelo de Cartagena. Desde el punto de vista topográfico, se viene postulando que, en determinados momentos de la geopolítica púnica y romana, la ciudad fue objeto de importantes remodelaciones urbanas, constatadas en evidencias de diverso carácter ofrecidas por determinadas edificaciones públicas; sin em-

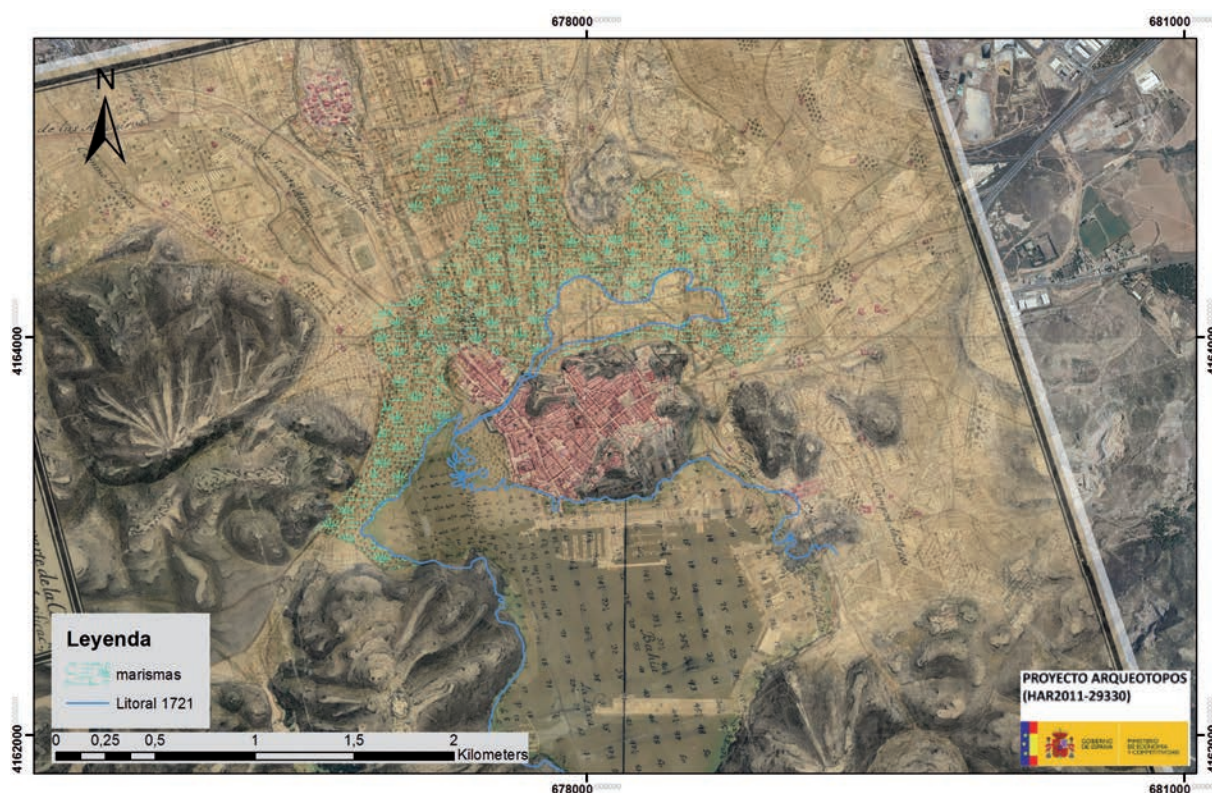


Figura 2. Superposición georreferenciada sobre la fotografía aérea actual del plano anónimo de 1721. S.G.E., N.º 43. Archivo Cartográfico y de Estudios Geográficos del Centro Geográfico del Ejército. Ministerio de Defensa.

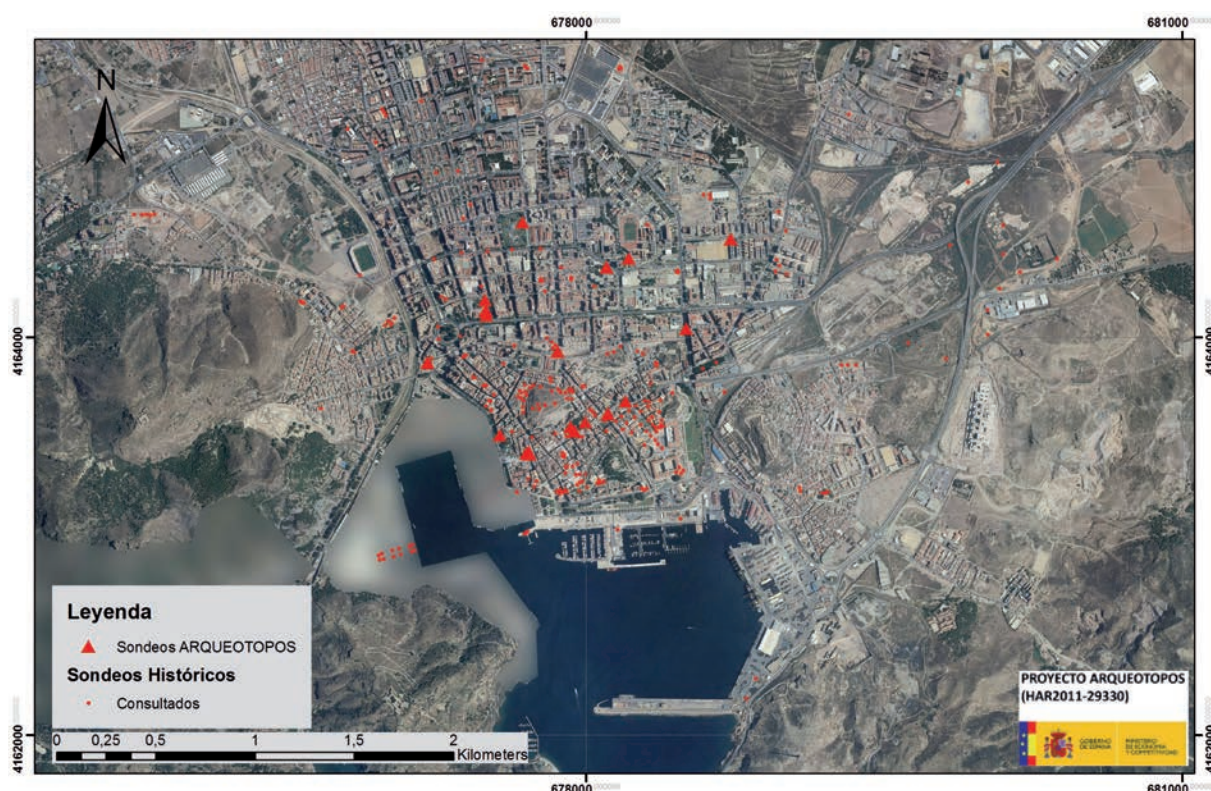


Figura 3. Ubicación de los sondeos geotécnicos realizados en el marco del Proyecto Arqueotopos (triángulos) junto a los cedidos por distintas empresas de Geotécnica (círculos).

bargo, no se ha tenido en cuenta sobre qué realidad física se materializaron estas remodelaciones: ¿sobre un marco físico no habitado? o ¿sobre un hábitat previo? ¿hostil o favorable? ¿objeto de arrasamiento o mediante una mera adaptación y ampliación del espacio habitado?; o ¿para qué se realizaron, qué objetivo tuvieron? De ahí que el Proyecto Arqueotopos se propone dar respuesta a estos y otros interrogantes sobre las paleotopografías de la urbe, mediante la restitución más fiable posible del perfil topográfico primigenio, asistida por la georreferenciación de la valiosa cartografía histórica (Fig. 2), la información suministrada por el registro de sondeos geotécnicos existentes en el ámbito administrativo, y la obtenida desde análisis multidisciplinares realizados a los registros sedimentarios proporcionados por nuevos sondeos perforados en el marco del proyecto, tanto en el subsuelo del casco histórico como en el sector inundable al norte de este y en la actual área portuaria.

Incertidumbres similares evidencian el conocimiento que tenemos de su *territorium*; así, por ejemplo, en relación con la red de comunicaciones externas, se viene enfatizando la presencia de diferentes viarios de los que solo en un caso se conoce algún tramo de calzada, caso del vial usado posteriormente por la Vía Augusta, antes y después del área de necrópolis de la Torre Ciega; para el resto se presuponen los trazados por la presencia de determinadas áreas funcionales que por normalización cultural se asocian a la cercanía de vías de paso. Sin embargo, el estudio del medio permite ir más allá, partiendo de un análisis riguroso y completo de la red hidrológica y abordando el estudio geomorfológico de la zona, derivada de la dinámica de cambios por incidencia de las condiciones climatológicas, la morfoestructura y edáfica de los suelos, actividad tectónica, etc.; dicho grado de incertidumbre se registra en la identificación de áreas productivas en relación bien con labrantíos y terrenos de uso ganadero o de pastoreo, bien con puntos de talleres artesanales e industriales, o sectores baldíos por recurrencia lacustre, entre otros. Desde esta hipótesis de trabajo, el proyecto compromete el análisis de dicho entorno

planteando el estudio de los más de 300 sondeos mecánicos antes aludidos, realizados en los últimos años al albur del desarrollo urbanístico del área conocida como Ensanche sobre los terrenos históricamente nombrados como Almarjal, junto con la realización de hasta 16 nuevos sondeos geotécnicos para control litoestratigráfico, cronológico y paleoambiental del sector en estudio.

Ciertamente, de todos estos factores que buscan una comprensión mayor y mejor del territorio, del paisaje y de los procesos de adaptación y transformación surgidos de la interacción humana con el mismo, la carencia de datos es prácticamente absoluta sobre la ciudad; es por ello por lo que el proyecto en curso busca abordarlos desde una perspectiva interdisciplinar, que permita definir y caracterizar los procesos morfogenéticos acaecidos en fases climáticas diferenciales; de igual forma la incidencia de la actividad tectónica sobre ellos, de tal manera que nos permita comprender determinadas circunstancias económicas y sociales, e incluso ideológicas, que pudieron estar condicionadas o favorecidas por una particular evolución del territorio; de esta forma se da continuidad a la línea investigadora que sobre esta ciudad portuaria de primer orden viene llevando a cabo el equipo de trabajo que lo desarrolla, ampliando los ámbitos de análisis con el concurso de otros colegas de disciplinas científicas insertas en la Geoarqueología, la Paleoecología, la Arqueología portuaria y la Geomática.

Concurre, además, en este momento la circunstancia de la desmilitarización de la ciudad en la década de 1980; ello ha provocado el cierre de una compleja red de instalaciones militares, baterías de costa y castillos, emplazados en los cerros y elevaciones que ciñen y controlan visualmente la bahía y el puerto, y su paso a dominio público. En consecuencia, amplias superficies de terreno hasta no hace mucho vedadas a cualquier investigación arqueológica, son hoy accesibles. Al mismo tiempo, y casi de forma paralela, el más reciente cierre y desmantelamiento de las industrias que bordeaban el casco antiguo de la ciudad por el este, como Española del Zinc y Potasas y Derivados, ha liberado para la investigación una enorme extensión de terreno, pegada al casco antiguo por su flanco este, precisamente por donde penetraba la Vía Augusta y donde se ubica una de las necrópolis tardorepublicanas de la ciudad conocida como de la Torre Ciega. Esta vasta zona, que no ha sido sometida hasta la fecha a ningún control arqueológico, va a estar expuesta en un futuro próximo a un intenso proceso de transformación urbanística con la construcción de las infraestructuras relacionadas con la llegada de la Alta Velocidad a Cartagena, circunstancia que la convierte en una zona especialmente atractiva para la finalidad del proyecto, dada su inmediatez a las áreas inundables de forma recurrente.

Así, pues, configurar, restituir y plasmar sobre bases fiables y metodología científica la paleotopografía de la ciudad púnica y romana de *Carthago Nova* es la finalidad de este proyecto de investigación; persigue una base realista para una inserción más ajustada de las estructuras y restos arqueológicos hallados en los últimos tiempos en la ciudad y su entorno periurbano. A partir de esta herramienta se podrá plasmar, de forma más sólida los patrones de edificabilidad caracterizados en la ciudad a lo largo de su historia y, trazar estrategias futuras de intervención arqueológica sobre las zonas en proceso de renovación urbana, aunando así resultados científicos con una necesaria rentabilidad socioeconómica de trabajos futuros.

Con este horizonte, se han emprendido las siguientes acciones específicas:

1. Restitución de los cursos originales de los cauces de las ramblas de Benipila, Los Dolores y el Hondón; sus aportes irregulares alimentaron unas veces las aguas del sector inundable y, en otras ocasiones, lo colmataron; fundamental para ello es el análisis de los factores desencadenantes de los episodios de avenidas y sus ritmos, y el estudio de la formación de abanicos aluviales. La red hidrográfica es un importante parámetro indicador del



Figura 4. Fuente de San Julián, próxima al Cabezó Gallufo.

grado de evolución del territorio, entendido como superficie modelada, heredada y actual, que se configura a partir de una serie de procesos focalizados, sobre todo, en la escorrentía de carácter concentrado al operar sobre una morfoestructura de base ligada a factores litológicos, tectónicos, bioclimáticos, edafológicos y antropogénicos. Su restitución es una tarea básica ya que permite identificar las unidades y cursos principales y asociar la forma y textura a las características geológicas y morfológicas del terreno.

2. Localización y estudio hidrogeológico de recursos en forma de manantiales en los cerros próximos o de fuentes u otras infraestructuras hidráulicas en el interior de la ciudad, que han contribuido a paliar el secular déficit hídrico de la ciudad (Fig. 4); muy significativo, en este sentido, ha sido el hallazgo reciente de dos inscripciones pertenecientes a otros tantos *lacus* que vinculan la creación de un sistema artificial de aprovisionamiento de agua en la ciudad desde mediados del siglo I a.C.
3. Estudio y determinación del trazado de las vías de comunicación de acceso a la ciudad, en relación con los elementos naturales caracterizados.
4. Delimitación del *suburbium* de la *ciuitas* y la modificación de sus límites a lo largo de las etapas históricas en análisis, estableciendo la funcionalidad de cada una de las zonas que lo componen, en relación con factores paleotopográficos, sedimentológicos y de contextualización de los materiales asociados.
5. Prospección sistemática, intensiva, del área periurbana, con el objetivo de definir y caracterizar posibles restos de hábitat previos y contemporáneos a la ciudad romana, determinar su relación con la dinámica de la red hídrica subyacente, y los procesos geomorfológicos que de ella se derivan, en relación con la periódica formación de áreas lagunares, conos aluviales, colmataciones de áreas subsidentes, etc.
6. Cotejación de resultados obtenidos en los puntos 2.º, 3.º y 4.º con las referencias planimétricas antiguas y actuales. Análisis de las estratigrafías urbanas, e identificación y georeferenciación de los rastros de episodios de inundación en el registro arqueológico y su contejación con las secuencias históricas constatadas documentalmente.
7. Determinación de los límites marítimo-continentales de la ciudad antigua mediante las siguientes actuaciones:
 - a) Delimitación del dominio lagunar o marino y su evolución, utilizando la información derivada de los registros geotécnicos obtenidos en áreas secularmente identificadas como paleolagunares.
 - b) Definición de los límites entre el medio marino franco y el continental, mediante análisis cartográfico de la topografía y batimetría histórica de las líneas de potencial contacto intermareal al oeste y sur del núcleo urbano, con una especial incidencia en las áreas portuarias, definidas y por definir.
8. Restitución volumétrica de las cinco colinas que configuran el soporte físico de la ciudad, con anterioridad a las intervenciones antrópicas que han transformado su imagen original. Para ello es imprescindible:
 - a) El análisis de los episodios de abandono, ruina y degradación de estructuras urbanas apreciables desde los datos arqueológicos.
 - b) La definición de los modelos de edificabilidad prerromana y romana sobre el solar de la península que modificaron el perfil primigenio (construcciones domésticas y civiles de gran envergadura, desmontes y aterrazamientos, canalizaciones de aguas limpias y sucias, trazado de viarios, etc.), obras de fortificación del siglo XVIII, instalaciones militares en el sector de Antigüones al sureste y del Arsenal al oeste, portuarias en el sur y oeste de la ciudad, con la finalidad de aproximar el perfil del suelo de base sobre el que se levantaron dichas edificaciones, así como los desmontes asociados a su construcción en el tiempo.
 - c) Revisión, georeferenciación locacional y medición altimétrica de sondeos mecánicos de control del terreno ya realizados en el contexto constructivo más moderno de la ciudad y depositados en la Oficina de Urbanismo del Ayuntamiento de Cartagena,

junto con los realizados en el curso de las últimas excavaciones en el solar urbano, y realización de nuevos sondeos –en los puntos aconsejados por el análisis comparado de la edificabilidad experimentada por la ciudad– que, altimétricamente medidos y georeferenciados, permitan completar el perfil basal buscado.

9. Materialización gráfica de la reintegración de los cursos de agua intermitentes que condicionaron, potenciaron y estructuraron el *ager* inmediato, así como de los límites lagunares recurrentes sobre el sector inundable al norte de la ciudad y su relación con los espacios extraurbanos relacionados con la secuencia ocupacional del asentamiento; de igual forma, con la línea de costa al oeste y sur de la urbe, especialmente en aquellas que pudieron funcionar como puerto o fondeadero. En los límites así materializados, integrar topográficamente el perfil restituído del suelo geológico de la península en la que se ubicaron las antiguas ciudades *Kart-hadast* y *Carthago Nova*, capitales hispanas de los Imperios cartaginés y romano.

Una metodología multidisciplinar para un proyecto interdisciplinar

La envergadura y complejidad del proyecto reclama métodos de trabajo múltiples y diversificados, abordados desde distintas disciplinas. Las finalidades buscadas requieren la complicidad de una metodología netamente arqueológica para determinadas acciones de la investigación, mientras que otras precisan del concurso de materiales y métodos de trabajo del ámbito de la geología, la geomorfología y la geotectónica, en connivencia con la bioquímica, la paleoecología y la geomática. La interacción entre los diferentes métodos de trabajo asociados a estas disciplinas, materializada en el cruce de resultados en curso en las acciones ya desarrolladas, está permitiendo construir y dar forma a determinados objetivos perseguidos, redireccionar otras acciones de la investigación ante determinados resultados muy relevantes de la misma por la competencia que suponen respecto de la información hasta ahora tenida por válida, y ahondar, mediante la implementación de otros métodos de trabajo como los que procura la geofísica marina o el sondeo de gravedad del fondo de la dársena/bahía actual de Cartagena, en una definitiva y contrastada respuesta que permita zanjar espejismos que, más allá de leyendas y ficciones, entorpecen el conocimiento integral de su Historia. Las acciones que para ello se están implementando y las metodologías que se les asocian son las siguientes:

- Prospección sistemática e intensiva del área periurbana, que permita definir y caracterizar posibles restos de hábitat previos y contemporáneos a la ciudad romana, y determinar su relación con el desarrollo de la red hídrica que la vertebra en zonas residenciales, espacios ideológicos, áreas de producción y viarios.
Implementa esta acción una metodología de prospección intensiva, largamente experimentada en el máster en «Arqueología Aplicada. Gestión profesional y estrategias de investigación en patrimonio arqueológico» de la UMU que miembros del equipo de trabajo del proyecto impulsaron años atrás. De los seis sectores en los que se diferencié el territorio a prospectar, en los identificados como 3 y 4, al norte de la ciudad, se efectuó una prospección intensiva en *tracks* de cinco y diez metros, dependiendo de la intensidad de análisis designada para cada espacio prospectado, con georeferenciación de hallazgos mediante GPS e integración en SIG de datos resultantes (Fig. 5). Como resultado, se ha delimitado el espacio ocupado por áreas funcionales previamente conocidas –necrópolis del Barrio de la Concepción, Torre Ciega, San Antón y Santa Lucía, vías de tránsito en los ejes este-oeste y norte-sur–, a la vez que se han localizado unidades rurales y estructuras diversas *extramoenia* novedosas de carácter funcional, así como el origen de recursos hídricos en *ager* y *territorium* y su relación con estructuras ideológicas o de ingeniería hidráulica de la ciudad y su entorno urbano.
- Restitución de los cursos originales de los cauces de las ramblas de Benipila, Los Dolores y el Hondón cuyos aportes irregulares en unas ocasiones alimentaron las aguas del este-

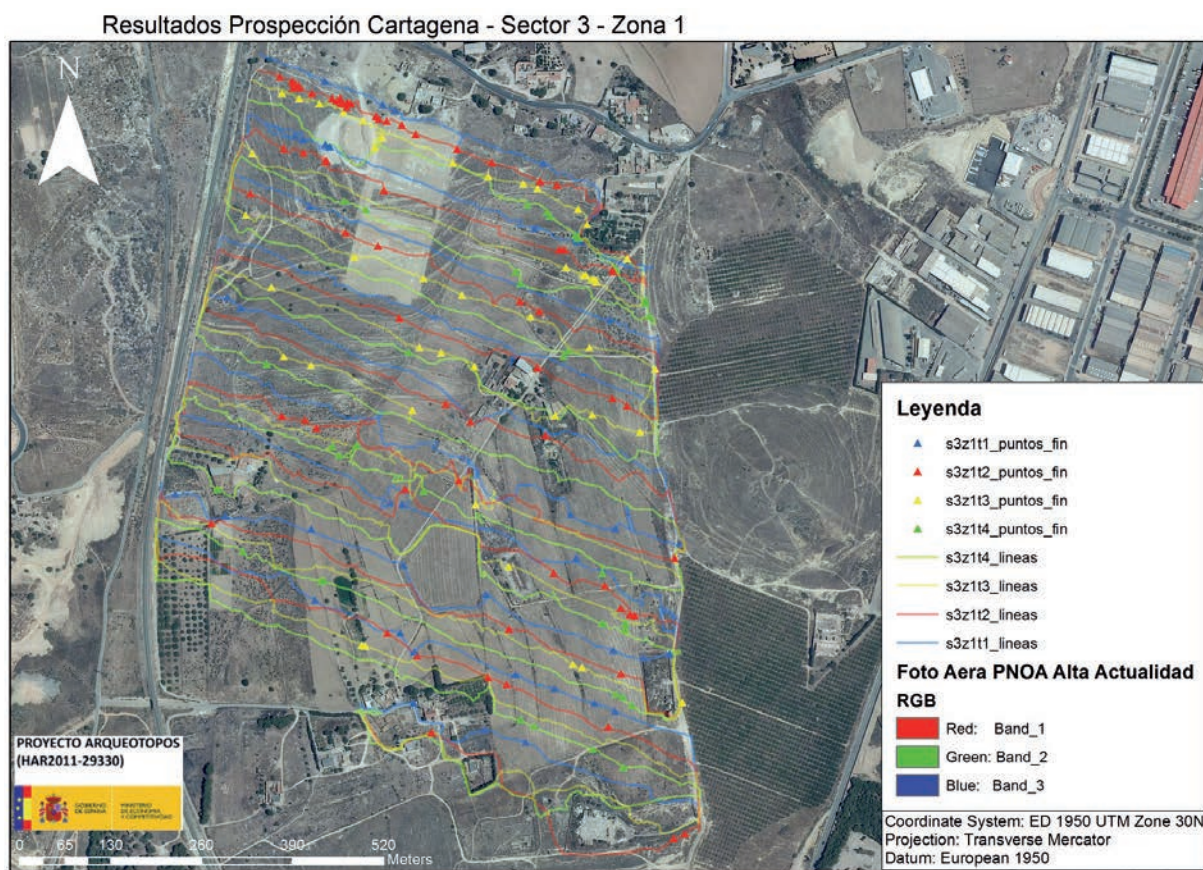


Figura 5. Modelo de prospección aplicado en el área periurbana de Cartagena.

ro y, en otras, lo colmataron, constituyendo un factor recurrente en el tiempo, muy beneficioso en determinadas áreas del territorio productivo pero limitador y restrictivo, a su vez, del poblamiento tanto en el área urbana como en la extraurbana, siendo además un factor de riesgo cuya gestión y valoración fue tomada en cuenta a lo largo de la historia de la ciudad sobre todo por las dramáticas inundaciones y efectos negativos en el mantenimiento de antiguas áreas portuarias.

La restitución de la red hidrográfica del entorno de Cartagena es una tarea básica ya que permite identificar las unidades y cursos principales y asociar la forma y textura a las características geológicas y morfológicas del terreno. Para ello se ha seguido el método de inflexiones máximas de las curvas de nivel (Morisawa, 1985) sobre una base topográfica a escala 1:15 000 con una separación de las curvas de 5 metros. Para algunos puntos problemáticos se han tenido en cuenta fotogramas aéreos de diferentes vuelos (1928, 1956; e imágenes de satélite). Como resultado se han identificado morfografías variadas (dendríticas, enrejada, subparalelas, centrípetas...) que responden a diferentes litologías y accidentes; líneas de falla a las que se adaptan de forma continua algunos cauces en su trazado general; entrecruzamiento de fallas por cambios bruscos direccionales de los cauces o acodamientos de casi 90°; difluencia fluvial e identificación de ápices de abanicos aluviales y pérdida del drenaje relacionados con sectores endorreicos. También han sido delimitados, aunque en otro orden, los sectores mejor irrigados o aquellos con posibles riesgos de inundación al confluir cursos de agua con redes de drenaje muy densas (Álvarez/Navarro/Granell, 2010).

- Determinación del soporte geológico subyacente, y definición de la geomorfología inducida desde la litología y tectónica leída en el registro sedimentario correlacionado de los

16 sondeos geotécnicos perforados en el casco histórico, en el ensanche de la ciudad y el actual área portuaria; Estas metodologías se han reforzado con la datación absoluta por ^{14}C sobre carbón orgánico total (TOC) en 18 muestras de sedimento, con análisis granulométricos, de conductividad en agua, tasas de sedimentación, contaminación por metales pesados, identificación de bioindicadores, etc.

- Delimitación del *suburbium* de la *ciuitas* y la modificación de sus límites a lo largo de las diversas etapas históricas, estableciendo la funcionalidad de cada una de las zonas que lo componen y su secuencia; se atiende para ello a los resultados del estudio y determinación del trazado de las vías de comunicación de acceso a la ciudad, en relación con los elementos naturales caracterizados, en razón a su vulnerabilidad por atravesar llanos de inundación fluvial o salvar ya posibles vados de ramblas intermitentes ya desniveles significativos del terreno.

Las metodologías implementadas en esta acción se relacionan estrechamente con las implicadas en la configuración de la red hídrica y en los resultados a nivel litológico y paleoambiental de los estudios realizados sobre los testigos obtenidos en los sondeos perforados sobre la amplísima superficie que ocupaba el antiguo Almarjal (sondeos CT-410, CT-411, CT-412, CT-413, CT-414, CT-415, CT-416 y CT-417). Desde los datos de curvas de nivel ofrecida por la litología identificada en los sondeos geotécnicos y datada mediante ^{14}C , y los ofrecidos por la red hidrológica restituida, tanto al interior como al exterior de lo que fue el trazado conocido de la urbe en estudio, se ha realizado la restitución planimétrica y volumétrica de los resultados según capas relevantes, topográficamente relacionadas con las facies litoestratigráficas caracterizadas. Sobre estas planimetrías se han reubicado viales, edificaciones, áreas funcionales exteriores, etc., en función

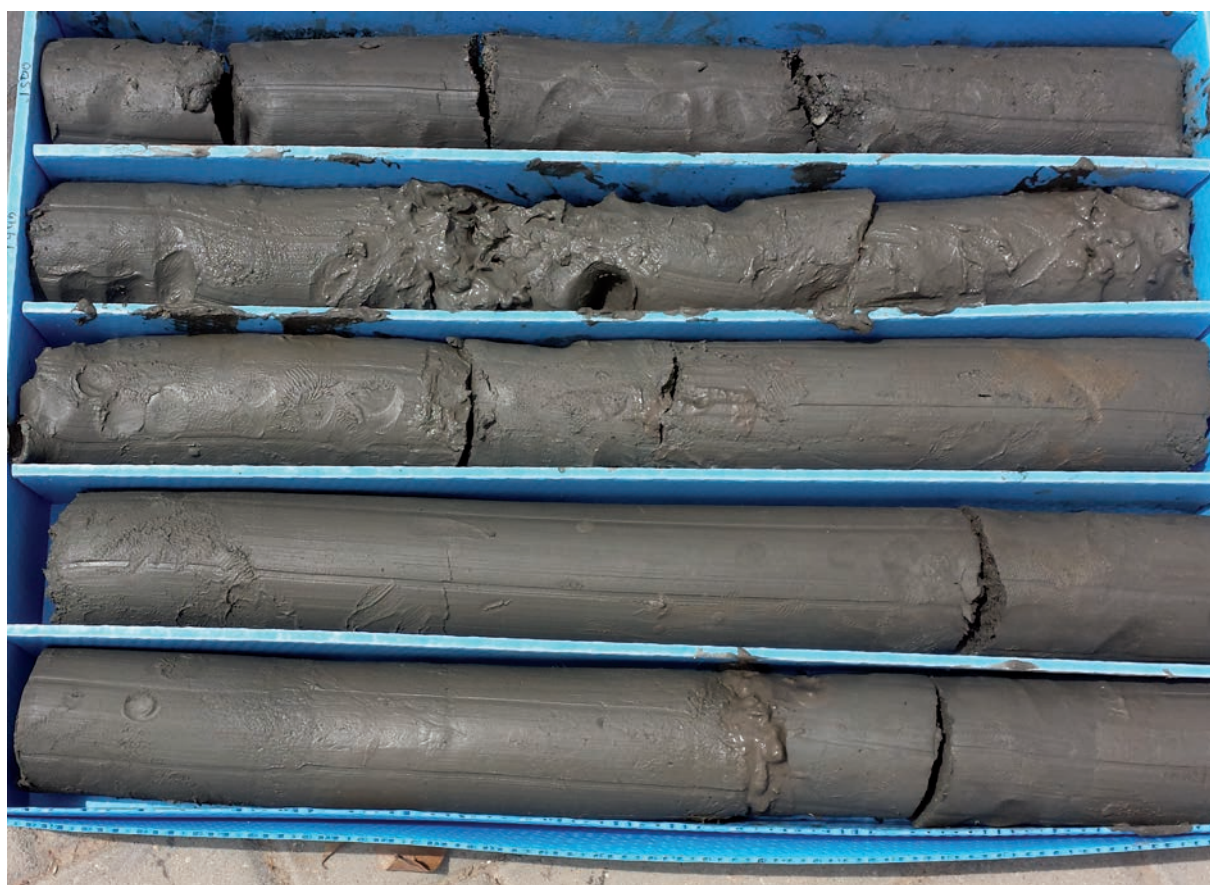


Figura 6. Core sedimentario del sondeo CT417.

- de la información disponible en cuanto a nivelación altimétrica y determinación cronocultural de origen arqueológico. Ciertamente, la recopilación de datos desde la revisión de la amplia bibliografía existente sobre restos hallados en la ciudad y su área de *suburbium*, ha sido un pilar metodológico fundamental; sin embargo, esta acción ha encontrado escollos importantes ante la falta de sistematización de algunos trabajos y, sobre todo, por la ausencia de referencias altimétricas y, todavía menos, de georeferenciación en el marco de la topografía actual de la ciudad.
- En relación con el estudio de los recursos hídricos, el proyecto ha intensificado el análisis de campo en aquellas zonas geológicamente proclives a su presencia, tanto en forma de surgencias en los cerros próximos, como de manantiales o fuentes y otras infraestructuras hidráulicas en el interior de la ciudad, que han contribuido a paliar el secular déficit hídrico de la ciudad; sus resultados se han cotejado con la documentación histórica existente al menos desde el s. XVI y con los recientes hallazgos arqueológicos que proveen de indicios de manantiales y su monumentalización como fuentes en época romana, en el interior de la ciudad o fuera de ella (Ramallo/Murcia, 2010; Ramallo/Ros, 2012).
 - Para el estudio específico de la zona marítima y sus funcionalidades portuarias se siguen metodologías propias de la Arqueología Portuaria (análisis históricos, paisaje marítimo, prospección arqueológica subacuática e integración y análisis SIG) asociados a los estudios geoarqueológicos en dicha área. Un trabajo de prospección arqueológica subacuática realizado en 2013 en colaboración con el museo ARQUA, se ha mostrado de gran utilidad para comprender ritmos de ocupación, tráfico marítimo y uso náutico de diferentes espacios portuarios; además, recientes hallazgos arqueológicos en el solar urbano han comenzado a arrojar luz sobre el origen de algunas estructuras en zonas de posible utilidad portuaria. Con los nuevos datos, se vislumbra una zona portuaria más amplia de lo que tradicionalmente se ha tenido en cuenta, dificultada por dragados históricos y destrucciones modernas. Se caracteriza ahora la génesis de dichos espacios, su evolución y, por consiguiente, la de su línea de costa para momentos históricos. Los resultados de los análisis de biomarcadores y granulometría, en conjunción con el análisis litoestratigráfico de algunos sondeos enmarcados en dataciones radiocarbónicas, sin duda ayudarán a profundizar en algunas hipótesis que empiezan a plantearse.

Resultados en marcha del proyecto

Los datos obtenidos desde las actuaciones reseñadas están permitiendo llegar a resultados significativos, y plantear nuevas perspectivas de investigación cuyas formulaciones preliminares se desarrollan sucintamente a continuación.

Para el caso de los resultados esperados en relación a la paleotopografía y la evolución del medio, se ha restituido el soporte geotopográfico sobre el que se levantan las ciudades que interesan al proyecto, determinándose los elementos geomorfológicos y la red de drenaje incidentes sobre aquel. En relación con el solar primigenio de la ciudad entre colinas, se ha constatado la configuración de un doble *bortz* en la zona oriental elevada de la misma, y una fosa tectónica en la zona occidental conformada por fallas de desarrollo fundamentalmente este-oeste y norte-sur que marcan fuertes pendientes y un bajo sector inundable en las estribaciones septentrional y meridional de los cerros de La Concepción y del Molinete respectivamente.

En relación al *territorium extramoenia* en el flanco septentrional de la ciudad, en el área del Almarjal, se han constatado dos fosas independientes, una más profunda, subsidente, en el sector occidental y otra más somera en el oriental. Esta realidad geotectónica marcará posteriormente dos dominios lagunares claramente continentales al formar parte de la dinámica aluvial de las ramblas de Benipila y Los Dolores así como las que vierten desde la cuenca del Hondón.

En estrecha relación con esta constatación, un resultado básico para entender la dinámica geomorfológica de los sectores norte, oeste y este de este sector norte de las ciudades afectas al proyecto, ha sido la caracterización y restitución de la amplia red de drenaje de los citados cauces fluviales, paleocauces y abanicos aluviales progradantes; de igual forma se ha procedido con los conos aluviales menores drenantes hacia este sector subsidente septentrional, tanto desde los sectores elevados al sur como al norte de la misma.

Ya en relación con posibles efectos de la transgresión marina holocena sobre el otrora sector pleistoceno emergido, se ha constatado la relación de la dinámica de las ramblas citadas que cursan en el sector oeste del área interior subsidente al norte de la ciudad, en cuanto a la formación del cono de la Concepción; un elemento estructural este que pudo dificultar la expansión del ascenso marino holoceno más hacia el norte. Precisamente en relación con esta posible influencia marina, fuera o dentro de la ciudad, la identificación de bioindicadores en las capas de fangos presentes en los cores extraídos, inducen nuevas estrategias identificativas relacionadas directamente con la dinámica de la sismica marina acontecida en esos tiempos en relación con los cambios en el nivel del mar, por lo que el ajuste de los resultados en esta parcela de la investigación, incluyendo el comportamiento regresivo asociado, será acometido en un nuevo proyecto continuador del presente, con metodologías de trabajo relacionados con la geofísica marina.

Al margen de ello, la constatación de un medio salobre de origen probablemente fluvial a tenor de las granulometrías trabajadas y los bioindicadores identificados, tanto en el bajo sector inundable del interior de la ciudad como en el del área norte extramuros de la misma, resulta un dato de enorme relevancia para lecturas alternativas a las efectuadas hasta el momento sobre el medio circundante y el propio desarrollo urbanístico de la ciudad, especialmente en lo que al trazado urbano compete así como a las sucesivas remodelaciones del orden primigenio. En este último sentido se observa una mimetización entre perfil orogénico y planificación urbana primigenia, verificándose que en las remodelaciones posteriores se tuvo en cuenta no solo el imaginario político, sino sobre todo dos cuestiones que hacen singular este aspecto en esta urbe mediterránea; de un lado, la necesidad de sanear y colmar el bajo sector inundable entre cerros de La Concepción y Molinete, para finalmente regularizarlo; de otra, la necesidad de desarrollar la zona pública de la ciudad en la inmediatez de sus puertos.

Finalmente, se va procediendo a materializar la reintegración gráfica de la delimitación del dominio lagunar esporádico interior, y el exterior marino franco, de los cursos de agua intermitentes que jalonaron, potenciaron y estructuraron su *ager* inmediato, de los espacios extraurbanos relacionados con la secuencia ocupacional del asentamiento a lo largo de su historia, de las áreas portuarias, etc. En los límites así materializados, previamente se integra topográficamente el perfil restituido del suelo geológico de la península en la que se ubicaron las antiguas ciudades *Kart-badast* y *Carthago Nova*, *Carthago Spartaria*, o *Qartayannat al-Halfa*, y los elementos geomorfológicos detectados en su amplio solar.

Perspectivas de investigación abiertas por el proyecto

Los resultados que el proyecto va suscitando, unos esperados, otros revelaciones novedosas trascendentes, abren nuevas incógnitas estrechamente relacionadas con la formulación definitiva de aquellos. Encaminadas a resolverlas el equipo de trabajo se ha planteado en la nueva fase de investigación las siguientes acciones:

- El análisis micropaleontológico de biorrestos, así como la determinación de asociaciones biocenóticas en los sedimentos de los *cores* obtenidos, en tanto que biomarcadores im-

prescindibles para la determinación de la influencia y ubicación de los dominios continental y, quizás, marino, del sector continental septentrional exterior y el occidental interior entre colinas en los que el medio salobre, pantanoso, parece dominar. A esta acción se suma el análisis de arcillas desde el muestreo de dichos sedimentos. Dos objetivos se buscan: a) conocer cómo se comportó esta última zona interna de la ciudad en sus diversas ocupaciones, en tanto que escenario de la vida pública de estas; b) qué áreas fueron las más aptas en el sector continental septentrional exterior a la ciudad, para su uso bien como labrantíos, bien como abrevaderos naturales, o por dónde discurrieron los viarios de personas, animales y máquinas, o dónde fue factible la ubicación de talleres artesanos de ceramistas, vidrieros, curtidores, etc. El análisis de ostrácodos permitirá, a la vez, conocer cambios más puntuales sobre dicho medio, y su datación mediante racemización de aminoácidos permitirá confirmar, matizar o puntualizar las temporalidades aportadas por los análisis de ^{14}C .

- La comprobación de los niveles de contaminación por metales pesados, tanto sobre el medio físico del *ager* como a nivel atmosférico, en tanto que aportación de datos que permitan concretar sectores funcionalmente relacionados con el tratamiento de determinados metales en la ciudad, así como abordar aspectos de salubridad y paleopatologías asociadas a dicho efecto, en una zona altamente expuesta a ratios contaminantes originados en la explotación minera de su entorno.
- La construcción de los modelos dinámicos de las ciudades *intramoenia*, a partir de las restitutiones 3D propuestas desde los resultados paleotopográficos propiciados por los sondeos geotécnicos, la información cartográfica histórica y los levantamientos urbanos realizados bajo el paraguas del actual Proyecto Arqueotopos. Se busca ligar, de forma más rigurosa, el perfil del solar primigenio revelado por las facies litológicas de los sondeos geotécnicos al urbanismo de las sucesivas «ciudades». Creemos que la modelización con MDT permitirá dejar atrás conjeturas, afianzar espacios y planos de construcción y áreas abiertas de la ciudad desde sus orígenes conocidos, y cómo han sido o colmatadas las abiertas o arrasadas o remontadas las construidas, concretar áreas de captación de aguas, etc.; en segunda instancia, pero no menos importante, se pretende facilitar la transmisión de los resultados obtenidos a la sociedad general, en un entorno más didáctico.
- Igual modelo metodológico se aplicará a los espacios del *suburbium* y el *ager* caracterizados desde la información paleoambiental obtenida. Se busca facilitar la realidad productiva de la ciudad en recursos subsistenciales y/o en recursos específicos de diferente naturaleza. Circunstancia que debe ser valorada desde el rigor de un análisis científico como el que este proyecto ofrece, para entender las luces y sombras de una ciudad como la que aquí interesa.
- Completar el análisis espacial marino y de utilidad portuaria de la bahía y ciudad de Cartagena, mediante la modelización hidrodinámica de vientos, oleaje y corrientes. Se utilizarán para ello 4 modelos paleobatimétricos de diferente cronología que sean capaces de responder al comportamiento de estos condicionantes en realidades cambiantes. Se busca así avanzar en el conocimiento de la utilidad náutica, accesibilidad y áreas portuarias de *Carthago Nova*.

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Instalaciones y funcionarios portuarios en el Mediterráneo antiguo

Facilities and port officials in the Ancient Mediterranean

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Resumen: la historia sobre Grecia y Roma ha monopolizado la investigación de las culturas del Mediterráneo antiguo. Un aspecto de este ámbito corresponde a los puertos y sus funcionarios. Su desarrollo registró un avance importante desde que se pudieron cimentar estructuras debajo del agua; antes, los fondeaderos y puertos dobles a resguardo de los vientos imperantes constituyeron los usos para las embarcaciones transeúntes. Nuestra atención se dirige a los puertos de Atenas, Siracusa, Alejandría y Cartago. Estos conjuntos se han estudiado ampliamente, pero no su funcionamiento interno en el marco institucional de las *póleis*. Una serie de voces técnicas, referidas a las instalaciones y a los funcionarios, nos ilustra sobre los procedimientos seguidos en cada caso; entre las primeras, *neórion*, *naústathmon/os* o *epíneion*; entre los segundos, *epimeletés*, *neorophýlax*, *grammateús*, *tamías*, *limenophýlax*, *limenárchos*, *astýnomos*, todos ellos mayormente de Atenas.

Palabras clave: instalaciones portuarias, funcionarios, Atenas, *neórion*, *limenophýlax*.

Abstract: The history about Greece and Rome has monopolized the research of the cultures around the Ancient Mediterranean. One particular aspect of this field corresponds to the installations of the harbours and their officials. The development of the harbours recorded a significant advance, from the moment they could build underwater structures. Earlier, dual ports and anchorages sheltered from the prevailing winds were the uses for passers ships. Here our attention is directed to the Athenian harbours, and of Syracuse, Alexandreia and Carthage, among others. These harbours have been copiously studied, but not their internal functioning in the institutional framework of the respective *póleis*. A large catalogue of technical words, covering both installations and officials, tells us about the proceedings followed in each case: among the

first type, *neórion*, *naústathmon/os* or *epíneion*; among the latter, *epimeletés*, *neorophýlax*, *grammateús*, *tamías*, *limenophýlax*, *limenárchos*, *astynómos*, all mostly in Athens.

Key words: Installations of the harbours, officials, Athens, *neórion*, *limenophýlax*.

En esta breve intervención, tan lejos de los importantes trabajos de K. Lehmann-Hartleben (1963 [1923]) o de J. Rougé (1966), exponemos unos conceptos previos sobre la navegación más antigua en el Mediterráneo oriental y el desarrollo de las instalaciones portuarias en este ámbito, para centrarnos después en los funcionarios de los puertos especialmente helénicos, pero sin llegar al gran desarrollo de época romana.

Los primeros asentamientos humanos de las islas del mar Egeo (islas Cíclades; islas Espóradas; islas anatólias: Lesbos, Quíos, Samos; grandes islas: Lemnos, Rodas, Creta) ponen de relieve una temprana actividad náutica con el nivel técnico del momento. Y esto por extensión también, en otros rincones del *Mare Nostrum*, expresión que se encuentra ya en César y Salustio (Caes., B.G., V 1; Sall., B.Iug., 17,4)

La navegación, en sentido estricto, por ríos y lagos debió de anteceder a la marítima y proporcionar una experiencia básica para acometer singladuras por mar (la navegación entre las islas griegas del Egeo y Jónico no implicaba necesariamente unas distancias importantes). Las navegaciones prístinas desde el continente europeo a estas islas pueden situarse hacia el x milenio (a Cefalonia o a Zacinto); de tierra minoroasiática a Chipre, en el vi milenio; a las islas Cíclades, en el v milenio a.n.e. Las primeras embarcaciones egeas que navegaron hacia Biblo pueden documentarse a partir de la III dinastía egipcia (Wachsmuth, 1979b: 67).

Las quebradas costas de Grecia –continental, insular y de Asia Menor– con sus cabos, golfos y promontorios (referencia importante para la navegación), propiciaron los viajes por mar merced a los fondeaderos, calas y ensenadas, al abrigo de estos accidentes geográficos. Los versos de la *Ilíada* nos ilustran sobre cómo varaban los griegos sus panzudas naves en la playa, a las que protegían con un foso y empalizada, como si se tratase de un campamento, si se preveía una larga estancia (p. ej., la estación invernal del *mare clausum*). Y la leyenda de los Argonautas nos habla de la construcción de la nave *Argo*, cuyos planos diseñó Atenea, y de su botadura en el mar no cerca del lugar de construcción: una verdadera tarea de titanes (Grimal, 1965: 46-51).

A propósito del *mare clausum* (referido no solo al bloqueo marítimo, sino también a la estación del año con serias dificultades para la navegación), la fiesta cultural de las Pleafesias (πλοιαφέσια) en Grecia, relacionada con el *navigium Isidis*, de época helenística pero con raíces egeas, tenía lugar todos los años a principios del mes de marzo inaugurando la temporada de navegación: se enviaba un bajel al mar como ofrenda con una oración rogando por un regreso feliz cosida a su vela; quienes dirigían el rito podían ser los mismos navarcos, los trierarcos o los hieronautas (ναύαρχοι, τριήαρχοι, ἱερονάυται) (Wachsmuth, 1967; 1979a: 938s; Rougé, 1966: 32-34). No son desconocidos tampoco los préstamos marítimos del momento, δάνεισμα (*dâneisma*) y sus derivados, normalmente al doble del valor, debido a los altos riesgos asumidos, con una usura de escasa regulación jurídica hasta época romana (cfr. σεισάχθεια (*seisachtheía*) de Solón), cuando se desarrollaron de modo importante, según sabemos por la literatura romanística (Rubio, 1954: 1539s.).

A pesar de que griegos y romanos hayan monopolizado las investigaciones históricas sobre el Mediterráneo antiguo, también conocemos las empresas marítimas, no poco destacadas, de cretenses o minoicos, griegos micénicos, fenicios y cartagineses o de los etruscos, en este sentido. Como sabemos, los fenicios siguieron en parte rutas abiertas previamente por los micénicos también en el Mediterráneo central y los griegos colonizadores de época arcaica se sirvie-

ron a su vez de la experiencia acumulada por los navegantes fenicios, tirios y sidonios principalmente, y también citienses de Chipre.

Los fenicios, en sus asentamientos, elegían promontorios sobre el mar o islas cercanas a la costa¹; como hemos expuesto en otro trabajo (Espada, 2010: 32) las primeras instalaciones de colonias griegas (*apoikíai*) siguieron también este ejemplo: Ischia (Pitecusa), cerca de Cumas, la isla de Ortigia en Siracusa y otros ejemplos menores.

Con el paso de los siglos, el desarrollo de las infraestructuras portuarias, en el contexto de una *koiné* náutica en el Mediterráneo (Wachsmuth, 1979b: 68), registró un avance importante desde el momento en que pudieron cimentarse bloques escuadrados debajo del agua, pasando de la pasarela y del muelle de madera, que cumplieron su función, a los de piedra; tampoco dejaron de combinarse los materiales, como *mutatis mutandis* podemos apreciar en los puertos deportivos actuales (pantalanes).

Así pues, dos procesos intervinieron básicamente en el tema que nos ocupa, a saber: a) los avances poliorcéticos empujados por la actividad bélica creciente, y b) los citados avances técnicos, en construcciones y materiales, de obras muertas y vivas en las instalaciones de ingeniería portuaria.

Entre los fenicios y cartagineses el ámbito de «ciudad» y «puerto» solía formar un *continuum* sin solución, pero no así entre etruscos y griegos:

- A) Caere tenía a su disposición portuaria tres poblaciones junto al mar, distantes unos 13 km de ella, Pyrgi, Álsium y Púnicum (Hülsem, 1897: 1281-1283). Tarquinia, a unos 3 km del mar, se servía de la población marítima de Gravisca (Philipp, 1960: 2343-2348). (No es necesario recoger aquí el binomio Ostia-Roma; Meiggs, 1985: *passim*).
- B) Atenas disponía de varios puertos: El Pireo, Zea, Muniquia, Falero. A Corinto, por decirlo así, le prestaban servicio marítimo las localidades de Céncreas y Lequeo, a uno y otro lado del istmo. A este respecto, podemos traer aquí a colación algunos puertos de nuestras tierras de Murcia y Valencia, bien incluidos en la población, bien separados de ella:
 - 1) entre los primeros: Cartagena, Alicante, Altea, Denia (Cullera en realidad forma un puerto fluvial, como Lixus o el antiguo puerto fenicio de Guardamar), Vinaroz o Benicarló.
 - 2) entre los segundos: Valencia (Grao), Castellón (Grao), Villajoyosa, Calpe, Jávea, Gandía (Grao), Sagunto (Grao), Burriana (Grao), Oropesa, Peñíscola.

Aparte del mundo romano –el que mejor conocemos en esta materia es el tardorrepblicano e imperial; los *duoviri navales* se crearon en 311 a.C. (Starr, 1970: 367)–, nuestros conocimientos de conceptos y sus términos correspondientes en este ámbito se refieren al mundo griego, especial –no exclusivamente– a Atenas, a sus instalaciones y sobre todo a sus funcionarios, datos que nos pueden proporcionar una idea plausible de cómo debieron funcionar las cosas entre otros griegos y en otras regiones, por mor de la *koiné* helenística que siguió a la Guerra del Peloponeso (campañas atenienses de Sicilia y expansión de colonias corintias) y sobre todo a las campañas de Alejandro y la creación de los reinos de sus diádocos, Lágidas, Antigonidas y Antioquidas, principalmente.

¹ Cfr. Tucídides, «Arqueología de Sicilia», Guerra del Peloponeso, libro VI, capítulos 2-5.

Conceptos portuarios previos

La voz básica para «puerto» en griego es λιμήν (*limén*), como en latín es *portus*, relacionado con *porta*, y el topónimo Ostia, relacionado con *ostium*; también en el latín *pons/pontem* está relacionado con el griego πόντος, una de las maneras de denominar el mar, en este caso en calidad de vía de comunicación (Daremberg/Saglio, 1897: IV, 594-601). Λιμήν (*limén*) vale tanto como «rada» o «fondeadero», y es el término más antiguo, recogido ya por Homero (Il. I, 432; Od. IV 846; V 404. 418. 440; XIII 195) (Rougé, 1966: 115-117). La derivación y riqueza léxica es variada en este campo. Adjetivos derivados de λιμήν, son εὐλίμενος (*eulímenos*), «que ofrece un buen puerto», y ἀλίμενος (*alímenos*), una zona costera «inhospitalaria, sin puerto». Λιμήν αὐτοφυής (*limén autophyés*) es un «puerto natural»; λιμήν ὀρυκτός (*limén boryktós*) es un «puerto excavado» y λιμήν χυτός (*limén chytós*), un «puerto recogido». Unos están reseñados por los grandes autores antiguos, otros por gramáticos y lexicógrafos. El nombre general es νεώριον (*neórion*), que se refiere a un concepto de puerto más elaborado y evolucionado que el anterior, más moderno, que incluye también arsenales y astilleros y funcionarios encargados de su guarda y supervisión: estos son los νεωροί (*neoroi*). En esta línea está el adjetivo χειροποίητοι (*cheiropoíētoi*), puertos artificiales contruidos por la mano del hombre. Un ἐπίνειον (*epíneion*) era una instalación adjunta al puerto, bien un ancladero o un depósito marítimo, recogido entre otros por Tucídides (I 30; II 84) y Aristóteles (Pol. VII 6,5) (Liddell/Scott, 1996; Glare, 2002; Rougé, 1966: 107-110). Otros términos, σάλος (*sálos*), el «lugar de anclaje»; ἀγκυροβόλιον (*ankyrobólion*), «lugar de anclaje en una costa rocosa»; αἰγιαλός (*aigialós*), la «playa o ribera», adonde se sacan las embarcaciones; ἀποδρομή (*apodromé*) y sus derivados, un término genérico para designar un refugio o abrigo; κατάβολος (*katábolos*) es un vivero de ostras y también el lugar para echar el ánora.

En una breve nota, F. Gschnitzer (2001: 331-333), entre sus *Kleine Schriften*, llama nuestra atención sobre un segundo significado, derivado, de λιμήν, término que puede servir también como sinónimo de ἀγορά, la «plaza pública», como centro de reunión ciudadana, la «plaza del mercado». Este aspecto está bien documentado en Tesalia (IG IX 2, 517 = Syll.³ 543); fuera de ella los testimonios son inseguros. El caso es que los espacios libres de un puerto, entrada de hombres y mercancías, en ausencia de un verdadero recinto del ágora o por distancia del centro de la *pólis*, podían suplir perfectamente esta función, pues se podían hacer cerca del agua a la arribada de las embarcaciones reuniones improvisadas respaldadas por la costumbre. Puede pensarse que las autoridades de la ciudad (las meramente portuarias o las metropolitanas) no centralizaran en un primer momento ni la actividad pesquera ni la marítima en general y que ciertos grupos empezaran a utilizar los espacios cercanos al mar favorables para sus actividades, separados unos de otros sin estorbarse, hasta el momento previsible de la cooperación y unificación centralizada.

Λιμήν κλειστός (*limén kleistós*) se trata de un puerto cerrado –tal es la expresión griega– incluido en el recinto amurallado de la ciudad. Este cuadro constituye una creación helénica, que aparece ya en época arcaica. Su disposición proporcionaba una seguridad a las embarcaciones, especialmente las de guerra, que no estaban operando necesariamente todos los días, y la garantía de los abastecimientos de todo tipo por mar (víveres, sobre todo) ante un posible sitio por tierra de un ejército enemigo; en algunos casos que conocemos por las fuentes literarias (la misma Cartago, p.ej., o Rodas), la bocana del puerto podía cerrarse a entradas y salidas tensando grandes cadenas que impedían la circulación de embarcaciones (Lehmann-Hartleben, 1963: 70-72).

Εμπορία (*emporía*) es en griego el «comercio», entendido por mar, así igualmente el «viaje de comercio»; con varias acepciones, *emporía* se refiere también al «lugar de comercio marítimo»; es una voz recogida por Heródoto (III 139), Tucídides (I 2; 7) o Aristóteles (Pol. IV 4,10);

en Atenas particularmente, se refiere a la bolsa para el comercio de exportación²; *emporía* también es un enclave o factoría comercial en la costa, bastante cercana conceptualmente a las de los fenicios: un mercado portuario, el puerto comercial de una *pólis*. Pero los diferentes términos empleados no siempre separan con su significado espacios físicos, sino muchas veces solo designan actividades o controles diferentes en un mismo lugar.

Sobre νεώριον en griego

En determinadas familias y ámbitos de palabras el griego antiguo ofrece una variedad léxica de voces, tanto literarias como institucionales, más rica que el latín. Por ejemplo, los términos especializados para designar los convenios, acuerdos y tratados entre comunidades, unos genéricos y otros específicos: a) γραφή (*graphḗ*) y συγγραφή (*syngraphḗ*), σύνθημα (*sýnthema*), συμβολή (*symbolḗ*) y σύμβολον (*sýmbolon*), όμολογία (*homología*), συνθήκη (*synthḗke*), φιλία (*philía*; término polivalente en gr.), σπονδή (*spondḗ*; en sg. y pl.), άναγκή (*anankḗ*), σύμβασις (*sýmbasis*), ρήτρα (*rhḗtra*); b) ειρήνη (*eiréne*), έπεχειρία (*ekecheiría*), όρκος (*bórkos*) (Fernández Nieto, 1975: passim), mientras en latín solo tenemos *foedus*, *pax*, *societas*, *amicitia*, *indutiae* (Espada, 2001: 18-2; 2013: 222).

Ya hemos indicado que la palabra básica y antigua para designar un puerto es en griego λιμήν. Aparece recogida por Homero (vid. supra), usada en sg. o pl. Por metonimia, incluso entre nosotros, podemos designar un lugar de la costa o del puerto por un nombre referido a una actividad concreta pero que no se realiza continuamente, sino esporádicamente: por ejemplo, la almadraba, la *xitā* (en el puerto Valencia), el malecón, etc. Λιμήν es el puerto en términos generales; es el abrigo o depósito en la costa donde dejar la embarcación y, tomando la parte por el todo, es en todo caso cualquier refugio o lugar de asilo (Bailly, 1963: 1193). Liddell y Scott³ se expresan igual, añadiendo (como recoge F. Gschnitzer) que λιμήν también se entendía, en Tesalia y Pafos (y también en Chipre, según Hesiquio el lexicógrafo, 207), como άγορά, es decir, que el espacio portuario, a falta de uno de estas características de cierta amplitud entre los callejones de la ciudad, podía servir de punto de reunión para los habitantes de la comunidad, en calidad de plaza del mercado o espacio despejado para una asamblea. Los diccionarios etimológicos del griego ponen en relación «λιμήν» con «λειμών», «prado» o «pradera húmeda» (Chantraine, 1999: 641 - 627; Frisk, 1991: 124 - 97/9).

En un país volcado al mar y que tenía su centro de gravedad en él, los fondeaderos y abrigos litorales naturales y desembarcaderos y puertos adaptados por mano humana tuvieron gran importancia –*domi militiaeque*– para la navegación y las maniobras de embarque y desembarque de hombres y mercancías. En un ámbito cultural y lingüístico como la Grecia antigua el concepto de «puerto» revestía una importancia ineluctable. En un primer momento, se trataba de un lugar donde poner a resguardo las embarcaciones, un fondeadero en una rada, en una bahía, protegido de los embates del oleaje; para ello bastaba un término genérico como la paz que ofrece una pradera, o el seno de su llanura. Pero con el desarrollo inevitable, en tiempos de paz y de guerra, de las instalaciones portuarias, primero simples y poco a poco más elaboradas, se hacía preciso utilizar una palabra, o unas palabras, más ajustadas a la función más específica de un puerto, como lo conocemos actualmente. Según observamos por las explicaciones etimoló-

² No está de más recordar el valor, desde el punto de vista del *marketing*, que tenían los vasos áticos de figuras negras destinados a la exportación de aceite de los olivos del Ática. Cfr. Ruipérez y Tovar, *Historia de Grecia*, Barcelona: Montaner y Simón, 1978 (1960), p. 108: «Y estas mercancías de exportación encontrarían mercados más fáciles si eran envasadas en atractivos recipientes de cerámica decorada».

³ Dejamos aquí de lado la acepción IV: *source of birth, womb*, en Liddell y Scott, *Greek-English Lexicon*, Oxford: Clarendon Press, 1996 (1843), p. 1050, s.v. «λιμήν».

gicas, la metonimia puede desempeñar un papel importante para ofrecer términos que designen el espacio portuario, con sus espigones, malecones, muelles, depósitos y almacenes y espacio para reparaciones de los bajeles, tanto de guerra como comerciales. Cuando se habla de arsenales, a propósito de *neórion*, parece que se refiera solo a embarcaciones de guerra y las otras, por cierto, también necesitaban sus jarcias, arreglos y abastos. Por lo que en muchas ocasiones puede entenderse perfectamente «*neórion*» como referido al conjunto del puerto.

Ciudades y puertos

1) Atenas dista de la línea del mar, como Valencia y Castellón o Gandía, unos 5 km aproximadamente. Tras las Guerras Médicas, Temístocles logró convencer a sus conciudadanos de que construyeran unos muros –aportando a la obra cada cual lo que pudo y tenía más a mano– que unieran la *pólis* ateniense con el *neórion* del Pireo, a pesar de la oposición de Esparta, y que garantizarían el aprovisionamiento de Atenas por mar en caso de un asedio por tierra. Seguramente fue él quien promoviera los grandes trabajos del Pireo: la concepción del puerto dataría de 490 y el plan de urbanismo de 470 a.C. Pero no había un único puerto, sino cuatro (en puridad tres más uno), el Pireo el Pireo citado o *Kántharos*, cerrado por muelles –aunque conceptos diferentes se refieren en la práctica a la misma zona: el Pireo era la población costera y el Cántaro, el puerto–, la Zea y la Muniquia en la península rocosa de *Akté*, con abrigo e instalaciones para barcos de guerra y astilleros de construcción y reparación,



Figura 1. Puertos del Pireo. Fuente: http://www.lahistoria.com.ar/archivos_varios4histor31.gif.

separando así el puerto naval del comercial (Ruzé-Amouretti, 1987: 124), y por fin el Falero en un extremo de la bahía del mismo nombre en el golfo Sarónico, con un muro posterior propio desde la ciudad⁴. Por otro lado, Atenas disponía de dos embarcaciones sagradas, la Πάραλος (*Páralos*) y la ναὺς Σαλαμινία (*naûs Salaminía*), que prestaban servicio para *teorías* o procesiones a Delos y para las embajadas, pero que podían integrarse en un momento dado en la marina de guerra (Dobesch, 1979: 504; Trecani, 1965: 180-189).

- 2) Los fenicios, en sus asentamientos, elegían promontorios sobre el mar o islas cercanas a la costa⁵; como hemos expuesto en otro trabajo (Espada, 2012: 15s.), las primeras instalaciones de colonias griegas (*apoikíai*) siguieron también este ejemplo: Ischia (Pitecusa), cerca de Cumas, la isla de Ortigia en Siracusa y otros ejemplos. Siracusa, colonia corintia, se dice en griego en sg. o en pl. (*Syrákusai*) y por ende también en latín. El puerto primitivo debió habilitarse en una pequeña rada, un fondeadero junto a Ortigia, el núcleo originario. La expansión urbana posterior, la Acradina, extendió las instalaciones portuarias hacia el oeste. Con ocasión de las guerras de Dionisio I y sus sucesores contra Cartago, se fortificaron los puertos, capaces de albergar a la gran flota siracusana, que intervino en numerosos episodios navales de la Antigüedad arcaica, desde Cumas (474 a.C.) hasta los numerosos enfrentamientos bélicos contra Cartago, pasando por el expolio sacrílego del santuario de Pyrgi en el s. iv a.C.
- 3) Corinto ha sido y es una de las ciudades más importantes de la Hélade, por su historia y su posición estratégica en el istmo y por su activo comercio y prosperidad a lo largo de los siglos. Destruída y arrasada por los romanos en 146 a.C., poniendo fin así a las Guerras Macedónicas, volvió a reconstruirse con mayor magnificencia al cabo de un siglo, sin duda por la misma necesidad estratégica anterior en el istmo. Como ciudadela de Corinto regía el Acrocorinto, una inmensa mole rocosa separada de la ciudad. Esta, en su posición privilegiada en el istmo, precisaba a una parte (golfo de Corinto) y a otra (golfo Sarónico) sendos accesos al mar, los puertos de las poblaciones de Céncreas y Lequeo, y además se sirvió de un διόλκος (*diólkos*), por el que transportaban a lo largo de carriladas sobre zócalo de piedra las embarcaciones de un golfo, de un mar a otro (Heuss-Schachermeyr, 1976: 304). Como los atenien- ses, los corintios fortificaron con murallas los accesos a los puertos y al Acrocorinto, para asegurar igualmente los abastecimientos⁶.
- 4) Cition, en Chipre, constituía una sucursal de Tiro, base adelantada de operaciones marítimas, como, andando los siglos, las Islas Canarias con respecto a Sevilla en las singladuras hacia América (Yon, 2005: 1215),
- 5) Mileto (*Mílatos* en dialecto dorio) ha sido una ciudad con múltiples peripecias a lo largo de su historia, destruida y reconstruida en varias ocasiones. En época arcaica destaca la colonización milesia, especialmente con fundaciones a lo largo de la costa meridional y oriental del Ponto Euxino. De cuatro puertos naturales sobresalen dos: a) la bahía del Teatro (por el gran teatro de época romana que se erigía al norte con actuales restos helenísticos de la escena); b) la bahía de los Leones, cuyo nombre se debe a dos leones de mármol que soportaban una cadena para cerrar la bocana del puerto. Los restos monumentales de la ciudad que han llegado hasta nosotros, proceden de época de los Antoninos (Zschiezschmann, 1979: 1295-1298).
- 6) La isla de Rodas (masc. en griego) dispone de amplias llanuras costeras; estaba colonizada ya desde época micénica. Posteriormente, la *chóra* de las ciudades de Yaliso, Camiro y Lin-

⁴ Pausanias, Descripción de Grecia, libro I 1, 2-3 y 2,2.

⁵ Cfr. nota 1.

⁶ Pausanias, Descripción de Grecia, libro II 1,5 y 2,3.

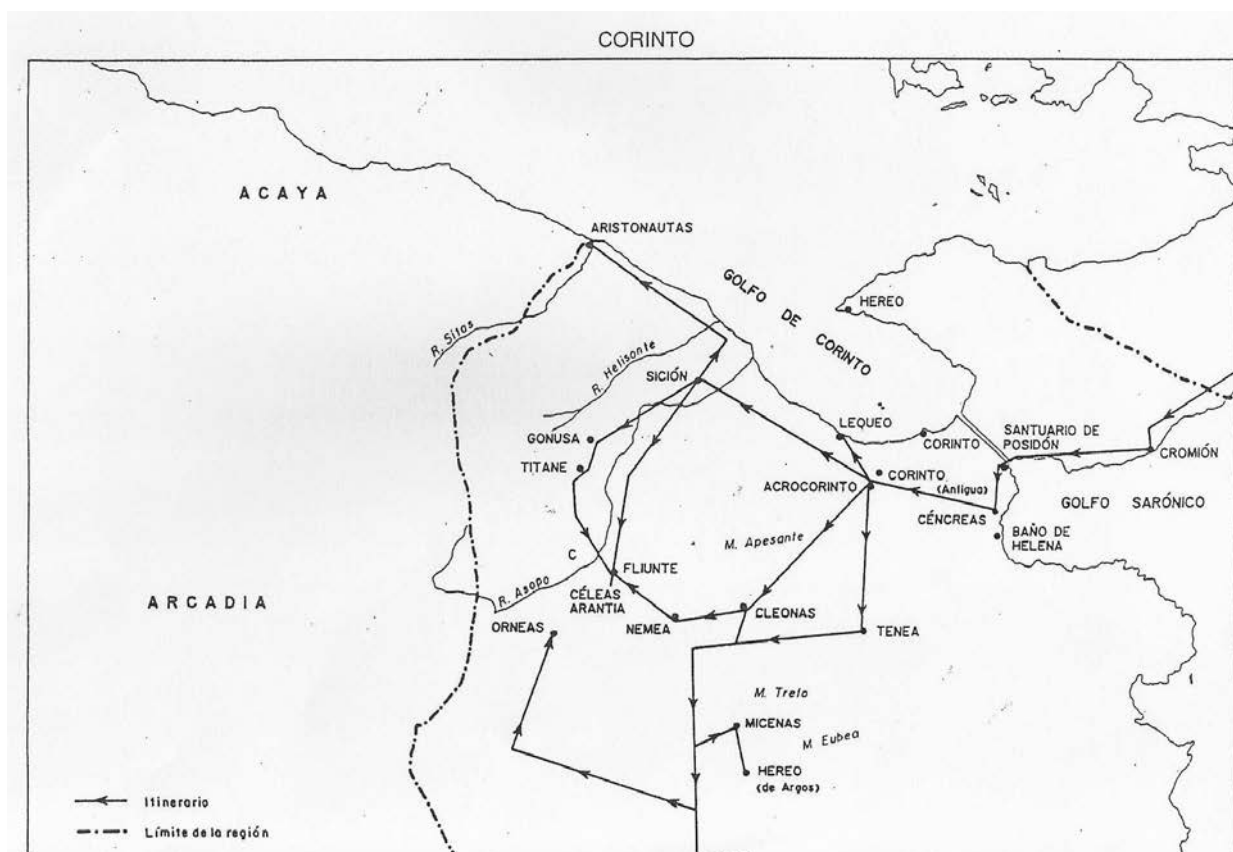


Figura 2. Céncreas y Lequeo, puertos de Corinto. Pausanias, Descripción de Grecia, Biblioteca Clásica Gredos.

do estaba dividida en distintos demos. En 408-407 a.C., en los años finales de la Guerra del Peloponeso, se fundó la ciudad de Rodas en el norte de la isla, que llegó a convertirse en la más importante; disponía de tres puertos artificiales (Diod. XIII 75,1). El Coloso de Rodas, una enorme estatua de bronce de 75 brazas de altura representando al dios Helios (Apolo), a la entrada del puerto principal desde el que se columbraba a gran distancia, se levantó para celebrar la defensa e independencia frente a los planes y sitio de Demetrio Poliorcetes en 307-306 a.C. En 227-226 a.C. un violento terremoto arruinó el monumento, que ya no volvió a reconstruirse, siguiendo las disposiciones del oráculo consultado (Ebert, 1927-1928: 133).

- 7) Alejandría fue fundada en 332 a.C. por Alejandro Magno sobre una pequeña población anterior, Racotis. La ciudad estaba, está, junto al brazo canópico del delta nilótico, sobre una leve colina de poca altura, entre el mar y la laguna Mareotis. La isla de Faros se unió a tierra firme mediante una escollera de unos 1200 m de longitud (cfr. Tiro y Motia), el *Heptastadion*. Con ello se formaban dos senos litorales: el puerto principal al este, fundamentalmente comercial, y el puerto de Eunosto al oeste, que incluía un arsenal naval para la marina de guerra, el *Ciboto*. Existía también un pequeño puerto que daba al lago Mareotis, Fiale (Rougé, 1966: 121-126). La planta hipodámica de la ciudad fue diseñada por Denócrates de Rodas. En el extremo oriental de la isla de Faros levantó Sóstrato la famosa torre señalizadora para la navegación en 279 a.C., que se derrumbó finalmente en 1326. El puerto oriental mencionado acogía un templo dedicado a Posidón. Diodoro Sículo dice que en su tiempo Alejandría albergaba 300 000 almas libres; la ciudad era desde un principio una *pólis* autónoma griega, separada administrativamente del conjunto egipcio, pero sin el órgano deliberativo de la *Bulé*.



<http://sofiaoriginals.com/se132egiptoantiguoycleopatravii.htm>.

En las fuentes literarias, encontramos una descripción de la ciudad en Estrabón (XVII 791-5); en Diodoro (XVII 52) o en Flavio Josefo (Bell. Iud. II 4).

8) Las fuentes clásicas nos describen los puertos de Cartago precisamente. De ambos puertos, comunicados entre sí, el circular, más interior, era el arsenal naval con la llamada Isla del Almirante (Strab. XVII 3,4) en su centro, posiblemente una especie de comandancia de marina, con un edificio desde el que se podía controlar el tráfico interno de ambos puertos, así como las naves que arrumbaran a Cartago, y con hangares para albergar las embarcaciones de guerra (*Schiffshäuser*); el otro, más cercano a línea litoral, de forma rectangular, era el puerto comercial (Rougé, 1966: 121-126). Esta disposición impedía que en el trájín del puerto comercial tanto propios como foráneos pudieran observar qué sucedía en el interior de las instalaciones navales. La bocana al mar se podía cerrar por medio de unas cadenas, que tensándolas, impedían el paso de embarcaciones a los puertos (Medas, 2000: 26-34). Las fuentes literarias nos señalan que el puerto se conocía con el nombre de *cothon*, palabra muy posiblemente semítica (pues la griega κῶθων, «vaso grande» y «festín», no tiene ningún sentido aquí), que vendría a significar «cortar» o «tallar» (Lewy: 1970) y se referiría por tanto no a un puerto natural, sino a una dársena construida artificialmente. Estas descripciones coinciden con las dos lagunas de Salambó, a una distancia de unos cien metros de la línea actual de la costa. Los trabajos de dragado de mitad de nuestro s. xx confirmaron que el fondo de la laguna circular está enlosado, por más que Pierre Cintas (1976: 139-237) haya argumentado que las lagunas no podían corresponder a los antiguos puertos de Cartago. Sin embargo, las investigaciones de H. Hurst (1992: 79-94) en la zona de los puertos confirman la relación de las lagunas con los puertos de la capital púnica⁷.

⁷ Agradecemos en este punto las valiosas y generosas aportaciones que nos hizo durante la celebración del congreso D.^a Patricia Torrado, doctoranda de la Universidad Rovira i Virgili de Tarragona.

Funcionarios portuarios⁸

Nuestros conocimientos sobre el funcionamiento, administración y supervisión de los puertos de la Antigüedad son escasos, debidos, como en otros tantos aspectos antiguos, a la parquedad y fragmentación de las fuentes históricas en general.

El número de funcionarios y su especialización y delimitación de funciones dependía de la importancia y magnitud de la actividad portuaria de cada ciudad (no era el mismo caso de Atenas o Alejandría, esta con el puerto comercial incluido en su recinto, que otras poblaciones más modestas). Las metrópolis empezaron enviando a parte de sus propios funcionarios a los poblados marítimos portuarios en auge. Funcionarios atentos a la entrada y salida de los barcos, exigían el tributo que habían arbitrado las autoridades portuarias de la ciudad. El estudio del funcionamiento interno en el marco institucional de las *póleis* fue iniciado por K. Lehmann-Hartleben y A. Köster (1969), por F. J. Fernández Nieto, sin olvidar a R. Meiggs, así como por los autores de artículos de las diversas enciclopedias de Realia. Jean Rougé (1966: 201-212) ha trabajado exhaustivamente la organización del comercio marítimo en el Mediterráneo antiguo, desde diversos aspectos locales, temporales y conceptuales⁹.

Así pues, la información más amplia que poseemos al respecto proviene, por motivos fáciles de comprender, de la vida portuaria ateniense (Fernández Nieto, 2009; 2011). Atenas, ciudad con un régimen democrático por excelencia, había desarrollado también las competencias de organización y control en sus puertos, en el Pireo principalmente. Una comisión de



Figura 4. Puertos de Cartago. Fuente: <http://upload.wikimedia.org/wikipedia/Karthago.PNG/440px>

⁸ La información básica e ineludible para este apartado se encuentra en la obra de K. Lehmann-Hartleben, repartida por los distintos capítulos y especialmente en el catálogo de instalaciones portuarias (*Hafenanlagen*, pp. 240-287) y en el excurso de funcionarios portuarios (*Hafenbeamten*, pp. 288-289), así como en los diferentes artículos de la enciclopedia de la Antigüedad, *Realenzyklopädie d. klass. Altwsch.* de A. Pauly y G. Wissowa y diádocos y su epítome *Der Kleine Pauly*, de K. Ziegler, W. Sontheimer y H. Gärtner.

⁹ Jean Rougé publicó en 1966 un amplio y pormenorizado estudio sobre la organización del comercio marítimo en el Mediterráneo antiguo: I - su infraestructura (naves y puertos), II - los actores del comercio marítimo, III - los problemas económico-jurídicos. Se trata de otro trabajo fundamental e insoslayable sobre el tema, en la línea del Lehmann-Hartleben pero con otro enfoque, con muchos elementos que entran en nuestra comunicación (más breve y menos profunda por naturaleza) y que abarca zonas y épocas tanto griegas como romanas mucho más extensas.

ἐπιμελοῦμενοι (*epimeloúmenoi*), «hombres al cuidado de» (*curatores* en términos romanos), estaban encargados del buen funcionamiento general del puerto (*neórion*) y los funcionarios ejecutivos eran los νεωροί (*neoroi*); en el s. IV a.C. esta encomienda pasó a diez ἐπιμεληταί (*epimeletaí*), «administradores» que estaban asistidos por secretarios y cobradores de tasas y tributos, γραμματεῖς (*grammateís*) y ταμίαι (*tamíai*); los helenotamías eran los funcionarios cobradores y depositarios del tributo φόρος/*phóros* de las ciudades integrantes de la Liga marítima ático-délica).

Φύλαξ (*phýlax*), «guardián», es un término genérico en griego; esta guardia de actividades referida a los puertos se designa, por consiguiente, como νεωροφύλακες (*neorophýlakes*) y λιμενοφύλακες (*limenophýlakes*). Su número era variable en las distintas ciudades en las que los conocemos; por tanto, también podían tener competencias en el cobro de tasas y tributos, particularmente en las grandes metrópolis, inspeccionando la carga de los buques (conocemos también los ξενοφύλακες/*xenophýlakes* de Quíos por una inscripción honorífica). Puede apreciarse, pues, una cierta similitud entre las instituciones portuarias atenienses y las rodias.

En otras ciudades de menor envergadura el despliegue de funcionarios también era menor y actuaba como supervisor general un solo gobernador portuario, como nos ilustra una inscripción de Creusis (IG VII 1826): se trata de un λιμενάρχος (*limenárchos* / limenarco); en ocasiones estas competencias podían recaer también en cargos militares. En pequeñas localidades, los magistrados comunales se hacían cargo también del recinto portuario, especialmente los ἀστυνόμοι (*astynómoi*), según señala Estrabón¹⁰, cuyas competencias abarcaban muros, mercados, puertos y santuarios, es decir, establecimientos públicos en general (p.ej., un ἐπιμελητής (*epimeletés*) en Mileto).

Las guarniciones portuarias (φρουρά / *phrourá* – φρούριον / *phroúrion*: «fuerte» y su «guardia armada»), mencionadas ya desde Esquilo (Eum. 919) y Tucídides (II 18; III 18, 51 y 53; VII 28), según los casos, podían cumplir cometidos combinados; Estrabón se queja de la rigurosidad de los φρουροί / *phrouroi* «los soldados de una guarnición» de Alejandría.

Sin extendernos en aspectos de la navegación, un ναύκληρος (*naúkleros*) era el propietario de una embarcación o el armador, el fletador (incluso el capitán de la misma), que podían ser la misma persona, pero no necesariamente; de él nos hablan Heródoto (I 5), Jenofonte (Mem. III 9,11) o Sófocles (Ph. 128; 547). Estaban asociados en cofradías de culto, pero, por lo que sabemos, no en gremios profesionales (Berneker, 1979: 8s.).

Un apartado muy interesante, que no es *stricto sensu* institucional, y del que no poseemos los datos deseables, es el de la figura del comerciante y representante y gestor particular de negocios en las ciudades y en los puertos (no esclavo, aunque sí podían serlo sus ayudantes) de otros ciudadanos en concreto o de ciudades en general, gestionando bien asuntos propios o haciendo de intermediarios y representantes de otros individuos, sociedades o ciudades. Reconocido por la institución griega de la προξενία (*proxenía*), ilustrando, un ciudadano ateniense podía representar los intereses de Corinto o de ciudadanos corintios en Atenas; o un corintio asentado en Atenas, con un prestigio obtenido al cabo de los años por sus acertadas gestiones, podía llevar a cabo los mismos contactos en la representación de negocios. En la actualidad podríamos hablar *mutatis mutandis* de un cónsul honorario, en términos franceses. Esta actividad de representación, aparte de los asuntos propios, está testimoniada por la misma *proxenía*, por las colonias de habitantes de tal o cual ciudad en otra diferente (Al Mina, Roma, etc.), o por los *oikistaí* que dirigían las diferentes expediciones marítimas de la gran colonización griega (ca.

¹⁰ Platón y Demóstenes nos hablan de los quince ἀστυνόμοι (*astynómoi*) de su tiempo, cinco de ellos destinados al Pireo.

775-750, 550 a.C.) y que se encargaban desde un primer momento de la empresa, acogiendo a hombres de diversas comunidades en el proyecto de la futura *apoikía*.

Otros conceptos

Existían una serie de instalaciones portuarias para atender a las diversas necesidades del tráfico comercial y del cuidado y mantenimiento de los buques: amarres, guarda y reparación, astilleros y calafateadores, arsenales, depósitos y almacenes, según la importancia de cada puerto. "ὄρμος (*bórmos*) es una cadena y el lugar de amarre de una embarcación, y por extensión un fondeadero o un puerto; los ὄρμοφύλακες (*bormophýlakes*) vigilaban y debían de ayudar en estas maniobras de atraque (Rougé, 1966: 113-115). Derivados suyos son: πάνορμος (*pánormos*), que ofrece un «anclaje seguro» y aparece ya en la *Odisea* (XIII, 195); ὑφόρμος (*hýphormos*), πρόσορμος (*prósormos*), ἐφόρμος (*éphormos*). Los restos arqueológicos encontrados en diversos lugares portuarios ponen de manifiesto la existencia de casas y hangares para embarcaciones¹¹, especialmente las de guerra. La literatura especializada alemana los denomina muy gráficamente *Schiffsbäuser* (casas de barcos), pero que en verdad son réplica de la voz griega νεώσοικοι (*neósoikoi*; en Hdt. III 45,4; Tuc. VII 25,5 y 6) (Moritz, 1979: 914), cuyo correspondiente conceptual y lingüístico en latín es *navalia* (Weiss-Philipp, 1935: 1888s.; Nash, 1962: 117-119), que valen como departamentos de un arsenal para carenar barcos, unas atarazanas. Relacionados con este sistema están los ὁμοτεγεῖς (*homotegeîs*; IG II² 1668,6; vid. Moritz), «bajo el mismo techo», en una suerte de cobertizos para dos o más embarcaciones. Las reproducciones ideales que se hacen actualmente sobre estas instalaciones en la Isla del Almirante de Cartago son muy ilustrativas. Los ὀλκοί (*bolkoí*) eran unas máquinas para tirar de las embarcaciones por las rampas para ponerlas en seco, tal vez una especie de cabrestantes del tamaño correspondiente. Los astilleros no se encontraban necesariamente en el recinto del puerto: ναυπηγία (*naupegía*; vid. Moritz) es la voz respectiva; la construcción naval se realizaba generalmente sobre gradas de madera en la playa, donde también se calafateaban¹² las embarcaciones (ψύκτρα/*psyktra*; vid. Moritz)¹³; σκευοθήκη (*skeuothéke*; vid. Moritz) se refiere al arsenal, como recoge Esquines (57, 27). Depósitos y almacenes (antaño, «tinglados» en el puerto de Valencia) constituyen dependencias indispensables en todas las épocas para los puertos con un activo tráfico comercial, incluidos los de la Antigüedad, de la que destacaban los almacenes de pieles en Siracusa y los de harina y cerámica de Mitilene. El nombre en griego es ἀποθήκη (*apothéke*; vid. Moritz), de tan amplia difusión posterior en diversas culturas y edades. Merece una mención particular δείγμα (*deígma*; vid. Moritz), que era un «mercado», pero que en Atenas se refería a un expositor de mercancías, una lonja.

En resumen, se observan algunos elementos comunes que, a pesar de las diferencias propias entre las ciudades griegas, fenicias, púnicas o etruscas, y de estas entre sí, podían considerarse plausibles en términos generales para el Mediterráneo central y oriental de época anterior a la hegemonía romana.

- Las poblaciones junto a la línea de la costa incluían el puerto en su recinto amurallado; las que estaban alejadas (3-5-13 km), se servían de una población costera para sus actividades y relaciones marítimas. El desarrollo militar y económico de una ciudad (una comunidad urbana, no rural) no lejos de la costa le impelía a buscar un puerto de salida

¹¹ A este propósito ilustran muy bien estas construcciones antiguas los actuales cobertizos o garajes sobre el agua de los canales para los *albuferencs* (barcas de la Albufera, antes a vela plegable) del Palmar en Valencia.

¹² El verbo griego para esta actividad es πακτώω (*paktóō*).

¹³ En el puerto de Valencia, en otro tiempo, los barcos de pesca se carenaban en un departamento del mismo al aire libre, pero su construcción no se hacía siempre allí, sino en talleres de la playa de la Malvarrosa, en este caso, embarcaciones de dimensiones pequeñas y medias. En Villajoyosa (Alicante) los astilleros estaban separados del núcleo central del puerto pesquero.

al mar, como se ha venido dando en las reivindicaciones y reclamaciones territoriales de tantos estados en nuestro mundo actual.

- En puertos importantes había autoridades portuarias propias, comisiones de la ciudad o gobernadores marítimos, auxiliados por una serie de funcionarios e inspectores específicos. Las más representativas eran las funciones navales y de guarnición, la función de policía de los puertos y en consecuencia el control de tasas y tributos.
- La noticia sobre la Isla del Almirante de Cartago nos ilustra sobre la posibilidad de comandancias de marina en puertos importantes y con competencias y necesidades de guerra en el mar.
- Las funciones podían ser parecidas en los puertos de las diversas ciudades y el número de magistrados y funcionarios dependería de la importancia del tráfico marítimo y las necesidades bélico-navales de las *póleis*.
- Nuestra visión general de la Antigüedad clásica está indudablemente mediatizada por la organización exhaustiva de Roma: es una visión filorromana –pues, siendo los vencedores finales, escribieron la Historia– y, es más, romanodependiente. Pero las cosas debieron tener en épocas y ámbitos no romanos un sesgo muy diferente, no tan homogéneo y sí mucho más variado, incluso polivalente.
- Al hablar de los funcionarios portuarios, parece que todo hubiera estado poco a poco perfectamente controlado: tal es la visión romana, que vale como decir cartesiana, y ciertamente así lo hicieron. Sin embargo, una observación atenta a los puertos de la propia Atenas nos permite vislumbrar otra realidad. El Pireo era (y es) la población lindante con la costa y el Cántaro, su puerto. Al promontorio lo conocen algunos atlas como la Muniquia, pero en realidad, el nombre era Akté: el puerto naval de Zea y el de Muniquia se abrían en este promontorio. Si observamos con detenimiento mapas de la antigüedad de la zona, vemos que al oeste, en Fecionea, se contempla un *φωρὼν λιμὴν*, un puerto de ladrones (cfr. lat. «fur»), bahía de contrabandistas. En realidad, no un puerto franco, sino, como indica su nombre, una rada o fondeadero para las embarcaciones y mercancías ilegales, que podía tener una localización diferente según las circunstancias (cfr. la novelita de Josep Pla, *Contrabando*): tanta organización metropolitana y portuaria para regular las actividades marítimas y tributarias de los puertos no podía impedir (ni entonces ni ahora) el intercambio subrepticio y franco de mercancías no sujetas a control; las zonas portuarias siempre han gozado de este *status* delictivo, con un halo aventurero. Este aspecto tan heterodoxo (desde nuestro punto de vista) como real debemos tenerlo muy en cuenta en otros puertos de la Antigüedad, del que no se vieron libres ni romanos, ni griegos, ni etruscos, ni fenicios o cartagineses, pues era práctica común en todas partes. Scripsimus.

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A mysterious slipway on the North coast of Mallorca

Un misterioso varadero en la costa norte de Mallorca

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Abstract: This short contribution presents a site at Can Picafort (Mallorca) that was surveyed by the authors in July 2013. The slipway was used by traditional fishermen and is ca. 3.75 m wide and 34.25 m long. Remains are visible of a relatively modern shed built into a probably earlier slipway. The floor of the slipway at its lower end was lowered several times, apparently to adapt to a small lowering of relative sea level. The form and dimensions of the slipway have rough parallels in other rock-cut slipways dating from the classical period onwards. It seems difficult to relate it to the nearest Roman town of *Pollentia*, ca. 12 km to the north-west. The question remains open whether we have to see here Ancient work or simply a traditional slipway used by fishermen or for other purposes in the island of Mallorca.

Key words: Slipway, Shipshed, sea level change, maritime heritage, Mallorca.

Resumen: esta breve contribución presenta un yacimiento situado en Can Picafort (Mallorca) que fue prospectado y topografiado por los autores en julio de 2013. Se trata de un varadero (conocido en catalán como *escar*) utilizado por pescadores tradicionales de cerca de 3,75 m de ancho por 34,25 de largo en el que observan restos de una cubierta relativamente moderna construida sobre una posible rampa anterior. Esta última fue rebajada en su parte final, en diversas ocasiones, aparentemente para adaptarla a los cambios relativos del nivel del mar. La forma y las dimensiones de la estructura recuerdan a algunos varaderos cortados en la roca que datan del período clásico en adelante. Resulta difícil relacionarlo con la cercana ciudad romana de

Pollentia, a unos 12 km hacia el noroeste. El problema reside en discernir si se trata de una obra antigua o simplemente de una rampa utilizada por los pescadores o para otros propósitos en la isla de Mallorca.

Palabras clave: varadero, embarcadero, cambios del nivel del mar, patrimonio marítimo, Mallorca.

Introduction

The Balearic Islands (Fig. 1) lie in a strategic position for navigation and trade routes in the western Mediterranean (Mascaró, 1971; Ruiz de Arbulo, 1990; Guerrero, 1993a; 1993b; 2004; 2006; Colom, 2013). Leaving aside the problem of the first colonisation of the islands (Guerrero 1993a; 1993b; 2006; Calvo/Guerrero/Salvà, 2002), it is clear that Phoenician, Punic, Greek and Roman mariners were fully aware of the archipelago or rather of the two archipelagos forming the current Balearic Islands. In fact, Greek and Roman writers separated what is currently known in administrative terms as Balearic Islands into two separate groups (Zucca, 1998; 2005; García Riaza/Sánchez León, 2000). On the one hand, Mallorca and Menorca, with other small islands and islets, formed the *Gymnesia*, *Baliares*, or *Baliarides*; on the other hand Ibiza and Formentera, with other small island and islets were considered the *Pityussae*. The *Baliares* had a strong Iron Age indigenous background represented by the Talayotic culture, famous for its slingers who were enrolled in Punic and Roman armies, and with architecture characterised by cyclopean constructions. The *Pityussae*, with Ebusus as the main city, had a strong Phoenician-Punic character. In 123 BC, Roman military actions led by Q. *Cecilius Metellus* to conquer the *Baliares* did not affect the *Pityussae* as *Ebusus* was already a *foederata* of Rome (see e.g. García Riaza, 1999). Subsequently, however, both groups of islands saw urban and commercial take-off, with the latter in turn aiding the rapid growth of the larger centres. Probably at the end of the 4th century AD all the Balearics formed a unique province within the Roman Western Empire, occupied later by the Vandals (455 AD) and Byzantines (534 AD) to fall finally under the Islamic World in the 10th century AD.

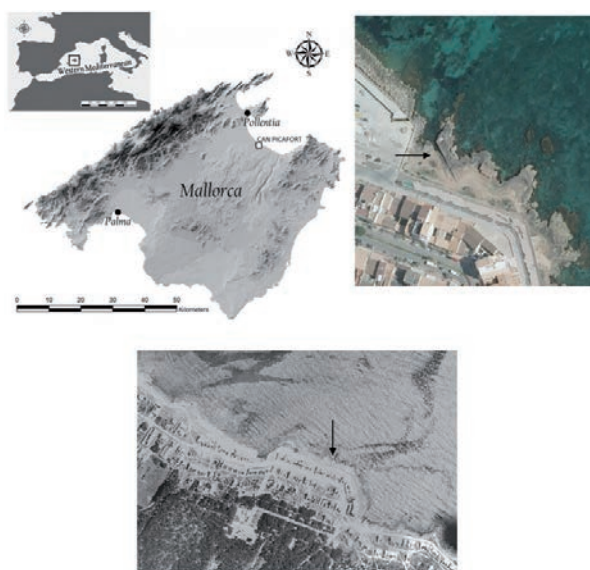


Figure 1. Map with the situation of Mallorca and Can Picafort, and recent aerial photograph of the slipway. Below, an aerial photograph of 1956; see the presence of the slipway, not as enclosed as it is now.

The importance of the Balearics in the navigation routes implied a series of harbours and ports for the boats. In Mallorca, the coast presents some large bays and many other inlets suitable to provide a good shelter. Although the excavation of some of these places has revealed interesting evidence of its frequentation, there are not many indications of the existence of moles or slipways on the island of Mallorca in Antiquity. In s'Illot d'en Sales, a small islet in the Bay of Palma, and probably occupied by a Punic factory, Guerrero (Guerrero, 1989) reported the existence of a sunken mole. In the islet of Na Galera (Guerrero, 1981), also not far from Palma, an islet with Punic occupation that is now also object of archaeological investigations, D. Cerdà (Cerdà, 2002: 57, fig. 2) showed the existence of a slipway in a plan, but we have not explored it. In the area of Santa Ponça in the western part of Mallorca a wall found currently inland related to a stream not far from the sea has been proposed to be a mole (Vallespir *et alii*, 1987). Tradition also locates remains of a Roman port at Portocristo, 2 km inland from the actual sea and this has been recently reviewed (Puig, 2015). The Roman city of *Pollentia* probably had two ports: one opened on to the Bay of Alcudia, and the second on to the Bay of Pollença. The first bay appears in mediaeval documents as *Portus Maior* while the second is often called *Portus Minor* (Domingo/Druget, 2004). There is already enough evidence for the existence of a port in parts of the actual port of Alcudia (Munar/Sastre, 2010), beneath some areas already silted up and urbanised, and some old oral tradition of the existence of port installations; the port in the Bay of Pollença could be located in the area of Es Barcarés towards the north of the city, where underwater finds of pottery (including a placename called Ses Olles, i.e. the cooking pots) demonstrate at least that the site was frequented in the Roman period. Other bays and inlets along the Mallorca coast provided refuge for the boats crossing the Western Mediterranean and arriving as a final destination or as a port of call in different historical periods. Some examples, such as port of Pollença (Cerdà, 2002), Cala Sant Vicenç (e.g. Nieto/Santos/Tarongí, 2002; Nieto/Santos 2008), Portocristo (Frey, 1970; Manera, 1983; Puig, 2011; Puig, 2015), Porto Colom (VV. AA., 2007; Riera/Martín, 2009), Colònia de Sant Jordi and the islet of Na Guardis (e.g. Cerdà, 1979; 1980; Guerrero, 1984; 1985; 1987; 1997; Colls, 1987), or Palma¹ and its port of Porto Pí (Cerdà, 1999; Cau, 2004): these, among many others, show evidence of ancient use. Also the island of Cabrera, on the southern coast of Mallorca, played an important role on the navigation routes, as proved by the shipwrecks and materials found in its waters (e.g. Guerrero/Colls, 1982; Colls/Domergue/Guerrero, 1986; Bost *et alii*, 1992; Pons/Riera/Riera, 2001).

The site presented here is a slipway used by traditional fishermen, situated at Can Picafort on the Bay of Alcudia, south of Cape Formentor and Alcudia on the north coast of the island (39° 45' 64" North; 3° 09' 44.40" East). It was examined by the geomorphologist N. C. Flemming, who made a preliminary investigation in July 1980, but no formal survey with equipment was carried out². The remains are still visible, just east of the new yachting marina. They were surveyed in a short visit by the authors and collaborators on 25 July 2013. The work included the topographical survey with a total station [Leica 1200] and a Laser Scan survey using a Leica instrument.

Description of the site

A single slipway oriented north-north-west (Figure 2) is cut into the Aeolianite sandstone bedrock on the shore. The side walls are vertical and appear to have a horizontal ledge which may

¹ In Palma a Roman anchor was found inland that could mark the existence of an ancient port very close to the city. However the area known as Porto Pí has been also considered as the port of the ancient city of Palma. Other medieval structures have been found in recent excavations in Palma for other historical periods.

² We are grateful to him for sending us the photographs, notes and sketch plans which formed the basis of the entry in Blackman, Rankov *et alii*, 2013: 557-61.

have served as footings for a roof. A line of at least six cut blocks are visible on the western ledge, just seaward of the later shed entrance.



Figure 2. Detailed plan of the slipway and three cross sections.

Cut in the floor of the slipway at its lower end is a shallow depression ca. 10 m long, ca. 2.55 m wide and ca. 0.25 m deep; cut into that for the lowest 6 m is a further depression ca. 1.75 m wide and ca. 0.25 m deep (Figs. 3a and 3b). These lowerings of the slipway must have been to adapt to small changes in relative sea level. The main slipway is ca. 3.75 m wide.



Figure 3. a) General view of the slipway from the sea; b) View up the slipway.

Two masonry-built projections from the side walls form the entrance to a relatively modern shed built into an earlier slipway; the projection on the western side has traces of a curvature which could correspond to the side of a ship's hull. This shed, which had a vault now almost entirely collapsed, was built over the slipway, from ca. 16 m to ca. 25.5 m from the present waterline; landwards from it the slipway can be traced for about a further 10 m, mostly buried under rubble. This provides an estimated slipway length of 34.25 m (Figs. 4a, 4b and 4c).

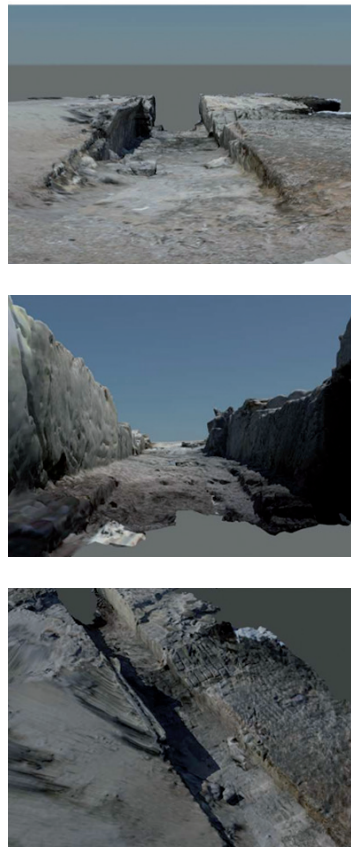


Figure 4. 3D scan laser survey: a) general from the upper part; b); detail of the lower part of the slipway; c) slipway with the quarrying.

Flemming estimated the gradient at ca. 1:10, or 5.7 degrees, with the gradient increasing towards the lower end within the above-mentioned depressions. There are cuttings in the floor for timber sleepers; the present, rather short and flimsy, sleepers must belong to a modern phase, but the slots could be original.

The rock-cut sides at the foot of the slip are 2.70 m high (Fig. 4). The bottom of the slip terminates at the cliff face, just beyond the side chamber; there are no cuttings or structures below sea level, and the water is 1 m or more deep at the foot of the cliff. A section of the rock-cut side of the slipway has fallen away on the west side. There is now ca. 0.3 m water depth where the slipway would have terminated, including the central depression. Fleming had suggested that there has been a relative uplift of the land of 0.3-0.5 m since the slip was originally cut, and that the depressions may have been cut after that and as a result. He comments: «It seems unnecessary to have such a long and wide slip for a boat which would be lifted onto the slip with so little water depth at the foot.»

A rock-cut side-chamber of uncertain date now adjoins the slipway on the west side. A rock-cut doorway with indications of a door-frame in the west wall of the slipway leads into an adjacent shallow rectangular space, 1.8 m wide and 1.9 m high. The back wall curves forward to the back of the doorway from a horizontal depth of ca. 1.45 m at the foot. The floor of the chamber, if it had one, has been broken away by wave action.

The construction of the Yachting Club has modified the shore just north-north-west of the slipway, so that the original seaward approach to the slipway cannot now be studied. The break-water of the club seems to have been partially built onto a slight natural promontory of the rocky coastline, which would have provided some shelter for the slipway entrance; it is fairly close but it is certainly not too close for small and medium vessels to manoeuvre safely on to the foot of the slipway. Without such protection, the slipway entrance is exposed to waves sweeping in directly from the north.

Just above and south-east of the slipway entrance, there is a cutting with a rather quadrangular plan and with a few steps to get in (Fig. 5). Comparison with other examples may recall fish tanks. A second example is located on the rocky shore towards the smaller fishermen's slipways seen also by Flemming ca. 250-350 m to the south-east.



Figure 5. View of fish tank just south-east of the slipway.

Traces of cuttings had already been noticed by Flemming on the edge of the upper wall of the slip and nearby; he suggested that they were perhaps for walls, or the result of quarrying for ashlar blocks. We have now verified that they are mostly the remains of quarry workings for the exploitation of sedimentary rocks commonly used in Mallorca as building materials and named «mares» (e.g. Mateos/Durán/Robledo, 2011; Sánchez-Cuenca, 2011; Salvà, 2013). Some of these cuttings are cut through by the slipway and this provides a general *terminus post quem* for the slipway.

The smaller slipways mentioned above, called «escars» in Catalan, form a set of three almost identical slipways running up from a central «spine» slip which enters the water: hence Flemming gave them the name «candelabra slips». They are only about 2-3 m wide and have a total length of about 12.5 m, with each branch leading into a vaulted shed ca. 8 m long; the doorways are 2.15 m wide. The roofing is fairly recent (in the last 50 years, Flemming estimates), but the slips are older. «They could easily be 500 years old or more, but they are designed for artisanal fisheries, not warships or trading vessels.» An interesting feature is the vertical slots for timbers in the rock-cut side walls, in line with the timber sleepers set in the ramp. These slips seem very exposed to the sea and winter storm waves: hence probably their steep gradient of about 1 in 10³. These are clear examples of fishermen's slipways, called in Mallorcan «escars», and there is nothing suspicious that might make us think of a preceding phase. Farther east, near the megalithic site of Son Real and an offshore island (probably Illot des Porros) Flemming noted some vestigial slipways on the shore, of uncertain date. We have not studied these.

Discussion

The main problem with this slipway is the question of dating. Flemming had commented that the single slipway with high rock walls is reminiscent of Matalon: «If it was not for all the confusion caused by re-use, adaptation, and the nearby modern rock-cut slips one would have no hesitation in attributing it to the Classical period. I think that is probably still the case, but one needs to be cautious and suspicious³.» Matala or Matalon in Crete has a slipway of about 35 m length (Blackman/Rankov *et alii*, 2013: 389-92) and we have now shown that rock-cut slipways, mostly single, were relatively common in the Greek and Roman periods in the Mediterranean (Blackman/Rankov *et alii*, 2013: especially Chapter 12).

For Can Picafort it is very difficult to propose a particular dating. One could be inclined to suggest a date rather in the Greek or Roman period. Greek imports have been found in Mallorca, and there is evidence of Greek contact in the area (Zucca, 1998; Cerdà, 2002): notably a ship of the late 6th century wrecked in Cala Sant Vicenç, just to the west of our site, at the south-west base of the promontory which ends in Cape Formentor (Niето/Santos, 2008); but there is no evidence of Greek settlement. A Phocaeen area of trade has been proposed for the northern part of the island of Mallorca, based on the ceramic evidence (Hernández, 2010), an hypothesis answered by Guerrero (2010) who prefers to see these materials as traded by Punic merchants.

³ Flemming commented: «The technology of these little slips seems similar to the indented slip on the big rock-cut slip, and the more modern vaulted hut on that big slip is similar to those associated with the «candelabra» slipways, and a similar distance from the water. Thus it looks as if the artisanal fishing boat boat-handling was superimposed on the older and bigger slipway.»

⁴ «I have never seen anything so massive cut into rock anywhere else, other than from the classical period. But I have not tried to estimate what sort of vessel it could have supported. I don't think people build slips like this for fishing-boats.»

Also, the question remains whether we could see here the work of indigenous population. Strabo refers to such work at *Carteia*: he quotes a third-century source for a «naustathmon of the Iberians», with shipsheds still visible at that time (3.1.7: see Blackman/Rankov *et alii*, 2013: 565). So far, there are no other remains of slipways, to our knowledge, related to the Talayotic Culture in Mallorca.

The problem with the Mallorcan site seems to us to be the lack of connection with any settlement or port. If it was ancient, could there be already a Carthaginian context, granted the provision of military aid, mainly mercenaries, by the Balearics to Carthage? In recent time an intensification of the provision of slingers recruited by Carthaginian forces not using the Ebusitans as an intermediate state has been proposed (Puig, 2008). Could this be the case with this slipway, and be related to the intensification of the recruitment process?

It seems difficult to relate the slipway in Can Picafort to Pollentia, the nearest Roman town founded in 123 BC (now next to Alcudia ca. 12 km to the north-west), which lies in the centre of the isthmus that separates the important bays of Pollença and Alcudia.

Shipsheds in Spain are attested at *Carthago Nova* (modern Cartagena) when it was captured by Scipio Africanus in 209 BC (App. *Hisp.* 23.90: *neosoikoi* and 33 warships); and *Carteia* seems to go back at least to the third century (see above) – Iberian rather than Punic? In North Africa, besides Carthage, we have shipsheds attested farther west of there at Hippo Diarrhytus (App. *Lib.* 520); the construction is ascribed by Appian to Agathocles, so would date to 308 BC. And on the «north shore» Massalia had an impressive complex of shipsheds by the second century.

The form and dimensions of the slipway in Can Picafort have rough parallels in other built and rock-cut slipways dating from the classical period onwards (though this slipway would have been for a vessel of smaller than trireme size), but there are internal indications of a somewhat later date. The horizontal ledge at the top of the rock wall appears to be a wall-footing for a vaulted roof (and seems to have been used as such much later). Apart from some parallels, and a few possible hypotheses, there is no dating evidence for the slipway phase in ancient times. The slipway does not seem to represent the first phase at the site: that is represented by the traces of quarrying, cut through by the slipway – and we have not dated these traces more precisely. Some of the traces are linked to fish-tanks, and the remains of the quarries, if so, are not very large. The quarries could be medieval and the vault seems to correspond to the modern traditional use of the slipway, so we should be really cautious in accepting an ancient origin for the slipway. Apart from this *terminus post quem* there is no dating evidence for this second phase: the slipway.

Conclusion

Chronological precision remains difficult. We can provide a *terminus ante quem* for the slipway period: the re-use of the slipway with the insertion of a roofed shed. This can be compared to the «candelabra slips» found by Flemming to the south-east, called «escars» in Catalan as we have already mentioned. These may well represent the continuation of a traditional form of slipway used by the fishermen of Mallorca. In fact, the Catalan word «escar» has a Greek origin – from ἐσχάριον. We are not suggesting that this etymology means that this slipway has to be Greek. Our «ancient slipway» could constitute an early representative of this local tradition of slipways for fishing boats, but for a boat larger than the later fishing-boats. Only further detailed research including archives, oral tradition and some scientific analysis could help to solve the problem of the dating of this slipway, but at least we leave this structure documented for the future, whether it is an example of an ancient or traditional slipway, a sample of maritime heritage on the coast of Mallorca.

Acknowledgments

We are grateful to N. C. Flemming for sharing with us his documents on the slipway; also to B. Vallori, C. Mas and S. Munar for helping in the topographical survey of the slipway in 2013. B. Vallori also took care of the final plans and C. Cabrera helped with some of the images. We are grateful also to A. Puig for sharing with us his forthcoming paper on the port of Portocristo. This is part of the activities of the Equip de Recerca Arqueològica i Arqueomètrica de la Universitat de Barcelona (ERAAUB), Consolidated Group (2014 SGR 845), thanks to the support of the Comissionat per a Universitats i Recerca del DIUE de la Generalitat de Catalunya.

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Baetic shipwrecks in the coast of Esposende (North Portugal)

Naufragios béticos en la costa de Esposende (norte de Portugal)

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Abstract: This paper present the results of the study of two roman *Baetican* shipwrecks and a fishery trap discovered in the coastal zone of Esposende (North Portugal). Those findings were possible due to particular meteorological and hydrological conditions responsible for a strong sand loss on the beach and the subsequent exhumation of former sedimentary deposits.

Key words: Shipwrecks, Esposende, *Baetica*, Roman, Fish-Traps.

Resumen: en este artículo presentaremos los restos de dos pecios béticos y una red de pesca en la costa de Esposende (al norte de Portugal). Estos hallazgos han sido posibles debido a las particulares condiciones meteorológicas e hidrológicas que han llevado a una pérdida de sedimento arenoso en la playa y a la consiguiente exhumación de los depósitos sedimentarios inferiores.

Palabras clave: pecio, Esposende, *Baetica*, romano, trampas para peces.

Introduction

During the last years the coastal zone of Esposende (North of Portugal) was exposed to particular meteorological and hydrological conditions, leading to strong sand losses and conducting to the exhumation of sedimentary coastal deposits. These events made visible two Roman shipwrecks. The first one was detected in 2005 in the low tide area of the beach of Rio de Moinhos, Marinhãs (Esposende), being collected a huge amount of fragments of *Baetican* ceramics. Their low dispersion, homogeneity, contemporaneity and the absence of rolled ceramics has pointed to a shipwreck (Fig. 1) (Morais, 2013: 309-334). The study of the collected materials has allowed attributing them to the Augustus period.

The coastal landscape

In the Augustus period the coastal landscape was very different from nowadays. The coastline would be jagged, with headlands and small lagoons in between, protected by barriers located westwards. Dominating the landscape, the lagoons were probably connected with the sea, at least intermittently. Even nowadays is visible a channel with NW-SE orientation in the subtidal rocky platform, being probably related with *Ribeira do Peralto*. Those findings were presented in *O irado mar atlântico. O naufrágio bético augustano de Esposende (norte de Portugal)*, a multidisciplinary book with an assemblage of papers pointing, under different perspectives, the importance of such a discovery in the Atlantic coast (Morais, 2013).

The coastline was located westwards of the present one, as testified by the sedimentary deposits outcropping in low tide. The lagoon was set in a depressed area of the rocky platform (Granja, 1999; Soares de Carvalho *et alii*, 2006) and worked as a natural anchorage place providing the conditions needed for receiving boats adapted to both maritime and fluvial navigation (Fig. 2). The highest areas of the platform were emerged and occupied as the numerous Roman remains found suggest (Almeida, 1988).

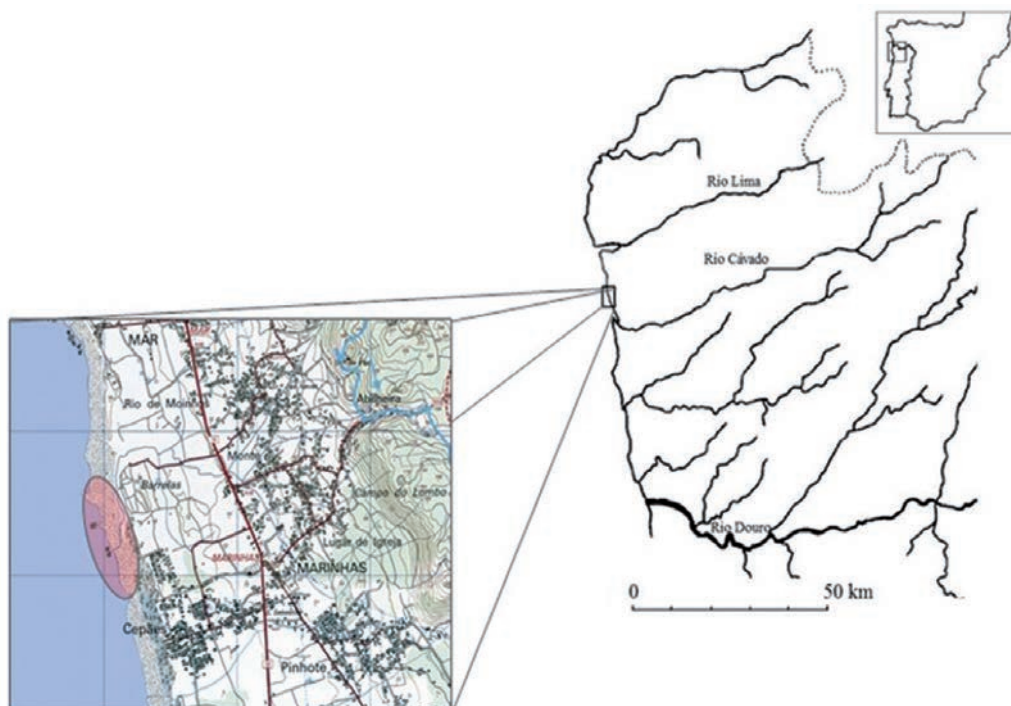


Figure 1. Location of Rio de Moinhos (Marinhãs, Esposende).

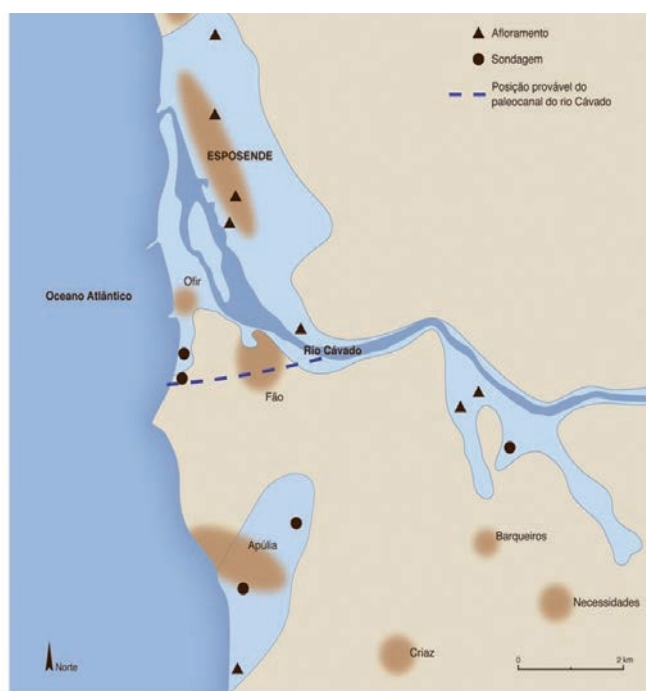


Figure 2. Paleo Estuary of the Cávado River in the Roman period.

The amphorae

According to the sampled materials and to the fact that the main load was of Haltern 70 amphorae, it is possible to infer that reduced dimensions ships were used in the commerce between the *Baetica* and the peninsular NW (Carreras/Martin, 2013: 283-308; Morais, 2013: 309-334).

It is very well known the existence of commercial routes between both regions. As Maria Luisa Blot (2003) refers, the commercial circuit through the Atlantic route was easy to perform due to the coastal morphology of the Iberian Peninsula, the favourable maritime currents and winds, the hydrographic net and the economic resources. These settings certainly promoted the establishment of routes and anchorage points or exchange places.

In the present study, we can be facing a small anchorage located in the vicinity of the settling of S. Lourenço, Vila Chã, located in the top of a cliff at the NE of Esposende, near the Cávado river mouth (Almeida, 1998; 2003; 2011: 27-55). Due to the collection of archaeological remains, particularly the elevated amount of Haltern 70 amphorae found till the moment, this settlement can be framed in the Atlantic fluvio-maritime commerce (Morais/Carreras, 2004: 93-112).

The abundance of Haltern 70 amphorae along the entire Atlantic coast helps to better understand the existence of sunken boats containing that type of containers. As an example, the shipwreck of Peniche (Sítio dos Cortiçais), also from Augustus time (Blot, 2003: 229-231; 2004: 465-480), can be pointed as well as the shipwrecks documented in Galicia (Spain). Here, the Cortegada (Ria de Arosa, Pontevedra) shipwreck, that furnished the boat remains and 34 amphorae (Luaces/Toscano, 1989: 259-62) and another in Cabo de Mar (Ria de Vigo) should be highlighted. Numerous isolated findings collected in sub-aquatic environments, from Algarve till Coruña coast, are also indicators of other probable shipwrecks (Carreras/Martin, 2011: 283-308).

The load and the content

In this context, the shipwreck of Ribeira de Peralto is another example of a Baetican boat whose principal load was Haltern 70 amphorae (n.º 1-19) (Fig. 3). This type of amphorae is a multiuse container, used in the transport of different products, such as olives in *defrutum* (Aguilera, 2004a: 119-120; 2004b: 120-132).

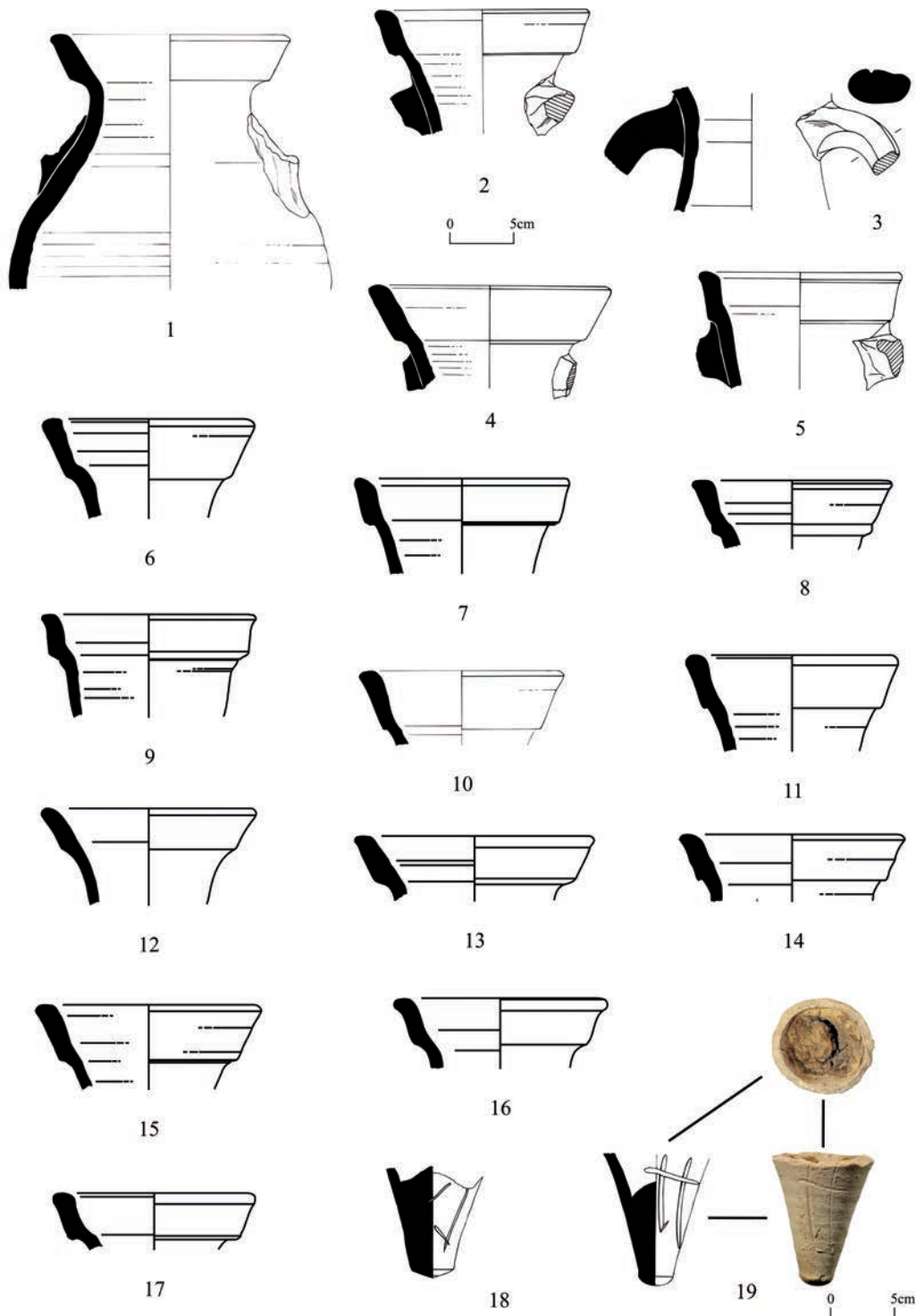


Figure 3. Haltern 70 amphorae from Rio de Moinhos (Marinhas, Esposende).

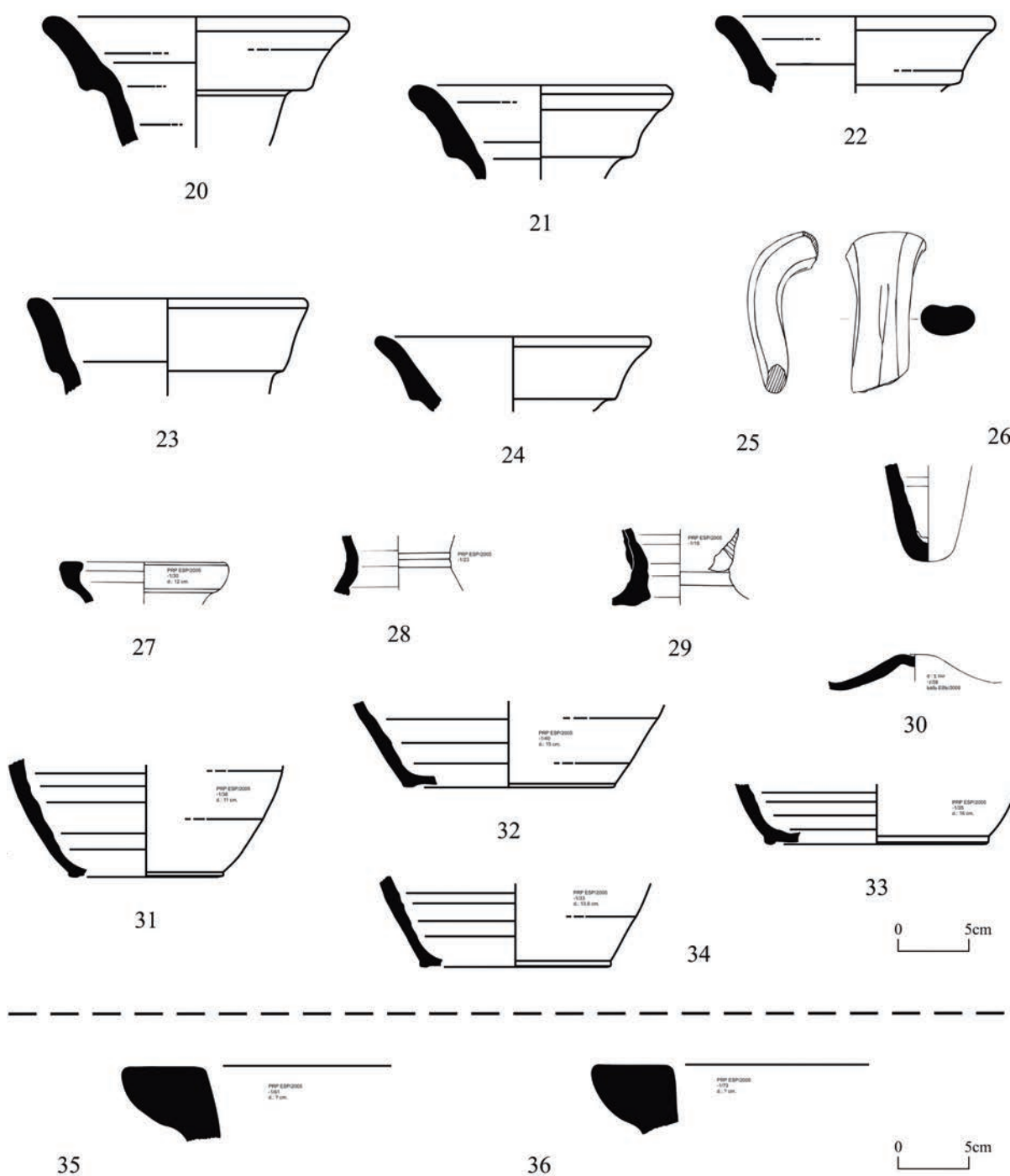


Figure 4. Salt fish amphorae (Dressel 7-11), wine amphorae (type urceus) and *doliola* from Rio de Moinhos (Marinhas, Espo-sende).

Included in the load was found a gaditanan type Dressel 7-11 (n.º 20-25) amphorae for fish and also ceramic productions from Guadalquivir corresponding to wine amphorae of *urceus* type (n.º 27-34) and small *doliola* (n.º 35-36) (Fig. 4).

Together with these containers were Baetic (n.º 37-51) and Italic (n.º 52-53) common ware (including two fragments of *doliola* from Guadalquivir), and thin-walled ware from Etruria (n.º 54-57), Central-Italy (n.º 58-60) and Campania (n.º 61) (Fig. 5).

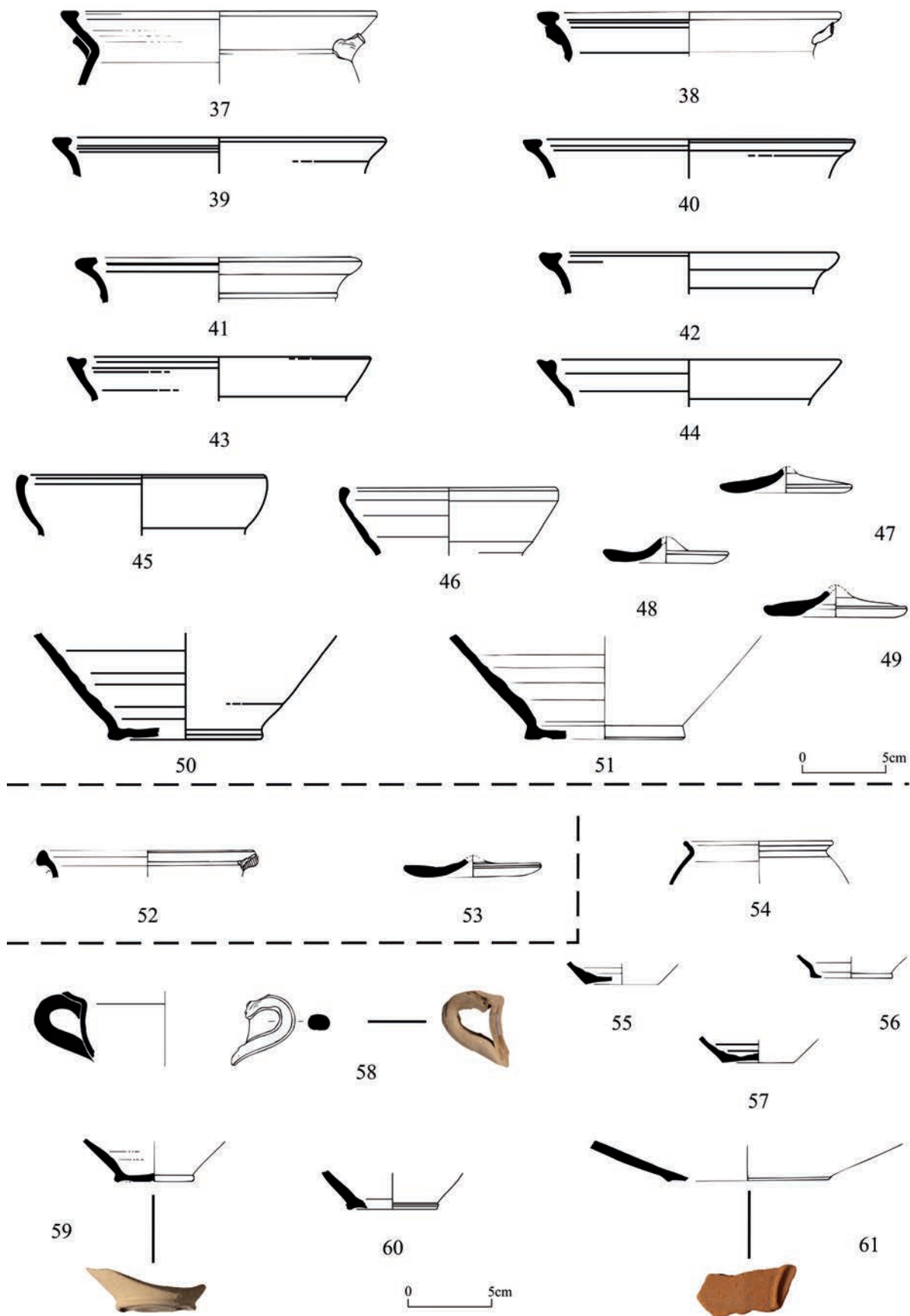


Figure 5. Baetican and Italic common ware and Italic thin-walled ware from Rio de Moinhos (Marinhas, Esposende).

The original content of these amphorae (Haltern 70 and *urceus* type) was analysed by gas chromatography with mass detection (GC/MS). The results obtained pointed to the presence of *defrutum* in the Haltern 70 amphorae (Fig. 6a) and a sweetish wine (*mulsum*) in *urceus* type amphorae (Fig. 6b) (Oliveira *et alii*, 2013: 263-281).

Shipwrecks and fishery practices

The above mentioned vestiges of a shipwreck suggested the existence of an analogous situation in Esposende coast. Storms occurred from October 2013 till February 2014, exhumed another shipwreck in a beach located at north of Rio de Moinhos. The main load of the Roman shipwreck was composed by gaditan fish amphorae Dressel 7-11, with a supplementary load of Haltern 70 and Dressel 20 amphorae from Guadalquivir. Though still in study, a preliminary analysis of the remains till now collected, point a chronology of mid-1st century A.D.

In 2014 several wood stakes lined in between were discovered near the area of the first shipwreck. Those were probably from a fishery trap analogous to other similar found in Silvalde

Ácidos orgânicos indicadores da presença de vinho				
4-etilguaicol	Guaicol	Vanilina	Siringaldeido	Calameneno
4-etilcatecol	Ácido octanóico	Hidroquinona	Eugenol	Guaiazuleno
Resinas				
Ácido levopimárico	Isopimariedeno	Ácido dehidroabiético	Eudalina	
Cembreno	Pimarinal	Bisaboleno	Cadalina	Aromadendreno
Indicadores da presença de azeite				
Ácido palmítico	Valenceno	Patcholeno	Copaeno	Muoroleno
				Alcanos de cadeia linear

Figure 6a. Chromatographic analysis on Haltern 70 amphorae.

Ácidos orgânicos indicadores da presença de vinho					
Tartárico	Octanóico	Sucínico	Málico	Vanílico	Isovanílico
Treónico	3-Hidroxiisovalérico		Azeláico	3-Hidroxicapróico	
Isoleucina	Ácido fumárico	Levúlico	Acético	Ácidos alcanóicos e alcenóicos de cadeia linear	
Açúcares					
D-Frutose	D-Glucose	Sucrose	Maltose	D-Turanose	
Galactopirranose	Xilofuranose		Lactose	Celobiose	
Indicador da queima de madeira					
Levogluocosano					

Figure 6b. Chromatographic analysis on *urceus* type amphora

(Espinho, north coast of Portugal), that was dated as high-empire (Alves *et alii*, 1988-1989: 187-226). This type of fishery traps was generally installed in lakes and lagoons. This is not an isolated example as are already known analogous traps in England, called «river fisheries or coastal weirs» and Spain, known as «calaes ou redolins». These are testimonies of a kind of collective fishery that consists in the nets disposed perpendicular to the coast in order to avoid the fish scape. One of the stakes sampled in Rio de Moinhos was radiocarbon dated of 1960 ± 60 yr BP (2 sigma calibrated: 106 cal BC-180 cal AD). This chronology is coincident with that of the shipwreck, what reinforces the thesis concerning the existence of a lagoon, previously inferred from geomorphological and sedimentological data.

Conclusion

According to the available results we can state that the Atlantic commerce was done through one of the natural ways of navigation and, consequently, in an area of culture confluences. This fact is not mentioned in most literary sources that usually do not stretch the commerce through the Atlantic maritime route. This situation contrasts with the Mediterranean navigation and commerce about what a vast literature was written, as is the case of the shipwreck research of A. J. Parker, published in 1992.

Organic acids tracers for wine				
Octanoic	Hydroquinone	Vanillin	1,3- dimethylnaphthalene	Syringaldehyde
Calamenene	Guaiacol	4-ethylguaiacol	4-ethylcatechol	Nonadecane
Eugenol	Guaiazulene	1,2- diphenylethylene		
Resin compounds				
Levopimaric acid	Isopimariedene	Dehydroabietic acid	Cadaline	Eudalin
Cembrene	Pimarinal	γ -Bisabolene	Diphenyl eter	Aromadendrene
Germacrene	α -patcholene	methylpimarate	Methyl sandaracopimarate	Creosol
Valencene	Pimaric acid	10,18-Bisnorabieta-5,7,9(10),11,13-pentaene		
Olive oil tracers				
Palmitic acid	Valencene	α -patcholene	α -copaene	α -muorolene
Homologous series of linear alkanoic acids				

Table 1. Chromatographic analysis on Haltern 70 amphorae.

Organic acids tracers for wine				
Tartaric	Octanoic	Succinic	Malic	Vanillic
Isovanillic	Threonic	3-hydroxyisovaleric	Acetic	Azelaic
3- hydroxycaproic	Levulinic	Isoleucine	Fumaric	Homologous series of linear alkanolic and alkenolic acids
Carbohydrates				
Fructose	Glucose	Sucrose	Maltose	Turanose
Cellobiose	Galactopyranose	Xylofuranose	Lactose	
Biomass burning tracer				
Levoglucosan				

Table 2. Chromatographic analysis on urceus type amphorae.

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Early and Late Roman Shipwrecks at Cape Uljeva, Croatia: Preliminary Report on the Excavations

Pecios romanos y tardorromanos en cabo Uljeva, Croacia: Informe preliminar de las excavaciones

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Abstract: In 2012 the International Centre for Underwater Archaeology in Zadar, with the support of the Municipality of Ližnjan, launched archaeological research of two shipwrecks in the Cape Uljeva area, on the northern part of the Adriatic Sea in Croatia. To the south Cape Uljeva shelters Kuje Cove and is situated near the town of Ližnjan in northwestern Croatia. Most of the amphora cargo was looted by divers in the second half of the 20th century, but many sherds remained *in situ*, and this offers a chance to excavate the site and reconstruct the story behind the shipwrecks. The investigation began with the plotting of crevices and cavities in the rocky seabed and documenting finds as separate contexts. The first shipwreck, Uljeva A, is dated by archaeological finds to the period of the 1st century BCE or 1st century CE, while Uljeva B can be dated to the 4th century.

Key words: Uljeva, Croatia, Roman shipwrecks, amphorae, Aegean coarse ware

Resumen: en 2012 el Centro Internacional de Arqueología Subacuática en Zadar, con el apoyo del municipio de Ližnjan, inició la investigación arqueológica de dos pecios en cabo Uljeva, al norte del mar Adriático en Croacia. Al sur de los refugios de la ensenada de Kuje, el cabo Uljeva está situado cerca del pueblo de Ližnjan en el noroeste de Croacia. La mayor parte del cargamento de ánforas fue saqueado por buzos en la segunda mitad del siglo xx, pero muchos fragmentos permanecieron *in situ*, lo que ofrece una oportunidad de excavar el yacimiento y reconstruir la historia detrás de los naufragios. La investigación comenzó con el mapeado de grietas y cavidades en el lecho marino rocoso y la documentación de los hallazgos como contextos distintos. El primer pecio, Uljeva A, está fechado por los hallazgos arqueológicos en el siglo I a.C. o el siglo I d.C., mientras Uljeva B puede fecharse en el siglo IV d.C.

Palabras clave: Uljeva, Croacia, pecios romanos, ánforas, cerámica tosca del Egeo.

Cape Uljeva is situated near the town of Ližnjan, in northwestern Croatia. Ližnjan is situated in the far southern part of the Istrian peninsula, with its access to the sea oriented more to the eastern Istrian coast. For the needs of maritime navigation the present day harbour is situated in the broad Kuje Cove, which offers for the most part good and in part excellent protection from all winds. The safety offered by the harbour at Kuje was also very important in the Roman period, as the far southern part of Istria is very dangerous on account of the characteristic southern wind (*jugo*) and the north-easterly wind (*bura*). Although it is the *jugo* that presents a very great danger to seafarers, at this location the *bura* is a much greater threat, as it appears very suddenly in its full force and very quickly creates waves. Both mariners plying the waters off the eastern Istrian coast, or the ones who approached it from the south between the island of Cres and the Istrian mainland, in the event of a storm, would try to make for Kuje Cove.

To the south side of the passage into Kuje Cove, however, is Cape Uljeva, and in front of it a broad expanse of submarine rocks ccovering some 70 by 200 metres. Countless rocks rise

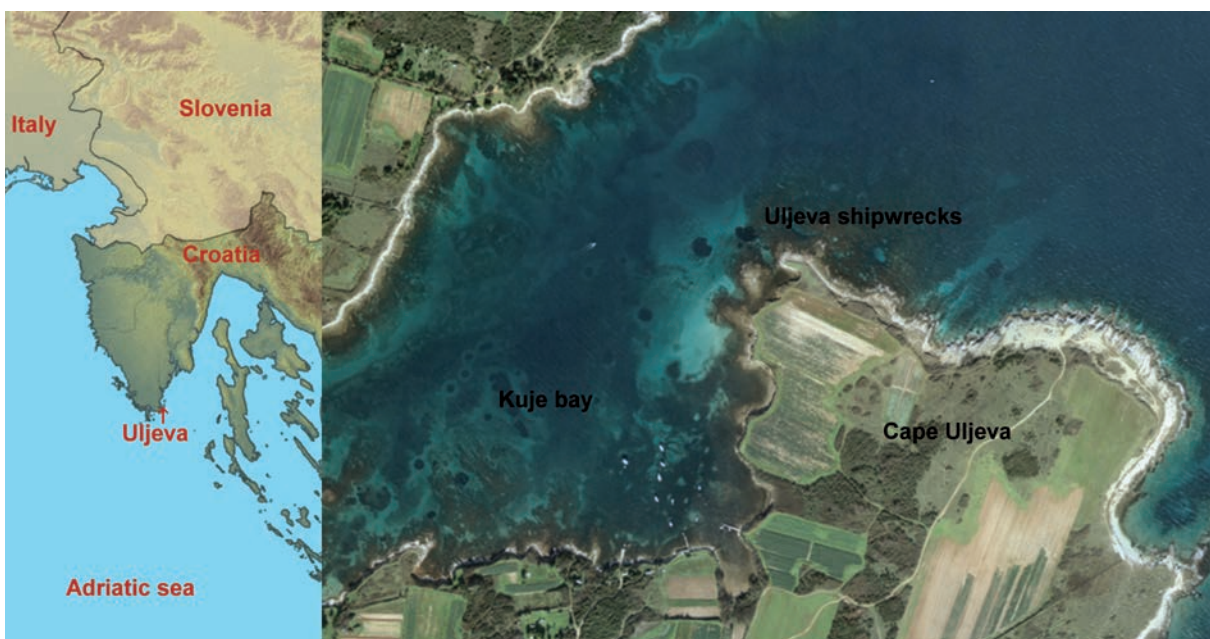


Figure 1. Location of Cape Uljeva and the Istrian peninsula within Croatia (Google Earth).

here from a depth of about five metres, at places reaching up to just half a metre under the surface, which means that in the Roman period the average depth was about one to two metres. These submarine rocks thus presented an obstacle to safe navigation into the harbour, especially in the event of strong gusts of the *bura*, which threw ships onto these rocks.

The site of Roman amphorae at the shallows off Cape Uljeva has been known of to the locals for a long time, and young inhabitants of Ližnjan found large amphorae sections here in the 1960s and 70s. With the development of the tourism industry the broader area of Kuje Cove became a destination for numerous tourists and the dispersion of the amphorae remains continued.

Several underwater archaeological explorations of this area have been undertaken over the past decade (Bekić, 2012a; 2012b; 2013; 2014). It was thus established that there are the remains of at least three shipwrecks on the submarine rocks off Cape Uljeva. The first was Uljeva

A, a shipwreck that can be approximately dated to the early Roman period, followed by Uljeva B from the late Roman period and the remains of Uljeva C from the early post-medieval period. Considering the long period of the removal and looting of the archaeological remains and the millennial action of waves, only greatly fragmented remains of the cargoes of these three ships now remain on the seabed. These remains are to be found in the crevices and cavities between the submarine rocks and cover –depending on the shipwreck– an area of 1000 to 3000 square metres. The most visible shipwreck is Uljeva A as it includes a large number of preserved body sections of massive early Roman amphorae, while the Uljeva B shipwreck is recognised on the surface only by smaller sherds of red amphorae in crevices, and Uljeva C by the many bricks scattered across the seabed.



Figure 2. Numerous sherds of broken amphorae visible between the submarine rocks at the Uljeva A site (I.Miholjek).

The strategy of archaeological investigation had to be adapted to work in the shallow rocky terrain, with very dispersed cargoes, which is technically very different from classic research of a compactly preserved shipwreck on deeper sandy terrain. A strategy was, therefore, adopted that would cover the entire site and properly document the finds. A fixed grid of survey points was first set up –about thirty points at each site– at intervals of from five to ten metres. In order to render them visible to divers, and to allow for proper use of tape measures, they were placed on the highest elevations of the submarine rocks. Technically, these are massive spikes with an attached label that were hammered into the rock. Over time it became evident that the waves here were too powerful, as they consistently threw the labels out of the rocks. The spikes were, therefore, subsequently cemented into small gaps, which rendered them much more resistant to the destructive power of the waves. On the basis of measurements made from one spike to another a grid was established for further documentation. Within the grid we began by drawing in each individual crevice containing archaeological finds. The measurements were entered into the Site Recorder application in which we began to build a map of the site. Each crevice was assigned a stratigraphic designation, followed by the start of excavation of each of these contexts.

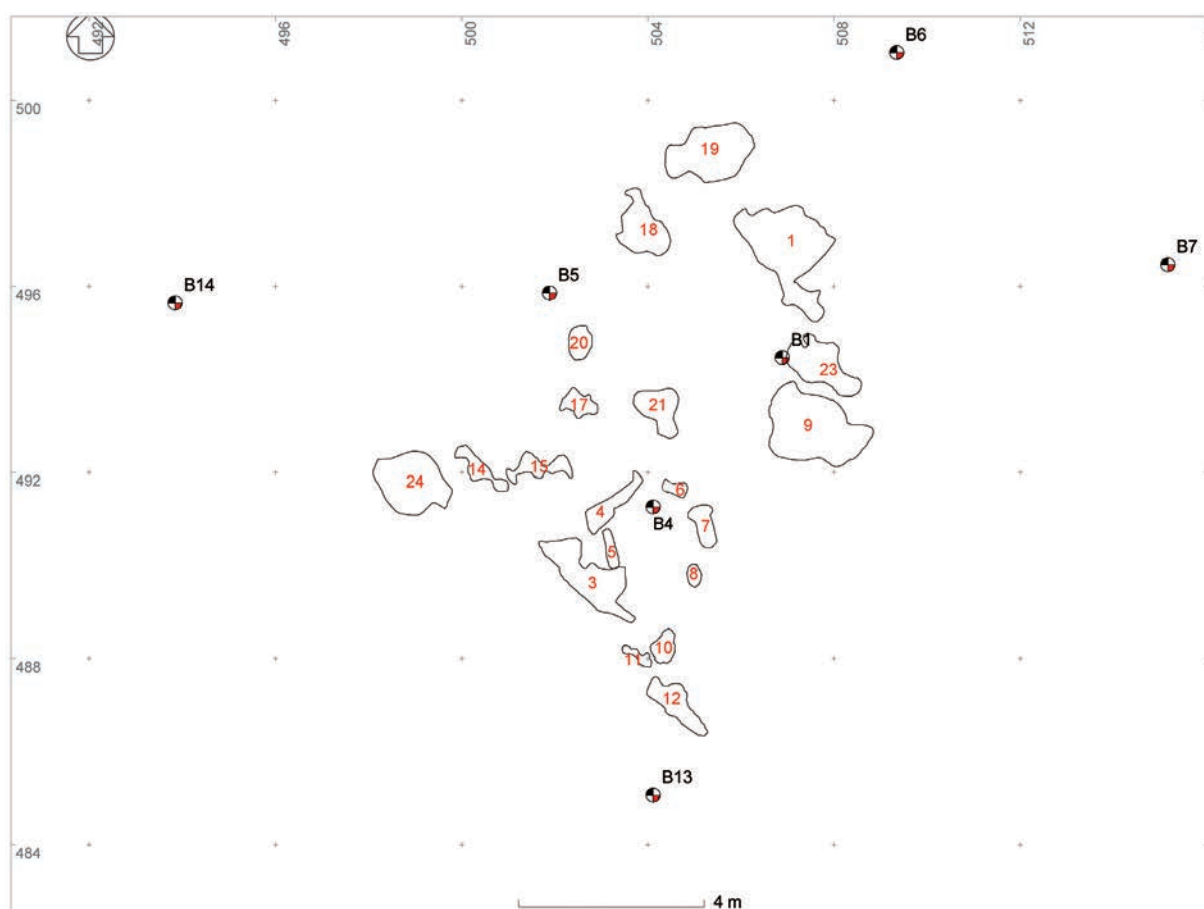


Figure 3. A layout of the Uljeva B site is started in Site Recorder (M.Pešić).

Excavation was assisted with a water pump placed on a boat above the site. During the excavation divers extracted all small finds they observed from each context, i.e. each crevice. The finds were raised to the boat in baskets where a second team counted and weighed all recovered finds, drew up primary documentation and made a selection of finds. All data on the represented number of a given element found in each context, such as the number of amphorae handles or spikes, metal nails etc. were also entered into lists. All typologically determinable fragments were packed for further processing in the laboratory. Drawings and photographs of the finds were made following the conservation-restoration process and they were processed by typology and statistically.

The objective of this approach was to produce in the end a map of all finds in terms of their positions in the crevices in order to gain insight into the dispersion of the cargoes on the seabed. This could contribute to our knowledge of the size of the ship and its orientation on the seabed. The key elements of the amphorae were counted in order to learn the minimum possible number of amphorae that com-



Figure 4. Excavation with the aid of a water pump at submarine rocks at the Uljeva B site (L.Bekić).

prised the cargo of the ship. A minimum number –besides by the number of handles or spikes– could also be arrived at by way of the final sum of all weighed amphorae sherds. This approach to researching devastated sites is experimental and we hope that it will in the end provide satisfactory results.

During several research campaigns with very limited funding and in total a small number of dives we established that the greatest problem lies in attaining a satisfactory speed and precision of drawing in the numerous crevices. The precise documentation of their exact positions simply required too much time. Therefore, when the first opportunity arose –when the project finally received much needed financial assistance from the Croatian Ministry of Culture– a campaign to make a digital image of the seabed was undertaken. This was conducted in collaboration with the Slovenian company Harpha Sea, which possesses the necessary equipment and experience in plotting underwater archaeological sites. Thus, using a rubber dinghy that was able to navigate above the shallow rocks of Uljeva and multibeam technology, a precise bathymetric map was made of the entire area. This new map of the seabed in fact saved many hours of underwater measurement and drawing of individual crevices, and freed up the diving team to undertake speedier and more effective excavation in future campaigns.

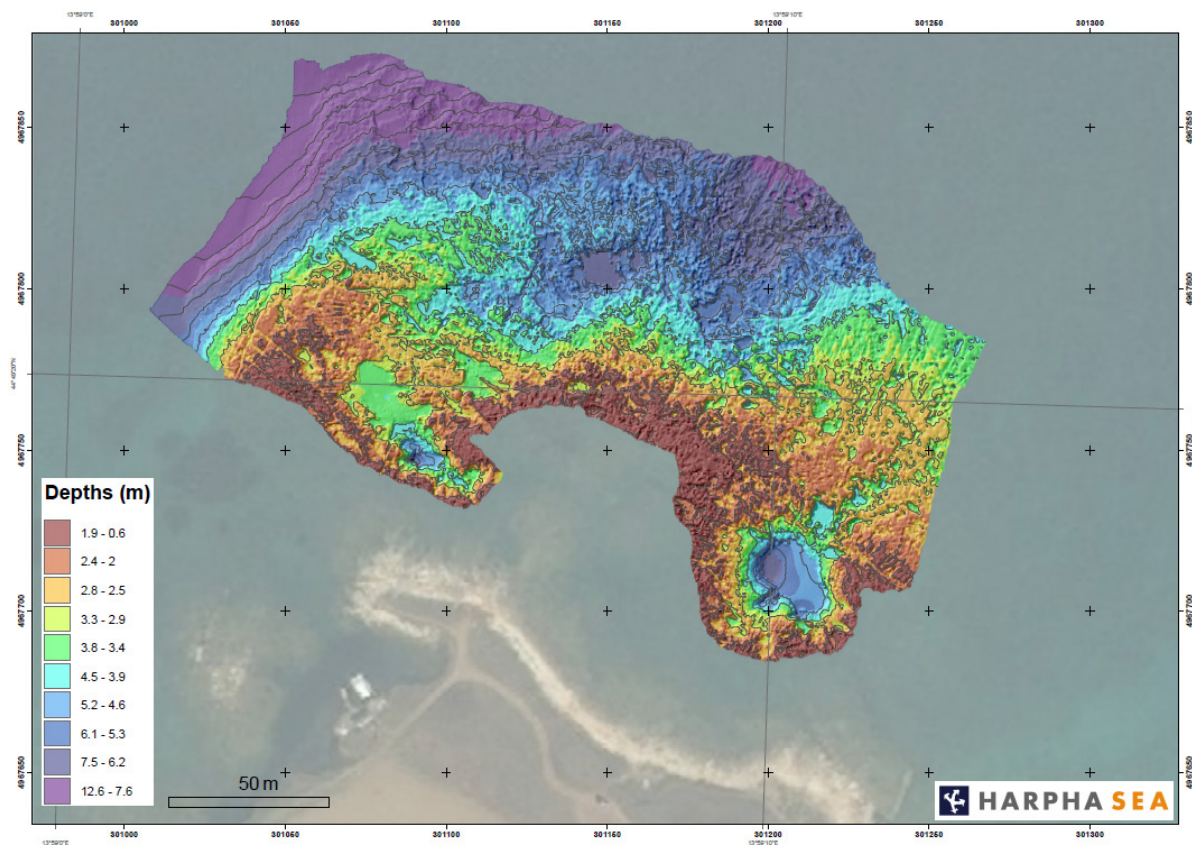


Figure 5. The bathymetric map of the submarine rocks at Cape Uljeva (Harpha Sea).

Uljeva A

The cargo of the ship that sank at the Uljeva A site evidently contained for the most part amphorae of the Lamboglia 2 type and a few of the Dressel 6A type. A conclusion in this regard is for now difficult to draw as the number of typologically determinable finds is too small for a final conclusion. Lying on the seabed are for the most part typologically indeterminable body sections of amphorae and only here and there do we find a small sherd from the neck of an amphora.

As the Lamboglia 2 amphora is the predecessor of the Dressel 6A amphora, they share many common characteristics, and it is difficult to differentiate them if they are not complete. It is also possible that this is a mixed cargo from a transition period during the development of the Lamboglia 2 amphora into the Dressel 6A. Of all the rimsherds collected to date, only one bears a workshop stamp, unfortunately poorly legible. A large quantity of various ceramic amphorae plugs was found along with the amphorae, many of which bear markings in relief.

Along with the numerous amphorae sherds the investigated cavities revealed at least thirty different forms of other ware. These are for the most part cooking pots, but also include jugs, platters and so forth. The greenish glass base of a large square bottle and several sherds of ware in the form of a phallus, likely oil lamp, stand out. As all of these artefacts were found individually, they are likely part of the equipment of the ship's galley or the property of individual members of the crew.

Based on the finds discovered to date the shipwreck at Uljeva A can be dated to the 1st century BCE.



Figure 6. Typical finds from the Uljeva A shipwreck (L.Bekić).

Uljeva B

At Uljeva B the core cargo consisted of large quantities of kitchen ware. For the most part these are small, medium sized and large bulbous or biconical pots with a flared rim and the accompanying lids. Found along with the pots are bowls of various size. All of this numerous ware, judging by the forms and fabrication, belongs to workshops from the Aegean Sea area (Aegean Coarse Ware) and was surely meant for further sale in the northern Adriatic.

Besides the ware, the ship also carried a smaller cargo of goods in amphorae. The amphorae are quite diverse, and a few key types can thus far be identified. These are the *Africana Piccolo* (Keay 3B), Keay 39 (Sidi Jidid 4b), and *Spatheion* amphorae in multiple variants. Along with these we have sherds of other, for the moment unidentified, amphorae, and one poorly legible stamp on the handle of an amphora. It is evident that the majority of the amphorae originate from North African workshops.

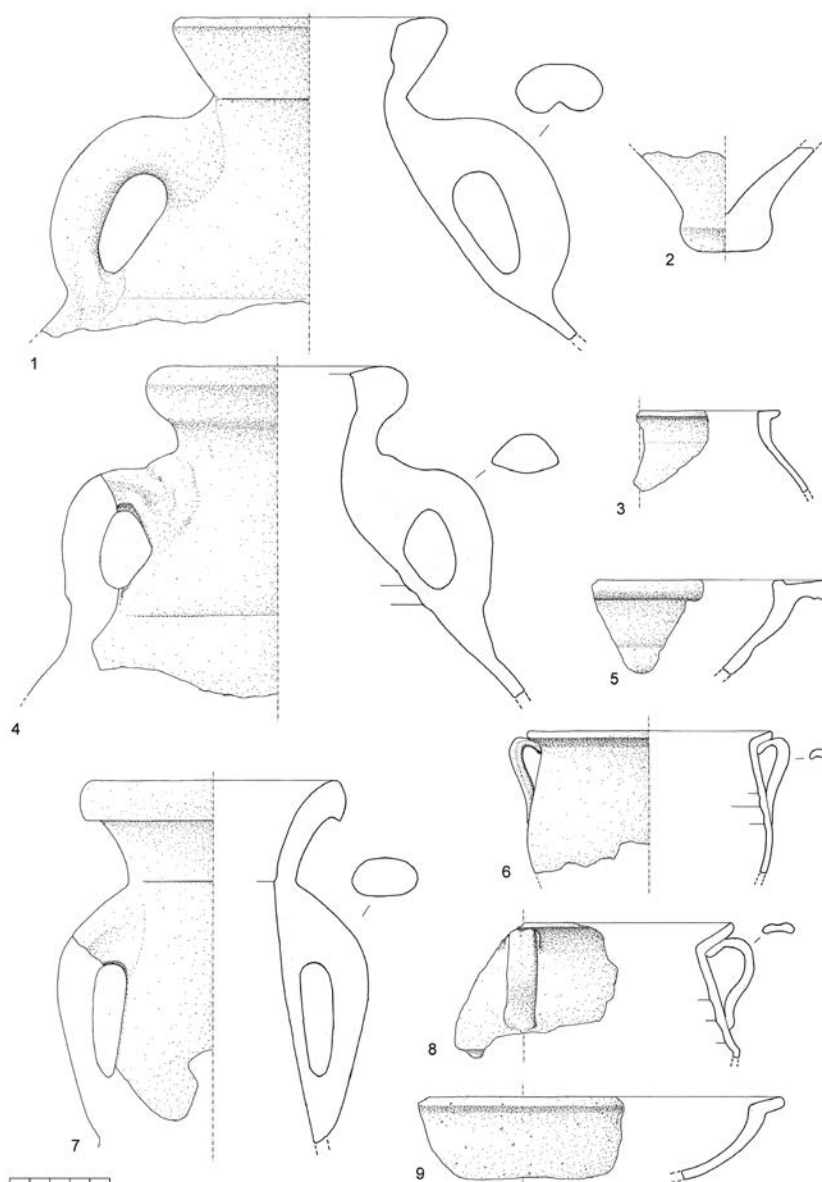


Figure 7. Typical finds from the Uljeva B shipwreck (L.Bekić).

Preserved among the equipment that belonged to the crew and the ship are fragments of three different glass cups of semi-spherical shape with an incised rim, and one part of a twisted and perforated bronze rod of unknown use. Remaining of the wreck of the ship are only individual iron and bronze nails and several pieces of ballast stones of green colour, weighing on the average two kilograms and of, for the moment, unknown origin.

Based on the finds discovered to date, observing them on the whole, it can be concluded that the ship at the Uljeva B site sank in the 4th century.

Eleven contexts/cavities were investigated in the course of several campaigns at Uljeva A. They yielded discoveries of: 1272 amphorae sherds (54.7 kilograms of amphorae), of which 16 neck sherds, 13 plugs, 36 handle sherds and 16 sherds of amphorae spikes. Twenty-three contexts/cavities have thus far been investigated at Uljeva B. They contained 1525 amphorae sherds (71.3 kilograms of amphorae), of which 15 neck sherds, 2 plugs, 14 handle sherds and 9 sherds of amphorae spikes. There are other excavated finds that have not yet been weighed and studied.

The investigation is to continue in the coming years and it is estimated that only a quarter of each ship has so far been excavated. Investigation will continue at the Uljeva A and B sites and of the post-medieval shipwreck at Uljeva C. This will be followed by a final analysis of all collected small finds and the processing of drawn documentation and statistical data. In the final publication we hope to be able to determine the core cargo of the ships, its origin, get an idea of the ships' size and deadweight and perhaps of their orientation on the seabed.

Over the three years of this investigation an advanced-level school of underwater archaeology was also active in the frame of the archaeological project organised by ICUA Zadar and the Unesco Office in Venice. An additional five to eight students and young archaeologists thus participated in two-week investigations, and the diversity of work on a project of this nature allowed them to acquire valuable experience. Another important aspect of this project is the cooperation with the local community, the administration of the Municipality of Ližnjan and the tourism board with the end goal of the presentation of the site to divers and tourists in general. The communication is also targeted towards all other inhabitants of Ližnjan, in particular fishermen and other people active at sea. One of the objectives is their education with regard to the importance of underwater archaeological and historical heritage and the cultural characteristics of their region. Through this two-way process lasting friendships have been made giving archaeological projects like this one special significance.

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La isla de Mallorca (Baleares) dentro de los circuitos comerciales de la Antigüedad

The island of Mallorca (Baleares) within the trade routes in antiquity

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Resumen: el presente artículo pretende centrarse en la relación de la isla de Mallorca (Islas Baleares) con las rutas marítimas y flujos comerciales existentes en la Antigüedad. Al tratarse de un punto de encrucijada en el Mediterráneo occidental, esta isla fue muy frecuentada por comerciantes procedentes de múltiples áreas geográficas. Del mismo modo, haremos un muy breve resumen de los yacimientos arqueológicos subacuáticos hallados en sus costas, con un abanico cronológico que va del siglo VI a.n.e. hasta el VI d.n.e. aproximadamente. Asimismo pondremos en relación la materialidad del registro arqueológico subacuático con el terrestre para una mejor comprensión de los fenómenos comerciales para el periodo que nos ocupa.

Palabras clave: arqueología subacuática, Mallorca, rutas comerciales marítimas, pecios, ánforas.

Abstract: The present paper pretends to focus in the relationship between the island of Majorca (Balearic Islands) and the sea routes and trade flows existing in antiquity. Being a point of intersection in Western Mediterranean, this island was very frequented by traders from multiple geographical areas. At the same way, we will try to make a very short abstract about the underwater archaeological sites found on its shores, with a chronological range comprised between the 6th Century B.C to the 6th Century A.D., more or less. Also we want to relate the materiality of underwater archaeological record with the terrestrial for a better understanding of the comercial flows for the indicated period.

Key words: Underwater archaeology, Mallorca, maritime trade routes, shipwrecks, amphoras.

Introducción

Las Islas Baleares ocupan una posición privilegiada en el Mediterráneo occidental, ya que se encuentran, aproximadamente, a medio camino de las rutas septentrionales y meridionales, en

una zona de encrucijada y con una importancia estratégica vital, constituyendo un hito marítimo de primer orden desde tiempos remotos. Antes de iniciar el desarrollo, consideramos oportuno hacer mención a un hecho crucial de estas islas en la Antigüedad: la distinción entre *Pytioussae* (Ibiza y Formentera) y *Gymnesias* (Mallorca y Menorca). Mientras que en Ibiza ya podemos hablar de frecuentaciones e influencias fenicias en la segunda mitad del siglo VIII a.n.e. (Ramon, 2008a), las *Gymnesias* se encontraban imbuidas en la cultura talayótica (Calvo/Guerrero, 2004: 96-98) por lo que fueron dos entidades diferentes tanto a nivel político, como económico, social y religioso. La isla de Ibiza (Ebusus) se convirtió a partir del siglo VI a.n.e. en un importante emporio comercial de producción y redistribución, como así lo demuestra la acuñación de moneda propia en el siglo IV a.n.e. (Campo, 1993), la fabricación de cerámica a torno y la escritura, mientras que en Mallorca y Menorca estos «avances» fueron ajenos a sus pobladores hasta que tuvo lugar la romanización.

Nótese que, por razones obvias de espacio, nos hemos centrado únicamente en la mayor de las Baleares, Mallorca, haciendo un muy breve resumen acerca de la relevancia que tuvo dentro de los circuitos y dinámicas comerciales de la Antigüedad a través del registro arqueológico subacuático y terrestre. Del mismo modo, intentaremos enterrar el cliché de la insularidad como sinónimo de aislamiento, menos comprensible aún en la Antigüedad, un periodo en el que el mar unía más que cualquier vía terrestre.

Vías de comercio marítimo en la prehistoria y protohistoria de la isla de Mallorca

Gracias a la condición de insularidad, y debido a la carencia de mineral de estaño en la isla de Mallorca, se cuenta con un indicador arqueológico incuestionable de los primeros viajes comerciales que tienen como objetivo dicha isla. Este no es otro que los primeros objetos de bronce aparecidos durante el primer cuarto del II milenio a.n.e., como los punzones del dolmen de s'Aigua Dolça (Salvà/Calvo/Guerrero, 2004: 57), cuyo estaño necesario para su elaboración tenía que importarse forzosamente por vía marítima; al igual que el marfil utilizado en la elaboración de diferentes objetos, como el peine de Son Matge (Waldren, 1998: 76), y la fayenza. A mediados del II milenio a.n.e., y coincidiendo con esta apertura a los flujos comerciales externos, los indígenas baleáricos empiezan a fabricar grandes envases cerámicos toneliformes, con una morfología apropiada para el transporte marítimo, en los que se envasarían productos susceptibles de ser comercializados e intercambiados. Cabe destacar que estos toneles son especialmente abundantes en enclaves costeros (Salvà/Calvo/Guerrero, 2002: 204; Guerrero, 2006a). Por otra parte existen toda una serie de asentamientos cuya ubicación responde a una voluntad de control del mar aledaño a la isla¹ (Fig. 1). Estas atalayas se ubican principalmente en las caras S, SO y SE de Mallorca, en lo alto de promontorios escarpados, pero siempre cerca de alguna cala o punto de desembarco guarecidos, por lo que muy probablemente servirían, no solo para el control visual del horizonte marítimo, sino también como puntos de referencia para guiar a las embarcaciones hasta lugares resguardados en los que poder descargar las mercancías (Guerrero, 2006a: 102-115). Estos asentamientos, por consiguiente, son propios de una sociedad que desde tiempos remotos ha estado íntimamente ligada al mar, y no aislada de él, como la historiografía tradicional ha venido insinuando.

¹ Para la isla de Menorca se ha realizado un estudio de las cuencas de visibilidad de estos asentamientos. Los resultados no dejan lugar a dudas (Sánchez/Gutiérrez/Orfila, 2013).



Figura 1. Asentamiento costero de Punta des Baus (Santanyí). Foto del autor.

Hasta el momento, la evidencia arqueológica más antigua que conocemos en el registro subacuático balear es el pecio de *Cala Sant Vicenç*, datado en el siglo VI a.n.e. Fue excavado en los años 2002 y 2004 por un equipo formado por arqueólogos mallorquines y del CASC, con el apoyo del Consell de Mallorca. De este pecio se publicó una magnífica monografía y suscitó un prolífico debate acerca de su llegada, accidental o intencionada, a la mayor de las *Gymnesias* (Guerrero, 2010; Hernández, 2010; Nieto/Santos, 2008), aunque desde aquí nos inclinamos a pensar que su llegada no fue un hecho fortuito. Su cargamento, heterogéneo y de tipo empórico, estaba formado por ánforas ibéricas y griegas, así como vajilla de barniz negro, copas jónicas, paquetes de herramientas, metal en bruto, etc. (Santos, 2009: 67-79; Nieto/Santos/Tarongí, 2004). Asimismo, este pecio ha proporcionado el mayor fragmento de barco cosido del Mediterráneo.

Sin lugar a dudas, el periodo de mayor auge importador en la protohistoria de Mallorca se caracteriza por un producto, el vino, y una zona, el *ager ebusitanus*; así se ha demostrado en las excavaciones de los principales poblados indígenas: Son Fornés (Gelabert, 2013; Fayas, 2010), Ses Païses (Quintana, 2006), Turó de ses Abelles (Camps/Vallespir, 1998) o el Puig de sa Morisca (Quintana/Guerrero, 2004), entre otros. Este flujo comercial se inició, como mínimo entre finales del siglo VI y principios del V a.n.e., ya que en el yacimiento protohistórico de Es Puig de Sa Morisca, se encontraron restos de ánforas púnico-ebusitanas T-1.3.1.2, encuadrables en dicha cronología (Ramon, 1991). Sin embargo, el verdadero auge importador de productos ebusitanos se manifestará con la irrupción del ánfora T-8.1.1.1, concretamente en el siglo IV a.n.e., coincidiendo con la fundación de la factoría de Na Guardis y Es Trenc, pero especialmente durante el transcurso de la Primera y Segunda Guerra Púnica, conflictos en que los honderos balearicos serán reclutados como mercenarios. Como recientemente algunos autores han puesto de manifiesto, los caldos ebusitanos «inundaron» la isla de Mallorca (Hernández/Quintana, 2013) a través de los principales poblados costeros del S, SE y SO de la isla, precisamente en los puntos donde mayoritariamente se localizan los asentamientos costeros a los que hemos hecho mención con anterioridad, además de la factoría costera de Na Guardis. También hay constancia de la frecuentación y ocupación de los islotes d'En Sales y Na Galera, situados en la bahía de

Palma por parte de los agentes comerciales púnico-ebusitanos (Guerrero, 1980; 1982). Junto a los cargamentos anfóricos, y para hacer más ventajoso el viaje desde el punto de vista económico, también llegó a Mallorca cerámica pseudocampaniense y común ebusitana, ática de barniz negro, ibérica y gris emporitana, entre otras (Gelabert, 2013: 256-292).

Existen una serie de yacimientos arqueológicos subacuáticos que refuerzan esta realidad en tierra firme. El primero de todos es el *Cabrera II*, cuyos restos de su naufragio se encuentran en la ensenada del puerto de Cabrera (Pons, 1999: Ficha Pro/15-99). Aunque fue expoliado en la década de 1960, algunos materiales recuperados pudieron ser estudiados (Cerdà, 1978; Veny/Cerdà, 1972). Se trata de un mercante que habría partido de *Ebusus*², probablemente en el contexto de la II Guerra Púnica, con un cargamento formado por ánforas púnico-ebusitanas T-8.1.3.1, púnicas norteafricanas T-7.2.1.1, T-5.2.3.2 y Mañá B-1, grecoitálicas Will-A1/MGS V e incluso un ánfora púnicomaltesa Merlín/Drappier-3, seguramente perteneciente a la tripulación (Guerrero, 2005: 108). El cargamento secundario estaría formado por cierto número de cerámica fina de barniz negro, del que destaca un plato Lamboglia 26c del «taller de las tres palmetas radiales» de *Rhode*, un *guttus* Lamboglia 45, un *louterion* y cerámica común ebusitana (Cerdà, 2000: 89-92). También se documentaron tres lingotes de plomo, ubicados dentro de conchas del orden de los lamelibranquios *Pinna Nobilis*, con un peso que oscila entre los 31 y los 40 kg. Dichos lingotes han sido objeto de análisis de isótopos, demostrando que provienen del área minera cartagenera (Trincherini *et alii*, 2009).

El siguiente caso es el pecio *Cabrera VII*, ubicado en el Illot de Conillera, cercano a Cabrera. Fue descubierto en 1996 y sondeado por el GAS (Grup d'Arqueologia Subaquàtica de Mallorca) Se trata de un mercante púnico-ebusitano del último tercio del siglo II a.n.e. que seguramente se dirigía a la isla de Mallorca o Menorca. Su cargamento principal estaba formado por ánforas ebusitanas T-8.1.3.2 y PE-24, grecoitálicas Will-E / MGS VI y jarras Eb-69. Junto a estos contenedores se hallaba un gran número de cerámica pseudocampaniense de producción ibicenca (Pons, 2004: 265; Carbonell/ Pons, 2001). Por los restos de la arquitectura naval puestos al descubierto, se pensó que podría tratarse de un navío de unos 20 m de eslora por 7 m de manga (Pons, 2005: 763; Pons/Riera/Riera, 2001: 27). Entre los demás materiales hallados cabe destacar una serie de objetos de plomo, entre ellos una anilla para maniobrar la jarcia, conducciones para evacuar el agua de la sentina, restos del forro externo y cuatro anclas de caña, de unos 1,5 m de longitud (Pons, 1999: Ficha Pro/10-99).

Volviendo a la isla de Mallorca, contamos con tres yacimientos relacionados con el comercio de ánforas de producción púnica. El primero de ellos es el *Carbó I*, naufragado al sur de la isla, en el que el GAS documentó en 1995 una gran acumulación de ánforas púnicas de tipología no especificada, restos del forro de plomo del navío y una caja fabricada en el mismo material, remachada con láminas de cobre (Pons, 2004: 259). El segundo es el denominado *Na Guardis II*, situado en las inmediaciones del islote homónimo y excavado a finales de los años 70 (Guerrero, 1984). El yacimiento³ está formado por ánforas contenedoras de vino ebusitanas T-8.1.3.2 y PE-24, cartaginesas T-7.4.3.1, un *stock* reducido de vinos itálicos envasados en ánforas grecoitálicas y Dressel 1A y productos no identificados transportados en jarras Eb-69. Toda esta carga principal vendría completada por cerámica pseudocampa-

² No estamos plenamente de acuerdo con la hipótesis planteada por V. Guerrero, quien argumentaba que dicho mercante habría partido de algún puerto del norte de África, para *a posteriori* completar su carga en *Ebusus* (Guerrero, 1993: 185). Teniendo en cuenta la naturaleza del cargamento, y dada la complejidad de las operaciones de estiba en la Antigüedad, el argumento más plausible es que, tanto los lingotes, como la vajilla y las ánforas púnicas norteafricanas habrían llegado a Ibiza, importante centro redistribuidor en la Antigüedad, para luego ser transportadas hasta su destino final, posiblemente la factoría púnica de Na Guardis (Ses Salines, Mallorca), hundiéndose en el archipiélago de Cabrera.

³ Mientras que V. Guerrero opina que se trata de un naufragio, dada la aparición de maderas calcinadas, para J. Ramon se trata de una acumulación de materiales fruto de un vertedero marino de desechos cerámicos (Ramon, 2008b: 72).

niense de imitación y morteros ebusitanos, además de campaniense A itálica (Guerrero, 1981: 204).

Aunque el navío de *El Sec* no contemplara como destino final la isla de Mallorca, pensamos que resulta interesante incluirlo. Se trata de un mercante del siglo IV a.n.e., cargado con ánforas y otros materiales de producción magnogriega y del Mediterráneo oriental (Arribas *et alii*, 1987), al que tradicionalmente se le ha adscrito una filiación púnica atendiendo a una serie de grafitos de carácter mercantil hallados en algunos recipientes cerámicos (Hoz, 1987: 622-631). Cabe destacar que parte de la cerámica a bordo contaba con grafitos griegos, demostrando lo extremadamente delicado que resulta establecer juicios acerca de su procedencia en base a la tripulación e intermediarios comerciales que, seguramente, debieron ser de lo más variopinto.

Como hemos podido comprobar, llama enormemente la atención el escaso número de yacimientos subacuáticos cargados con materiales de producción púnico-ebusitana, en contraste con la elevada dispersión que estos presentan en los yacimientos terrestres. En esta línea, los últimos estudios están relativizando en gran medida la intensidad de dicho flujo comercial, ya que la cuantificación del NMI anfóricos es muy inferior a lo que tradicionalmente se pensaba, especialmente en algunos yacimientos como Na Guardis, es Puig de sa Morisca, es Turó de ses Abelles y Son Fornés (Gelabert, 2013: 444-447). Del mismo modo, el modelo comercial colonial defendido por Guerrero y Quintana (2004) está siendo objeto de revisión desde una óptica poscolonialista, dando un mayor protagonismo al factor indígena (García, 2010; Hernández/Quintana, 2013). La circulación mercantil ebusitana evolucionará, convirtiéndose en un importante centro de redistribución de productos procedentes tanto de la Magna Grecia como de la costa norteafricana, aunque con altibajos, como el receso experimentado durante el transcurso de la Segunda Guerra Púnica y los momentos inmediatos a la conquista romana, como veremos a continuación.

El comercio marítimo en época romana

Coincidiendo con la expansión romana en la península ibérica para explotar sus ricos yacimientos metalíferos, se hizo más necesario que nunca abrir una nueva ruta más rápida y por alta mar, que pasaba obligatoriamente por las Baleares. Así, la importancia estratégica de las Baleares no pasó inadvertida para el Senado romano, y rápidamente se tomaron medidas para incorporarlas bajo su órbita. La travesía entre Hispania y Roma, pasando por dicho archipiélago y a través del estrecho de Bonifacio, era mucho más rápida y segura que navegando de cabotaje por el golfo de León, donde la mayor presencia de tierra firme favorecía el acecho de los piratas, ocultos en pequeñas calas, a las naves mercantes (Orfila, 2008).

Ya fuera por controlar el problema de la piratería, o por colapsar la pujante actividad púnico-ebusitana, Quinto Cecilio Metelo conquistó las Baleares en el 123 a.n.e. y estableció, como mínimo, dos campamentos militares en Mallorca: el primero en la zona que ocupa el actual hospital de Son Espases, en Palma (Estarellas/Merino/Torres, 2012), y otro posiblemente en Ses Salines (Bauzá/Ponç, 1987). Este hecho, junto a la llegada a las islas de 3000 *Iberias Rhomaioi* acompañando a Metelo (Str. III, 5, 1), demuestra la enorme importancia estratégica que tenían las Baleares para la república de Roma. En el contexto de las Guerras Sertorianas se fundaron las ciudades, con estatuto de colonia (Zucca, 1998: 147-151), de Palma y Pollentia para asegurarse el control de las tres bahías de la isla, es decir, en una inmejorable posición para controlar el tráfico marítimo. Poco después, en el 67 a.n.e., tuvo lugar la promulgación de la *Lex Rogatio Gabina*, ocupando Cneo Pompeyo el cargo de *navarca*, lo que de facto le confería un *imperium infinitum* para erradicar la piratería en el Mediterráneo. Se sabe que nombró a dos

legados para llevar a cabo dicha tarea, uno para la zona del estrecho de Gibraltar, y otro para el *Mare Balearicus* (Orfila/Chávez, 2006: 109).

En los momentos posteriores a la conquista, y hasta finales del siglo I a.n.e., la isla de Mallorca importó principalmente productos itálicos, sobre todo vino, envasado en ánforas Dressel 1 y Lamboglia 2, además de cerámica campaniense, aunque eso no significa que antes de la intervención militar no hubiesen llegado a la isla materiales itálicos (Sanmartí *et alii*, 1996: 67). Este hecho se constata en los niveles de época tardo-republicana de Palma (López/Estarellas/Merino, 2008: 133-135), el pozo D-18 de Pollentia (Equip d'Excavació de Pollentia, 1993: 239-240) y en el conjunto de *tabernae* de la misma ciudad (Cerdà, 1999: 33-71; Orfila, 2005); así como en los asentamientos indígenas de Son Fornés (Fayas, 2010: 148-160), Ses Païsses (Quintana, 2006: 60) o es Turó de ses Abelles (Camps/Vallespir, 1998). Del mismo modo, complementando los cargamentos anfóricos itálicos, las importaciones cerámicas aretinas llegan a la ciudad de Pollentia a partir de mediados del siglo I a.n.e. (Roca/Orfila, 1988; Roca, 1992).

En el registro arqueológico subacuático contamos con diversos testimonios de esta irrupción de materiales de procedencia itálica. El primero de ellos el pecio de *Colònia de Sant Jordi A* (Ses Salines). Fue excavado en 1977, tras recibirse noticias de su expolio, por un equipo dirigido por D. Cerdà y coordinado por D. Colls. Se trata de un navío romano-republicano, de unos 11-13 m de eslora, que naufragó en una fecha comprendida entre el 100-80 a.n.e. Su cargamento estaba formado por vino de Campania envasado en ánforas Dressel 1A y 1C, vino de Apulia en ánforas Lamboglia 2, cerámica campaniense «B» y «D», lucernas, cerámica de paredes finas y común (Cerdà, 1980). También se conservaron dos fragmentos del casco de la nave, que ocupan un espacio de 11,30 m de largo por 3,60 m de ancho (Colls, 1987). Cerca de este yacimiento se encuentra el de *Es Carbó II*, prospectado por el GAS en 1995, con un cargamento formado por ánforas Dressel 1 (Pons, 2005: 260). Al norte de la isla se encuentra el *Cala Sant Vicenç II*, descubierto durante las prospecciones llevadas a cabo por el CASC en esa zona con motivo de la excavación del pecio griego arcaico. Se trata de un yacimiento formado por ánforas Dressel 1B, cerámica de barniz negro y gris ibérica, además de un denario de plata acuñado en el 96 a.n.e. (Nieto/Tarongí, 2009: 16). Finalmente, el aficionado a la arqueología Font Obrador, hizo hincapié en la existencia de un yacimiento en proceso de expolio, con multitud de ánforas Dressel 1B, en la zona de Es Freu del islote Dragonera (Font, 1963), una zona tradicionalmente peligrosa para la navegación a vela, aunque, desgraciadamente, dicho yacimiento no se ha podido reubicar en la actualidad.

Este claro predominio de productos itálicos cambiará totalmente en el último cuarto del siglo I a.n.e. A partir de este momento la dinámica comercial viene marcada por la expansión del comercio provincial, principalmente del tarraconense y ebusitano, en detrimento del itálico (Marimon, 2005). Esta situación estaría provocada, según la historiografía tradicional, por la crisis del sistema de producción esclavista y de la antigua «villa varroniana», entre otros motivos (Carandini, 1989). Este fenómeno también podría explicarse por el crecimiento demográfico que debieron experimentar las Baleares en época altoimperial, que hizo crecer la demanda de vinos más comunes y baratos para poder cubrir las necesidades de la población con menor poder adquisitivo, como ocurrió en otras ciudades romanas (Pérez, 2009: 562). Sea como fuere, los vinos layetanos y tarraconenses sustituirán paulatinamente a los itálicos en los mercados de consumo. De la misma manera lo harán los ebusitanos que, en ese mismo periodo, vivirán un auténtico auge, evidenciado por la dispersión de los tipos PE-25 y PE-26, que buscan imitar las ánforas Dressel 1 y Pascual 1 respectivamente, plenamente aceptadas y reconocidas dentro de los mercados baleares (Ramon, 1991: 130-148). En diversos vertederos de época altoimperial hallados en las ciudades romanas de Palma (López *et alii*, 1996; López/Estarellas/Merino, 2008) y Pollentia (Rivas, 2006: 314), se puede observar un predominio de tipos anfóricos tarraconenses. Lo mismo sucede en el poblado talayótico de Ses Païsses (Quintana, 2006: 64), pero no así en otros antiguos núcleos indígenas, como Son Fornés, con una muy escasa representación (Fayas,

2010: 231; Gelabert, 2012: 207). Del mismo modo, en el yacimiento subacuático Na Guardis I, mercante de redistribución de época de Claudio-Nerón, contamos con un cargamento formado por ánforas tarraconenses Pascual 1 y Dressel 2-4, PE-24 y PE-41 ebusitanas, además de T.S. Sudgálica e Hispánica y cerámica de paredes finas (Guerrero, 1982: 204; 1984: 22). También hay que hacer hincapié en la llegada de *Terra Sigillata* Sud-Gálica a la isla de Mallorca, mucho más abundante en la zona sur (Ses Salines) que en cualquier otra área (Roca/Orfila, 1988). En relación a este hecho, contamos con un yacimiento al norte, el *Cala Sant Vicenç III* cargado con este tipo de *sigillata* procedente de La Graufessenque y con cerámica bética de paredes finas (Nieto/Tarongí, 2009: 16). El pecio de *Portocristo*, con un importante lote de lucernas itálicas del taller de Caius Clodius (Domergue, 1966; Frey, 1970) demuestra que las importaciones de productos itálicos perduraron hasta, al menos, mediados del siglo I d.n.e.

A partir de época Flavia las importaciones tarraconenses decaerán, manteniéndose las ebusitanas, aunque modestamente, hasta principios del siglo II d.n.e. Este hecho pudo ser debido a una más que probable expansión de una economía de autoabastecimiento, ya que gracias a la *Naturalis Historia* de Plinio sabemos que en las Baleares se producían gran cantidad de productos como trigo de excelente calidad (xviii, 13, 67), cebollas (xix, 30, 94), minio (xxv, 31), higos (xv, 21, 82) y vino que, según el mismo autor, era equiparable a los mejores caldos itálicos (xiv, 71). En este sentido hay que tener en cuenta el hallazgo de una posible prensa de vino en Can Maiol, en el municipio de Felanitx (Orfila, 1993). Tampoco hay que olvidar la importante explotación salinera en el área de la Colònia de Sant Jordi, explotada de forma intensa en época altoimperial y en uso hasta el siglo VI d.n.e. (Guerrero, 1987: 93). Del mismo modo no debemos descartar una posible producción local de productos destinados a la exportación. Así se ha puesto de manifiesto en la villa de Sa Mesquida (Calvià), en la que existió una producción de cerámica común romana (Cau, 2008) y en el análisis geoquímico de algunas ánforas halladas en el subsuelo de Palma, cuya arcilla usada para su fabricación parece provenir de las inmediaciones de la ciudad (Vila, 2008: 593).

Otro dato a tener en cuenta es que, autores como A. Poveda (Poveda, 2000), han sugerido un eje de proyección económica entre Carthago Nova y las *Insulae Baliares*, en base al hallazgo de unos lingotes de plomo con la marca *SOC(ietas) BALIAR(ica)* en el pecio Escombreras III, pequeño mercante de redistribución hundido probablemente hacia el último cuarto del siglo I a.n.e. Estas barras plúmbeas serían exportadas hacia las islas para la fabricación de utensilios diversos, aunque sabemos que en Mallorca fue explotada, al menos en época tardo-republicana y augustea, la mina de galena argentífera de Bunyola (Domergue, 1987: 46-48).

La isla de Mallorca como lugar de paso de los mercantes procedentes de la bética

Mención aparte merece el fenómeno observado en torno al cambio de era, en el que se observa como las Baleares se convierten en un lugar de paso muy frecuentado por los navíos mercantes que unían la ruta entre los puertos del sur de Hispania y la península itálica. Como estos yacimientos, incluidos el *Cabrera III* y *Sa Costera* del siglo III d.n.e., ya fueron objeto de estudio en un artículo nuestro de reciente publicación (Colom, 2013), remitimos al mismo a los lectores interesados. A los 16 yacimientos analizados en dicho trabajo habría que añadir un hallazgo reciente. En agosto de 2014, la organización Oceana, dedicada a la protección y salvaguarda de los océanos, se encontraba prospectando el canal que separa Mallorca e Ibiza cuando el sónar detectó una serie de anomalías y mediante un ROV, se procedió a inspeccionarlas. De esta manera, a más de 500 m de profundidad, se descubrió una gran acumulación de ánforas dispersas en un radio de unos 150 m. En las imágenes inéditas facilitadas (Figs. 2, 3, 4 y 5), podemos observar que se trata de ánforas contenedoras de salazones, posiblemente de tipología Dressel 7-11.



Figura 2, 3, 4 y 5. Ánforas de salazones, posiblemente procedentes de la Bética. Imágenes cedidas por Oceana® (especial agradecimiento a X. Pastor).

La dinámica comercial en el periodo bajo imperial

Desde finales del siglo III d.n.e. en adelante, los productos cerámicos importados en las Baleares proceden casi exclusivamente del norte de África (López, 2004: 368). Así queda atestiguado en los niveles bajo imperiales de Pollentia, en los que predominan las cerámicas de mesa y ánforas de producción africana (Cerdà, 1994; Cau/Chávez/Orfila, 2007; 2008; Villaverde, 2004: 398); en algunos depósitos de principios del siglo V a.n.e. de la villa de explotación romana de Sa Mesquida (Orfila, 1988; Orfila/Merino, 1989); en dos fortificaciones tardorromanas de Alaró (Aramburu, 2000a), en numerosos asentamientos rurales dispersos a lo largo y ancho de la isla (Aramburu, 2014), así como en las prospecciones superficiales realizadas en el archipiélago de Cabrera (Aramburu, 2000b). Sabemos, gracias a la *Encíclica del Obispo Severo*, que los contactos entre las Baleares y el norte de África y el sur de Francia eran numerosos, especialmente a principios de siglo V d.n.e. (Amengual, 1982). En este periodo, la explotación económica de la isla de Mallorca está atestiguada por la explotación salinera de la Colònia de Sant Jordi, a la que ya hemos hecho mención con anterioridad, y por el hallazgo de cubetas para la elaboración de salazones en Cabrera (Orfila/Hernández/Cau, 1992). Además, la *Notitia Dignitatum*, de principios del siglo V d.n.e., hace referencia a la existencia de una factoría de púrpura en las Islas Baleares bajo la responsabilidad de un *procurator baphii insularum Balearum* (Blanes *et alii*, 1990: 46).

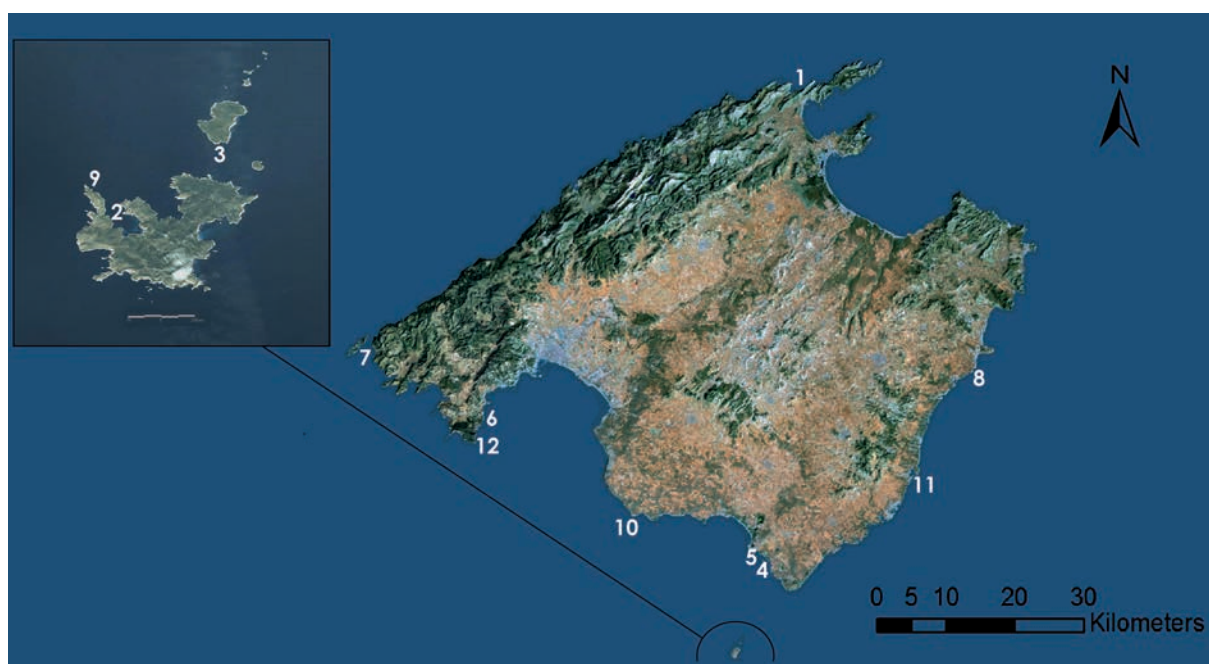


Figura 6. Ubicación aproximada de los yacimientos subacuáticos a los que hemos hecho mención en el texto. 1- Cala Sant Vicenç; 2- Cabrera II; 3- Cabrera VII; 4- Es Carbó; 5- Na Guardis y Colònia de Sant Jordi; 6- El Sec; 7- Dragonera; 8- Portocristo; 9- Cabrera IX; 10- Cap Blanc; 11- Portocolom; 12- Cala Figuera.

A partir del siglo III d.n.e. podemos apreciar, nuevamente, un cambio en los cargamentos de los navíos mercantes naufragados en las costas mallorquinas, evidenciando una metamorfosis en la dinámica comercial: la presencia de ánforas béticas es cada vez menor, siendo las norteafricanas y lusitanas las más abundantes en el registro arqueológico subacuático. Prueba de esto es el yacimiento *Cabrera IX*, en el que en 1999 el GAS documentó un individuo completo de Almagro 51A-B junto a lingotes de plomo y restos cerámicos dispersos en una zona de fuertes pendientes submarinas (Pons, 1999: Ficha Pro-18/99; 2000: Ficha Pro-09/00). En Cap Blanc, al S-SO de Mallorca, se halló y expolió en 1970 una nave del Bajo Imperio. Su cargamento estaba formado por ánforas Almagro 51C, Africana 2B-D selladas con discos de corcho, y un solo ejemplar de Beltrán 72, además de una tubo-dovela, instrumento cerámico utilizado para la construcción de arcos y bóvedas (Llabrés, 1976). Otro caso es el Colònia de Sant Jordi C, citado por D. Cerdà (Cerdà, 1980: 13), quien afirmaba que dentro de la bocana de la ensenada de dicho puerto existía un pecio cargado con ánforas africanas de la Bizacena, que fue durante años objeto constante de expolio. Según los sondeos efectuados por D. Colls (Colls, 1987: 9), en la zona solo se encontraban fragmentos de ánforas del tipo Africana 2B-D, sin ningún resto significativo que pudiera suponer la presencia de un navío hundido. El siguiente testimonio es el pecio de *Portocolom*, descubierto durante las tareas de dragado de este puerto ubicado en el municipio de Felanitx. Allí se constató la existencia de un yacimiento del que se conservan restos de su arquitectura naval y, asociado a estos, ánforas contenedoras de salazones del tipo Almagro 51C (Riera *et alii*, 2006: 121-127). En Cala Figuera, ubicada al SO de Mallorca, el GAS halló una gran concentración de cerámicas, algunas de ellas pertenecientes al tipo Late Roman 2 / Keay LXV de procedencia oriental, hecho que, de confirmarse, lo convertiría en el primer yacimiento subacuático de época bizantina hallado en Mallorca (Pons, 2005: 275). Finalmente, citaremos el *Cala Sant Vicenç IV*, yacimiento del siglo V d.n.e., asociado a restos cerámicos y cerca de veinte *solidi* de la ceca de Mediolanum con la efigie del emperador Honorio (Nieto/Tarongí, 2009: 16).

Recapitulación y reflexión final

Como hemos podido ver a lo largo de la lectura no hay lugar a dudas acerca de que las Baleares, y para el caso que nos ocupa, Mallorca, fueron un hito marítimo de primer orden, tanto desde el punto de vista comercial y económico, como para corregir la derrota de las embarcaciones y la realización de paradas técnicas y acopio de agua potable. En gran cantidad de puntos costeros en los que existieron fuentes de agua dulce se han hallado restos anfóricos, como en Font de ses Aiguades (Gràcia/Clamor, 2002; Gràcia *et alii*, 2001), en Cova des Coll (Gràcia *et alii*, 1997) y en la isla de Dragonera (Guerrero, 1997: 210-213); en el archipiélago de Cabrera contamos con la Cova de sa Llumeta y Cova del Burri (Trias, 1974). Por tanto, pensamos que se debe desterrar la idea de una sociedad indígena impermeable y aislada del mundo exterior hasta la conquista romana, siendo Mallorca un importante punto de importación de productos así como un centro de consumo propio e independiente. Del mismo modo, dada la condición de insularidad, las gentes que habitaron esta isla antes de la conquista romana, debieron estar íntimamente ligadas al mar, por lo que la hipótesis que planteó V. Guerrero (2006b) sobre la posibilidad de que los indígenas baleáricos fueran capaces de construir embarcaciones medianamente complejas, sigue siendo compartida hoy por la mayoría de los investigadores.

Dada su buena comunicación y su situación de encrucijada en las rutas comerciales del Mediterráneo occidental, la isla de Mallorca fue susceptible de importar cualquier tipo de producto que causara aceptación entre sus habitantes. Incluso se dan variaciones entre un área u otra de la isla, siendo muy abundantes algunos tipos cerámicos en unos puntos, e inexistentes o poco frecuentes en otros. Asimismo, hay que tener en cuenta que un viaje comercial de ida comporta forzosamente uno de vuelta, por lo que los navíos que partían de las Baleares debían ir cargados con variedad de mercancías y productos manufacturados en este archipiélago. Incluso, si tenemos en cuenta los interesantes resultados de los análisis realizados por Ll. Vila, en la ciudad de Palma posiblemente existió un centro de exportación en época romana. Actualmente tenemos en fase de preparación un trabajo que aportará más datos sobre esta hipótesis.

Es sabido por todos que las Baleares cuentan con un potencial arqueológico subacuático muy rico, tanto desde un punto de vista cualitativo como cuantitativo. Esperemos, por lo tanto, que los años venideros vean salir del letargo actual a la prometedora arqueología subacuática mallorquina.

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El comercio de los metales en el Mediterráneo occidental en la época romana a través de los hallazgos subacuáticos. Estado actual de la investigación

The trade of metals in the western Mediterranean during the Roman age through the underwater discoveries. Research's actual stage

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Resumen: el artículo propone hacer el balance de los principales avances de la investigación de los últimos 30 años sobre el comercio de los metales en la época romana, concretamente en el periodo comprendido entre los siglos II-I a.C. y el siglo II d.C. Un comercio activo y dinámico, con sus propias especificidades aunque plenamente integrado en el comercio marítimo romano. Se insiste aquí en la diversidad de la documentación proporcionada por la arqueología subacuática y sobre los aportes de la colaboración interdisciplinar (historia, arqueología, epigrafía, arqueometría) para valorar mejor desde el registro económico el comercio romano de los metales.

Palabras clave: metales, comercio marítimo, época tardorrepública, Alto Imperio, Mediterráneo occidental.

Abstract: The paper means to weigh up the investigations on Roman metal trade over the past 30 years, concretely from the II-I c. BC to the II c. AD. It was an active and dynamic trade, with its specifities but also fully integrated in the Roman sea-borne trade. We insist here on the variety

of the documentation afforded by underwater archaeology, and on the contributions by the interdisciplinary collaboration (history, archaeology, epigraphy, archaeometry) for a better evaluation of the Roman metal trade considering the economic register.

Key words: Metals, sea-borne trade, Late Republic, Early Empire, Western Mediterranean sea.

Frente a la línea de costa de La Vila Joiosa, provincia de Alicante, arqueólogos submarinos liderados por Carles de Juan Fuertes (Universitat de València) y Franca Cibecchini (DRASSM Marsella) trabajan cada verano desde el año 2008 sobre los restos bien conservados de un gran mercante romano, denominado *Bou Ferrer* (Juan/Cibecchini/Miralles, 2014). De este, se han extraído actualmente 12 grandes lingotes de plomo sellados, entre un importante cargamento de ánforas gaditanas Dr. 7-11. Al mismo tiempo, más al norte, a escasa distancia de la costa, frente a la localidad de Sète en el golfo de León, otro equipo de buceadores supervisado por Marie-Pierre Jézégou (DRASSM Marsella) explora los fondos marinos en busca de un pecio perdido, del cual se han ya localizado y recuperado 23 imponentes tortas de cobre (Jézégou et alii, 2011). He aquí los dos más recientes ejemplos de operaciones arqueológicas, todavía en marcha, sobre barcos romanos hundidos con un cargamento compuesto entre otros productos por metales. Hallazgos fortuitos y aislados debidos a buceadores deportivos, a pescadores o a labores de dragado, como el que permitió recuperar en 1992 22 lingotes romanos de plomo y de cobre frente a la playa de Regla en Chipiona al norte de Cádiz (Rico/Domergue, 2010), son otros muchos testimonios que, conjuntamente con los pecios bien identificados, constituyen la evidencia más clara de la circulación por vía marítima de los metales en la época romana en vista de su comercialización a mayor o menor distancia. Hoy contamos con no menos de 115 pecios, yacimientos o hallazgos aislados de lingotes de metal, plomo, cobre, hierro y estaño, repartidos frente a las costas medi-



Figura 1. Mapa general del Mediterráneo occidental con indicación de los principales yacimientos subacuáticos con lingotes metálicos y de las principales vías de suministro en metales del comercio.

terráneas de España, Francia, Italia y Sicilia, incluyendo las islas Baleares, Córcega y Cerdeña (en último lugar, ver Domergue/Rico, en prensa-b) (Fig. 1). Si en su gran mayoría ponen de manifiesto el dominio de los productos hispánicos, principalmente plomo y cobre (79 yacimientos), la presencia de metales de otras procedencias, *Germania*, *Britannia*, Cerdeña (plomo), y Galia (hierro) muestra como el Mediterráneo occidental fue el punto de encuentro de los metales producidos en el mundo romano, a excepción del oro y de la plata, metales para los cuales carecemos totalmente de evidencias de un transporte por vía marítima.

Metales bajo el mar. La contribución de la arqueología subacuática al estudio del comercio romano de los metales. Problemas y objetivos

Sin duda hablar de comercio marítimo de los metales no es ninguna novedad. Ya a finales del siglo XIX, al incluir en su obra la epigrafía de las *massae plumbeae* entonces conocidas, los editores del *Corpus Inscriptionum Latinarum* informaban de forma indirecta de la realidad de tal comercio. Algunos años más tarde, R. Besnier hizo el primer estudio pormenorizado de la circulación del plomo en la época romana (Besnier, 1920; 1921a; 1921b) basado exclusivamente en el estudio de los lingotes conservados en museos o descubiertos en excavaciones terrestres, estudio seguido años más tarde por los trabajos de Cl. Domergue sobre los lingotes de plomo conservados por distintos museos españoles, como los de Cartagena y Madrid (Domergue, 1966). Habrá que esperar el desarrollo del submarinismo y a raíz de este el de la arqueología subacuática para experimentar un salto cualitativo en el estudio del comercio del metal en épocas antiguas. Con la puesta a punto de la escafandra autónoma en 1940, el mundo subacuático se abrió a la investigación. A partir de 1952, fecha de la primera excavación arqueológica subacuática, la del yacimiento del Grand-Congloué, los hallazgos, aunque no fueran sistemáticamente seguidos por excavaciones, se han multiplicado proporcionando a los historiadores una información cada vez más importante y precisa y a la vez valiosísima para profundizar en el conocimiento del comercio a larga distancia por vía marítima en las épocas preindustriales, y romana en particular. El metal por supuesto se ha beneficiado de este avance. Destacaremos aquí, a título informativo, las excavaciones realizadas a inicios de 1970 del pecio *Port-Vendres 2*, que proporcionaron un conjunto inédito de lingotes de estaño (Colls *et alii*, 1975; 1977), unos años más tarde el salvamento en el estrecho de Bonifacio del pecio denominado *Sud-Lavezzi 2* que puso fin a su expolio (años 1978-1981) y permitió documentar un mercante de medianas dimensiones procedente de la Bética con un cargamento compuesto de salazones, vino y aceite y varios centenares de lingotes producidos en las minas de la Sierra Morena y del suroeste de Hispania (Liou/Domergue, 1990). También se recordará la espectacular excavación, a inicios de 1990, del pecio *Mal di Ventre C* hundido en los primeros decenios del s. I a.C. frente a las costas occidentales de Cerdeña con su no menos espectacular cargamento de cerca de 1000 lingotes de plomo procedentes de la zona de Cartagena-Mazarrón y que se pudo estudiar en gran parte (Salvi, 1992).

La arqueología subacuática y, de modo general, los hallazgos subacuáticos, se cuentan hoy entre los principales subministradores de información sobre la economía del metal en la época romana. Con los ya señalados 115 yacimientos con lingotes metálicos actualmente identificados, tanto pecios como hallazgos aislados, se dispone de una documentación suficientemente amplia como para poder intentar reconstruir los procesos de comercialización del metal en la época romana, principalmente para los periodos tardorrepblicano (ss. II-I a.C.) y altoimperial (ss. I-II d.C.), así como sus evoluciones. En esta tarea, la cada vez más estrecha colaboración entre arqueólogos submarinistas, arqueólogos e historiadores de la economía antigua, museos y especialistas en arqueometría constituye la mejor, por no decir única, vía para explotar de forma profundizada una documentación muy diversa a fin de responder a las problemáticas que conlleva. Los objetivos, necesariamente interconectados entre sí, se resumen a continuación:

- Identificar y clasificar los productos metálicos comercializados. Hablamos aquí de la materia prima, objeto de una primera transformación en lingotes en los mismos lugares de su producción, las fundiciones, generalmente asociadas a los cotos mineros. Las tipologías de referencia que, evidentemente, se enriquecen permanentemente con nuevos descubrimientos, son imprescindibles a la hora de adscribir a una zona geográfica específica y/o a una fase cronológica determinada tal lingote o grupo de lingotes sacado del mar (Domergue/Rico, 2003; en prensa-b). Entre los avances más destacados desde este punto de vista, señalaremos la primera clasificación de las barras de hierro romanas elaborada gracias a los trabajos realizados sobre los pecios localizados frente a las bocas del Ródano, en Saintes-Maries-de-la-Mer, por L. Long (DRASSM Marsella) a partir de finales de la década de 1990 (Long, 1997; Long/Rico/Domergue, 2002; Coustures *et alii*, 2006). Esta consta hoy con seis tipos que se pueden dividir en varias formas según su longitud, pequeña, mediana y larga.
- Caracterizar los medios de transporte. Entre los numerosos datos aportados por la excavación de un pecio, interesan aquí tanto los que permiten conocer el tipo de barco, sus dimensiones y su carga máxima como, por supuesto, el cargamento en sí mismo, cuya composición informa tanto sobre el origen del mercante, como el del metal, como sobre el volumen ocupado. Sin embargo, las dificultades de recursos, humanos, logísticos y financieros, a las que la investigación subacuática ha de hacer frente hoy constituyen un freno, siendo pocas y en la actualidad cada vez menos numerosas las actuaciones arqueológicas sobre pecios antiguos. Las labores realizadas año tras año sobre el pecio *Bou Ferrer* son una de ellas. Pero, si el tiempo de las grandes excavaciones subacuáticas parece haber terminado, cualquier operación (inspección técnica, prospección, excavación de urgencia sobre un yacimiento amenazado por el expolio...) aporta su lote de información que, aunque incompleta, participa de este indispensable proceso de reconstrucción del proceso comercial antiguo. Las ya mencionadas investigaciones de L. Long frente a la Boca del Ródano son ilustrativas: una serie de prospecciones, completadas por catas arqueológicas, permitieron identificar no menos de doce pecios romanos con sus cargamentos de barras de hierro, lo que supuso un progreso incomparable en el conocimiento del comercio marítimo de este metal en época romana. Los hallazgos casuales son otra fuente importante de información. Debidos a submarinistas deportivos o pescadores, suelen dar lugar a operaciones de evaluación, de carácter más o menos limitado, a fin de identificar el yacimiento, determinar su interés científico y sobre todo valorar el grado de amenaza, lo que puede llevar a decidir una operación de salvamento o de protección. Basta hablar aquí, entre los numerosos ejemplos de hallazgos fortuitos, del de La Albufeireta, frente a Alicante, declarado en 2002, un mercante bético de ánforas olearias Dr. 20 y de lingotes de cobre, objeto de una rápida intervención arqueológica previa a la protección del yacimiento (Fernández/Berni/Aguilera, 2007), o de la actuación en 2006 en Capo Passero en el sur de Sicilia, a raíz del hallazgo por un buceador de varios lingotes de plomo tardorrepublicanos hispánicos pertenecientes a un barco aparentemente muy destruido por el paso del tiempo (Tisseyre *et alii*, 2008).
- Reconstruir los circuitos de difusión de los metales. Cada yacimiento, pecio o hallazgo aislado o descontextualizado, representa una marca o indicación. Examinados conjuntamente y combinándolos con los datos de otras fuentes, literarias en particular, los hallazgos subacuáticos permiten redibujar los itinerarios seguidos por los metales desde su punto de embarque hasta, a veces, su posible punto de destino, e identificar los puertos probables de salida o, en algunos casos, de redistribución. Bien conocido era el papel de los puertos de *Carthago Nova* para la difusión del plomo del sudeste peninsular, de Hispalis y Gades para los metales, plomo y cobre, de la Bética y del sur de Lusitania, y los últimos estudios han confirmado su importancia (Domergue/Rico, en prensa-a). Más novedosa ha sido la valoración del complejo portuario narbonense, en el sur de la Galia, no solamente como punto de salida del hierro producido en su *hinterland* sino también

- como puerto de redistribución de metales, en particular del estaño británico (Rico, 2011: 52-63), esto es, entre otros tantos productos que llegaban hasta él.
- Reconstruir los procesos de difusión y comercialización propios de los productos metálicos. El lingote, destinado a ser transformado, estaba condenado a desaparecer como tal. Solo circunstancias extraordinarias han permitido a unos pocos permanecer intactos en su lugar de destino y llegar hasta nosotros, como los encontrados en Roma en el Tíber, sin duda caídos al agua durante su descarga (*CIL* XV 7916 y 7917; Besnier, 1921b: 111-112, plomo hispánico; *CIL* XV, 7914, plomo de Cerdeña), o los hallados en un taller de Ercolano destruido durante la catástrofe del 79 d.C. (Monteix, 2004). De aquí la importancia de los hallazgos submarinos. Objetos comerciales, los lingotes recibían marcas epigráficas correspondientes a las dos etapas de su corta vida, la producción por un lado y la comercialización por el otro. En la fundición o el taller metalúrgico, eran sellos que identificaban a los productores. Los mejor conocidos son las cartelas, a veces de grandes dimensiones, que ocupan el dorso de los lingotes de plomo. Se documentan también en los lingotes de cobre pero son mucho más pequeños y concisos, limitados a siglas que, si bien identifican al taller, no permiten conocer a los productores por su nombre. Las barras de hierro de los pecios de Camarga llevan, aunque no sistemáticamente, pequeños sellos que nombran a individuos por medio de sus *duo* o *tria nomina*. Ya fuera del coto minero o de las fundiciones, los lingotes eran a menudo identificados por los negociantes que los habían adquirido, mediante contramarcas a su nombre. Frecuentes en los lingotes de plomo hispánicos de época altoimperial (Domergue, 1994a), son más difíciles de distinguir e interpretar en los lingotes de cobre.
 - Valorar el papel de los diferentes distritos productores en el abastecimiento en metales del mundo romano. Es otro reto importante del estudio de los lingotes antiguos, el poder relacionar los metales objeto de un comercio a larga distancia con los lugares donde fueron obtenidos y, de este modo, valorar desde el registro económico el protagonismo respectivo de las diferentes zonas metalíferas y seguir su evolución a lo largo del tiempo. El estudio de los cargamentos de los pecios o la epigrafía suelen a menudo dar ya alguna indicación, caso por ejemplo de los pecios *Sud-Lavezzi 2*, *Sud-Perduto 2* o, más recientemente, *Bou Ferrer*, cuyos cargamentos principales, compuestos por ánforas de salazones, apuntan a la Bética como punto de salida de los barcos; y así fue de los metales. Recordaremos también cómo la onomástica de los lingotes republicanos fue decisiva al relacionar los productores de dichos lingotes a Cartagena-Mazarrón (Domergue, 1990: 321-330; Stefanile, 2013a; 2013b). Pero los datos arqueológicos y epigráficos no siempre son suficientemente elocuentes. Aquí entra en juego la arqueometría, por medio de los análisis físico-químicos e isotópicos. Más que una alternativa a la arqueología y a la epigrafía, ofrece una vía complementaria de gran interés para determinar con mayor grado de precisión la procedencia de los metales. Para el plomo y el cobre, los análisis de isótopos del plomo (LIA, *Lead Isotope Analysis*) han demostrado toda su eficiencia, confirmando el origen de metales para los cuales ya existían argumentos tipológicos, arqueológicos y/o epigráficos para adscribirlos a tal o tal zona geográfica, Cartagena en último lugar (Trincherini *et alii*, 2009), permitiendo a veces apuntar a los cotos mineros más probables¹. Destacaremos aquí los avances realizados estos últimos años sobre los lingotes de cobre hallados frente a las costas francesas del golfo de León, en su mayoría descontextualizados, y cuya procedencia hispánica los LIA han confirmado (Klein *et alii*, 2007; Jézégou *et alii*, 2011: 65-67). Decisivos pueden ser por otro lado los LIA, caso de los realizados sobre los lingotes del pecio de Comacchio. Al identificar los distritos del su-

¹ Son en cambio inoperantes para el estaño y el hierro. Para este último, un método alternativo con base en los elementos traza del metal y, del conjunto de la cadena operatoria del hierro, aporta excelentes resultados en cuanto ya ha permitido identificar varias procedencias para las barras de hierro de Camarga, entre ellas el distrito siderúrgico de la Montagne Noire en el territorio de Narbona; Coustures *et alii*, 2006: 256-259; Baron/Coustures, 2011: 8-12.

deste hispánico (Cartagena, Mazarrón) como procedencia más probable del plomo, permitieron poner fin a la discusión que oponía distintas hipótesis pero ninguna con argumentos a toda prueba (Extremadura; sur de Galia; Cerdeña) (en último lugar Domergue *et alii*, 2012a). Llamativo también es el caso del centenar de lingotes de plomo del pecio *Saintes-Maries-de-la-Mer 1* publicados como hispánicos sobre la base de argumentos epigráficos y arqueológicos (Long/Domergue, 1995). Los análisis realizados sobre un fragmento de lingote con sello del mismo productor encontrado en Alemania cambiaron totalmente las perspectivas al apuntar a los yacimientos de plomo del Sauerland o del Eiffel como zona de fabricación del lingote (Rothenhöfer, 2003) considerando además el protagonismo del plomo germánico en los circuitos comerciales en tiempos de Augusto (Baron/Coustures, 2011: 86-89; Rapsaet-Charlier, 2011).

La reconstrucción de los procesos comerciales del metal en la época romana se ha beneficiado tanto del desarrollo de la arqueología subacuática y, de modo general, de la multiplicación de los hallazgos, como de la asociación cada vez más estrecha entre distintas disciplinas, por lo cual parece hoy impensable trabajar cada uno por su lado. Esta «interdisciplinarización» de la investigación, en torno a la arqueología subacuática, parece hoy ser la mejor garantía para alcanzar la mayor precisión en el conocimiento del comercio de los metales romanos. Los avances de estos últimos años, que se presentan a continuación de forma sintética, son buena ilustración de ello en tanto en cuanto avalan las orientaciones en que se trabaja, en particular desde el laboratorio TRACES, hace no menos de 20 años².

El Mediterráneo occidental, cruce del comercio marítimo de los metales del mundo romano

Bien conocido desde antiguo es el gran protagonismo de los metales hispánicos dentro del comercio romano, y en primer lugar el del plomo, tanto el de Cartagena identificado gracias a la epigrafía de los lingotes como el de Sierra Morena identificado gracias a la composición de los cargamentos de los cuales formaban parte o a la situación geográfica de los hallazgos, a lo largo de rutas marítimas bien determinadas; así, por poner solo algunos ejemplos entre otros muchos, destacan *Sud-Lavezzi 2*, *Sud-Perduto 2*, *La Albufereta* o *Cabrera 6*. La arqueometría, y los LIA en particular, han ido estos últimos años confirmando la adscripción de la mayoría de los lingotes metálicos mediterráneos a los grandes distritos del sur peninsular a la vez que han permitido orientar la búsqueda de su procedencia hasta determinados cotos mineros (Domergue *et alii*, 2012b). Resalta el papel jugado en los albores de la época altoimperial por las minas de Sierra Morena oriental y más concretamente del distrito Linares-La Carolina ya identificado como uno de los principales cotos hispánicos para la obtención de plomo y plata a inicios de la época imperial (Domergue, 1990). El declive de las minas de Cartagena, a partir del cambio de era, coincidió al mismo tiempo que favoreció el auge del plomo bético, cuyo periodo de máxima expansión corresponde al s. I d.C. Es también el caso del cobre de cuya difusión por vía marítima tenemos numerosas evidencias pero en su mayoría descontextualizadas, siendo pocos los

² Proyecto «El comercio de los metales en la época romana», dirigido por los firmantes del artículo y que asocia tanto fuerzas propias del laboratorio TRACES (M.-P. Coustures, S. Baron, arqueometría) como investigadores exteriores a él, arqueólogos submarinos en primer lugar (L. Long, M.-P. Jézégou, F. Cibecchini del DRASSM, M. Rauzier o C. de Juan Fuertes, Valencia) y especialistas en arqueometría y sus respectivos laboratorios, Departamento de Física del Politécnico de Turín (P. Quarati, A. Nesta, P. R. Trinchieri), Instituto de Mineralogía de la Universidad de Frankfurt (S. Klein). http://traces.univ-tlse2.fr/accueil-traces/equipes-et-poles-de-recherche/metal-histoire-et-archeologie-du-metal/theme-3-economie-diffusion-et-commerce-des-metaux-338321.kjsp?RH=histoire_traces. Señalaremos también los trabajos realizados por el equipo liderado por A. Hauptmann sobre el plomo romano desde el Bergbau-Museum de Bochum (Alemania) y que da un papel central a las analíticas, y los LIA entre otros : <http://www.bergbaumuseum.de/index.php/en/research/projects/lead-silver-antiquity/corpus-massarum>.

pecios con un cargamento de tortas de cobre nuevamente identificados y/o excavados desde las labores realizadas en *Sud-Lavezzi 2* en 1980. La campaña sistemática de análisis llevada a cabo sobre las piezas conservadas en distintos museos del sur de Francia ha designado de forma clara y segura las minas peninsulares como lugar de procedencia del metal. Si lógicamente los estudios han valorado el papel de las grandes minas imperiales de la faja pirica del Suroeste (Klein *et alii*, 2007: 214-216), también subrayan el de las de la Sierra Morena central y oriental, apuntando esta zona como origen más probable de los lingotes de cobre de Chipiona en la desembocadura del Guadalquivir (Nesta *et alii*, 2011: 200-204) o de Maguelone frente a las costas del Languedoc (Rico *et alii*, 2005-2006: 466-468). Se puede hablar de un dominio casi completo de las minas hispánicas sobre el comercio marítimo occidental del cobre en época altoimperial, explicándose este por la ausencia de grandes distritos cupríferos en las otras provincias occidentales capaces de rivalizar con los hispánicos.

Más competitivo fue, o mejor dicho, se volvió el comercio del plomo. Si Hispania lo controló ya desde la época tardorrepública gracias a sus minas del sudeste en torno a los distritos de Cartagena y Mazarrón y un poco más tarde las de Sierra Morena, la llegada en el cambio de era del plomo germánico seguida algunas décadas más tarde por la del plomo británico, es testimonio de la diversificación de los abastecimientos. Sin embargo resulta todavía difícil valorar desde el punto de vista económico la presencia de plomo procedente de las regiones septentrionales del Imperio en el ámbito mediterráneo. Escasos son los pecios, entre los cuales destacan *Saintes-Maries-de-la-Mer 1* ya mencionado, y *Rena Maiore* (norte de Cerdeña) publicado como hispánico (Riccardi/Genovesi, 2002) aunque obviamente los lingotes, por su tipología y su epigrafía, son germánicos. Escasos también los hallazgos de lingotes británicos, bien identificables por su tipología y su epigrafía. El plomo hispánico siguió dominando el comercio del metal durante gran parte del s. I d.C. Solamente los productos béticos de Sierra Morena oriental sustituyeron a los de Cartagena-Mazarrón, que perdió a principios de la época altoimperial su protagonismo; los lingotes de Comacchio y el conjunto de 98 lingotes anepigráficos procedentes del yacimiento hoy destruido de Baie de l'Amitié frente a la localidad de Sète, atribuidos a las minas del sudeste hispánico por los isótopos de plomo, son los más recientes testimonios, de época altoimperial, de la difusión de productos salidos de las fundiciones cartageneras y ciertamente los últimos.

El estaño y el hierro fueron otros metales que viajaron por el mar pero las pocas evidencias arqueológicas impidieron durante años hacer una valoración exacta de su papel dentro del comercio romano de metales. El primero es sobre todo conocido por los lingotes de tipología específica de *Port-Vendres 2*, en el Sur de Francia. Una reciente revisión de este conjunto y de otros lingotes de estaño atestiguados hoy defiende un origen británico para las piezas de *Port-Vendres 2* (Rico, 2011: 58-63). En cuanto al hierro, la realidad de un comercio en parte marítimo a gran escala fue la gran novedad de la investigación de estos 20 últimos años desde los hallazgos realizados frente a la desembocadura del Ródano. Doce pecios con cargamentos de barras de hierro de cierta diversidad, algunos importantes, hasta 100 toneladas, son hoy conocidos. Testimonian un comercio de hierro, tal vez con destino a las provincias septentrionales del Imperio, procedente al menos en parte del puerto de Narbona (Long/Rico/Domergue, 2002: 183). La adscripción de los pecios al periodo que va de mediados del s. I a.C. a mediados del s. I d.C. podría testimoniar un fenómeno coyuntural en relación con la actividad militar romana en el Rin durante el periodo augusto y julio-claudio.

Plomo y cobre hispánicos, plomo germánico, británico, estaño británico y sin duda también hispánico, hierro galo... El mar Mediterráneo se puede presentar como una vasta plataforma que redistribuía los metales de distintas procedencias a todos los mercados de la parte occidental del Imperio. Poquísimas muestras de metales hispánicos u otros en efecto tenemos para Oriente. Sin duda hay que atribuirles en parte al retraso de la arqueología.

logía subacuática en aguas del Mediterráneo oriental, cuando no al control de las minas locales (Balcanes, Chipre, Egeo y otros) sobre el mercado oriental. Otro reto para las investigaciones futuras.

La organización del comercio romano de los metales. Barcos, rutas, puertos y mercados

Según el dicho, todas las rutas conducen a Roma. Sin duda el dicho se verifica perfectamente para el comercio de los metales. Más que los hallazgos terrestres, escasos como se ha visto, las rutas que dibujan los distintos lugares donde aparecieron lingotes de metal apuntan hacia un comercio en parte dirigido a Roma, y a Italia de forma general, en parte también dirigido a la Europa continental (Domergue/Rico, en prensa-a) (Fig. 2). De la península ibérica (Domergue/Rico, en prensa-b) partían dos grandes rutas, una más bien costera, la otra de alta mar. El recorrido de la primera, pasando por Denia, era la vía normal hacia los puertos galos, Narbona y Fos-Arles, y fue, en la época altoimperial, el eje habitual por el que el cobre hispánico se dirigía hacia los mercados galos. La segunda, apoyándose en el archipiélago balear, conducía en vía directa hacia los puertos itálicos de Puteoli y Ostia por el célebre estrecho de Bonifacio. Rutas alternativas existían, como la seguida por el mercante *Mal di Ventre C* hundido con su imponente cargamento de plomo de *Carthago Nova* cerca del islote del mismo nombre. Los datos son insuficientes para determinar en qué medida esta ruta pudiera ser utilizada con regularidad si bien otros hallazgos (*Mal di Ventre A* –s. I a.C.– y *B* –s. I d.C.–) atestiguan su uso. Tampoco se puede descartar que el navío tuviese otro destino que el puerto campano de Puteoli y no pretendiera alcanzar directamente algún puerto siciliano.



Figura 2. Las grandes rutas del comercio romano de los metales. En verde: itinerarios marítimos y terrestres de redistribución.

La documentación permite reconstruir una red algo tupida por la que transitaban los metales producidos en diferentes ámbitos de Europa occidental, apoyada en algunos puertos principales, cabeceras de las diferentes rutas identificadas, como lo fueron para Hispania, Cartagena en la época tardorepublicana, Hispalis y Gades ya en el Alto Imperio, o Narbona para el hierro galo. Los avances de la investigación ponen aquí de manifiesto los procesos redistributivos, a partir de puertos no siempre de carácter secundario. Los puertos galos, como Narbona y Fos, tal vez también Marsella, a los que llegaban los metales de Europa del norte, los redirigían hacia los mercados mediterráneos, a parte de ellos. Así lo indican los ya mencionados pecios *Saintes-Maries-de-la-Mer 1*, hundido con su centenar de lingotes de plomo al salir del Ródano, y *Rena Maiore*, cuyo viaje hacia algún puerto itálico, si no hacia la mismísima Roma, fue interrumpido antes de emprender la travesía delicada del estrecho de Bonifacio. Esta función de redistribución también la pudieron tener los mismos puertos itálicos, y el primero de ellos Puteoli, principal destino en la época tardorrepública y durante el primer siglo del Imperio del comercio marítimo occidental. Los argumentos existen para situarlo como cabecera de un probable comercio de redistribución de los metales, hispánicos en particular, hacia los puertos y mercados del norte del mar Adriático, cuando no, en todo caso a finales de la República, hacia Grecia y el mercado oriental (Domergue/Rico, en prensa-b).

Sobre los barcos y sus cargamentos metálicos, los datos son por desgracia muy parciales: pocas son las excavaciones de pecios, pocos cargamentos metálicos han sido recuperados completos, y si no fuera bastante, numerosos yacimientos sufrieron expolios a mayor o menor escala. Difícilmente pues se puede extrapolar a partir de una documentación dispersa e incompleta, si bien no es del todo prematuro sacar algunas conclusiones que excavaciones futuras habrán de precisar o infirmar. La primera de ellas es la total inserción del comercio de los metales en los circuitos habituales del comercio marítimo. Tal es el caso en la época altoimperial para los metales procedentes de las minas de la Hispania meridional así como, lógicamente, los que fueron objeto de una redistribución ulterior. La comercialización de los metales béticos no dependía de un circuito específico. Por el momento, no se conocen pecios únicamente cargados con plomo y cobre hispánicos. Sendos metales eran embarcados conjuntamente con otras mercancías de la provincia, ánforas de vino, aceite y salazones. Otro elemento que resalta de la documentación es el volumen aparentemente reducido de los metales dentro de estos cargamentos diversificados: 48 lingotes de plomo en *Sud-Perduto 2* hundido en la zona del estrecho de Bonifacio con un cargamento principal de ánforas vinarias y de salazones (Bernard/Domergue, 1991), un número casi igual en *Cabrera 6* (Parker, 1992: n.º 1017). En cambio fueron unos cien lingotes de plomo y hasta unas 300 tortas de cobre, totalizando un peso aproximativo de 11 toneladas, que formaban el cargamento metálico de *Sud-Lavezzi 2* a casi igualdad de peso con las 300 ánforas que el navío también había cargado (Liou/ Domergue, 1990: 121). Del gran mercante *Bou Ferrer*, en proceso de excavación, sabemos que su cargamento estaba compuesto principalmente por ánforas de salazones. Difícil es imaginar el número total de lingotes de plomo –12 han sido recuperados en la actualidad–, pero su acondicionamiento en el barco en al menos dos hiladas paralelas dispuestas directamente sobre el casco, como en *Sud-Lavezzi 2*, no deja *a priori* prever un importante lote de lingotes frente a las posibles 2000 a 3000 ánforas que el barco podría haber contenido. De hecho, las dimensiones importantes de un barco no permiten intuir la carga de lingotes metálicos³.

Con sus 1000 lingotes de plomo de las minas de Cartagena, o sea más de 45 toneladas, *Mal di Ventre C* podría ser figura de excepción. Sin embargo se inscribe el pecio en un periodo diferente, la época tardorrepública, en el que, salvo sus metales, la economía hispánica poco

³ Respecto a *Bou Ferrer*, tampoco hay que descartar que transportara lingotes de cobre, almacenados a proa y a popa, como se ha observado en *Sud-Lavezzi 2*.

tenía que ofrecer a la exportación, si bien no hay que descartar que el mercante transportara otras mercancías (productos alimentarios del campo de Cartagena o esparto, por ejemplo) que no han dejado rastro alguno. Fuese cual fuera efectivamente su cargamento, hay que suponer que el barco de *Mal di Ventre* era uno de estos numerosos mercantes que atracaban en el puerto de *Carthago Nova* con las bodegas repletas de productos itálicos, ánforas vinarias entre otros, y el plomo disponible en grandes cantidades permitía al barco emprender su viaje de vuelta con toda seguridad, jugando aquí el plomo a la vez el papel de lastre estabilizador y el de cargamento comercial. O sea, se puede pensar que las expediciones de metales se adaptaron a las condiciones locales: cuando en Cartagena existía la posibilidad de fletar barcos enteros para el solo transporte del metal, décadas más tarde la diversificación de las exportaciones desde la Bética llevó a compartir los mercantes. Se puede pensar que aunque en tamaño fueran menos importantes que a finales de la República, las exportaciones de metales fueron al contrario más numerosas aunque sin duda de cierta diversidad.

La organización del comercio romano de los metales. Transportistas y negociantes. Los actores

La exportación a larga distancia por vía marítima de los metales estaba en manos de negociantes que solo conocemos por medio de la epigrafía que suelen llevar los lingotes objeto del comercio. Forman sin embargo un mundo que no se deja fácilmente penetrar. Difíciles de distinguir en los lingotes de cobre y de estaño, los comerciantes están ausentes en los de hierro; discretos, cuando no ausentes, del plomo germánico y británico, al igual que en el plomo de Cartagena-Mazarrón. La excepción está en los lingotes de plomo de Sierra Morena del s. I d.C. cuyos sellos impresos en los flancos permiten identificar a estos negociantes: hombres libres, ciudadanos o libertos, trabajando por su cuenta, ajenos al propio mundo de la minería, a los que ni la onomástica ni la prosopografía permiten relacionar con familias locales conocidas. Un grupo independiente dentro del mundo de los negociantes romanos, con su propia organización tal y como lo indica el examen de las distintas marcas que aparecen a veces asociadas en los mismos lingotes (*Sud-Perduto 2*, *Cabrera 4*, *Chipiona* p. ej.), permitiéndose reconstruir el proceso de adquisición de los lingotes y de su posterior expedición por vía marítima por parte de individuos distintos (Domergue, 1998: 203-209). A pesar de la escasa documentación existente, esta rápida presentación bien podría aplicarse a los comerciantes que intervinieron en la comercialización de otros metales, tanto hispánicos como de otras procedencias. Así por ejemplo los lingotes de estaño de *Port-Vendres 2*. La profusión de sellos impresos en la cara inferior de los lingotes impide identificar con certeza el papel exacto de los distintos personajes nombrados en ellos y, de este modo, reconstruir el proceso por el que las piezas llegaron hasta el barco con el que se perdieron. Entre ellos, si no hay que descartar algún productor, la mayoría de los sellos parece sin embargo relacionarse con la distribución, designando a comerciantes y otros intermediarios implicados en el largo viaje que los lingotes emprendieron desde su lugar de fabricación, tal vez Britannia, hasta el punto donde fueron embarcados. Desde el punto de vista de la onomástica, los personajes no se presentan de forma distinta a los que aparecen en los lingotes de plomo bético. Las cosas no son diferentes para el cobre, siempre y cuando se pueda distinguir a los comerciantes entre las numerosas marcas epigráficas que a veces suele llevar impresas o grabadas el metal.

* *Negotiatores metallorum* o **neg. plumbi* o *aeris*, tales son los nombres, no atestiguados en la epigrafía lapidaria, que pudieron darse todos estos comerciantes: negociantes especializados en metales y, más seguramente, en uno u otro de los metales. Hoy no se tiene en efecto constancia de que estos comerciantes negociaran indiferentemente metales de cualquier tipo. El reparto de competencias aparece con claridad para los productos metálicos béticos. Los comerciantes de plomo por un lado y los de cobre por el otro son gentes diferentes, hasta cuando los

dos metales se encuentran asociados en los mismos barcos, como en *Chipiona* o *Sud-Lavezzi 2*. Unos y otros fletan en común un barco para el transporte de sus mercancías respectivas. Sin embargo, no se puede excluir del todo la intervención de mayoristas que, en un último momento, fueran propietarios del cargamento metálico en su totalidad (Rico, 2011: 50-51). Tal podría ser el caso, no solo del cargamento de plomo y cobre, sino de la totalidad de las mercancías de *Sud-Lavezzi 2*, de cuyo transportista conocemos el nombre por las inscripciones de las anclas de plomo halladas en la excavación, Appio Junio Zetho (Liou/Domergue, 1990: 47-50 y 92-94). Al marcar con un sello su nombre el centenar de lingotes de plomo que el barco transportaba, significaba ser propietario de los lingotes. Si bien no lo encontramos en los demás lingotes de cobre y en las ánforas del cargamento, no sería imposible que estos no fueran igualmente suyos. Ante todo un transportista (*naucularius*), Appio Junio se presentaría en este caso también como un negociante. Y tal vez solo lo fue de forma ocasional. Este ejemplo revela la complejidad de la organización del mercado de los metales romanos. Si bien la epigrafía de los lingotes facilita datos que permiten identificar a unos individuos implicados en el proceso de comercialización, posiblemente deja en el anonimato otros actores, del tipo mayoristas que intervendrían en un momento ulterior del proceso⁴.

En el caso del comercio del plomo de Cartagena-Mazarrón a finales de la época republicana, son escasas las contramarcas atestiguadas en los lingotes por lo que son varias las posibilidades de reconstrucción del proceso de exportación del plomo hacia Italia en particular. La primera consiste en dejar el protagonismo a los mismos productores de metal identificados por los sellos realizados en los lingotes durante su fabricación. Como es bien sabido, la producción estaba en manos de empresarios con base en Italia. No les era difícil fletar estos mismos barcos llegados, como ya hemos visto, a Cartagena con productos itálicos y ordenar su posterior envío a Italia donde disponían de relaciones que aseguraban el relevo una vez los barcos llegaran a buen puerto. La segunda es la intervención, independientemente de los productores, de *mercatores*, estos mercaderes, también de origen itálico, son bien conocidos por los textos en las provincias durante los siglos II y I a.C. (p. ej. Andreau, 2000), pero han dejado poco rastro en la epigrafía de los lingotes. Un tal *Val(erius) Sam(...)* atestiguado por un sello impreso en uno de los lados pequeños de un lingote estampillado al nombre del productor Cnaeo Atellio Miserino (Stefanile, 2009: 560-561) bien podría ser uno de ellos. Una tercera opción consistiría en dejar a los transportistas la iniciativa de embarcar plomo en sus bodegas a fin de garantizar la seguridad del barco durante su viaje de retorno. No por eso el cargamento deja de tener un valor comercial del cual se beneficia el mismo transportista. De hecho, ninguna de las propuestas es excluyente de las otras.

Llaman la atención para terminar los sellos imperiales, titulaturas de emperadores como IMP CAES en *Saintes-Maries-de-la-Mer 1*, IMP GERM // AVG (¿Nerón?) en *Bou Ferrer*, IMP CAES // VESP AVG (Vespasiano) en *Cabrera 6* y NER AVG en Pompeya (*CIL* X, 8339). Al igual que otras contramarcas mencionando a particulares, estas señalan al emperador o, globalmente, al Estado, como último propietario de los lingotes. Probablemente los sellos identifican el metal adquirido por cuenta del Estado más que al Estado como un actor más del comercio (Domergue, 1994b: 105-107). Cuando personajes públicos son nombrados, como Agripa en los lingotes de Comacchio o el liberto imperial Lucio Valerio, secretario *a commentariis* de Claudio, en los lingotes de estaño de *Port-Vendres 2*, se puede discutir sobre su verdadero papel. Según la reconstrucción propuesta del proceso de comercialización de los lingotes de Comacchio (Domer-

⁴ También se nos escapa todo el proceso de puesta en el mercado del metal, una vez este ha llegado a buen puerto, una etapa sobre la que, obviamente, los lingotes encontrados bajo el mar nada pueden aclararnos. De aquí el interés de estos lingotes hallados en las excavaciones terrestres, como los del taller de Ercolano que llevan sellos que identifican con gran probabilidad a otros intermediarios, esto es, distintos de los mercaderes activos en las zonas mineras y en los puertos de salida de los metales; ver Monteix, 2004: 370-371.

gue *et alii*, 2012: 100-102), Agripa parece haber actuado por su propia cuenta. El segundo en cambio claramente aparece más como un agente de la administración provincial de la que dependían las minas de donde provenía el metal (*¿Britannia?*) que como un intermediario en el proceso comercial (Colls *et alii*, 1975: 78-79). De modo general, el Estado no intervenía directamente en el comercio, es bien sabido. Nada sin embargo le impedía, en un segundo momento, poner en el mercado libre metales de los que se había adueñado anteriormente (Domergue, 1994b: 106-107).

El Mediterráneo occidental fue el escenario durante el Imperio romano de un vasto tráfico de metales de distintas procedencias y que se revela en toda su complejidad a medida que los hallazgos de la arqueología subacuática van multiplicándose. Así hemos intentado mostrarlo en las páginas anteriores, en un balance necesariamente provisional de los avances hasta hoy realizados, subrayando los aportes de una investigación que se ha ido diversificando, utilizando todos los recursos ofrecidos por la arqueología, la historia y la arqueometría. Por imperfecto que pueda ser este panorama dibujado a grandes rasgos de la organización del comercio marítimo de los metales, destacan aquí algunas ideas que parecen caracterizar bien este comercio desde el registro económico: el gran protagonismo de los metales hispánicos en época tardorrepública y el Alto Imperio, y que no parece haber sido realmente amenazado por la diversificación de las fuentes de suministro de los mercados occidentales (plomo germánico y británico); un comercio plenamente integrado en el gran comercio marítimo, en cuanto comparte las mismas rutas, los mismos barcos, los mismos circuitos; un mercado de metales libre, a manos de comerciantes especializados. No faltan sin embargo las cuestiones aún pendientes que, en su estado actual, la documentación no permite resolver. Cabe decir que mucho se espera de los hallazgos futuros, sean cuales sean, que a su medida son piezas de un complejo puzzle que se irá poco a poco completando.

Yacimiento	Fecha	Lingotes	Otras mercancías
España			
Chipiona	10/25 d.C.	4 Pb (SMO) - 18 Cu (SMO)	
La Caleta (Cádiz)	s. II-I a.C. (?)	Varios	
Pecio del Cobre	50 d.C.	18 Pb - 28 Cu (SM)	
Nido del Cuervo (Aguilas)	80/50 a.C..	15 recuperados Pb (C)	Dr. 1C-Dr.28
Escombreras 00	s. I a.C.	20 Pb (C)	
Cartagena (puerto)	s. I a.C. - s. I d.C.	Pb 50 ? (C)	
<i>Escombreras</i>	s. I a.C. - s. I d.C.	1 Pb	
Bajo de Dentro (cabo de Palos)	s. I a.C.	42 ou 44 Pb (C)	
Bou Ferrer	50 d.C.	12 estudiados Pb (SM)	a. salazones béticas
<i>Denia (Dianum) (puerto)</i>	s. I a.C.	1 Pb (C)	
<i>Río Girona (Denia)</i>	s. I a.C.	1 ou 2 Pb (C)	

Yacimiento	Fecha	Lingotes	Otras mercancías
<i>Grau Vell de Sagunto</i>	s. I d.C.	1 Pb (SM)	
Sierra de Garraf (Playa norte de)	s. I a.C.	2 (C)	
La Albufereta	50 d.C.	11 Cu	Dr.20
Cap Prim (Xabía)		Num. indet. Cu	Dr.20
Ben-Afelí (Castellón)	85-95 d.C.	+ 19 Fe	a. hisp. Dr. 2-4, morteros campanos
Les Sorres A	150-75 a.C. ?	Varios Fe	a. itál. Dr. 1A
Baleares			
Cabrera 5	10 a.C. - 25 d.C.	45 estudiados Pb (SMO)	a. salazones béticas
Cabrera 4	1-15 d.C.	26 estudiados Pb (SMO)	a. salazones béticas
Cabrera 6	70-80 d.C.	20 estudiados sobre 50 Pb (SMO)	
<i>Baía de Ses Figueretes (Ibiza)</i>	s. I a.C.	1 Pb (C)	
Cap d'en Font 1 (Menorca)	Fin s. I a.C.	1 Pb (SMO)	a. Bética
Cap d'en Font 2 (Menorca)	2a m. s. I d.C.	2 Pb (SMO)	
Illa del Aire (Menorca)	s. I d.C.	4 Pb	Dr. 7/11, Haltern 70
Punta Nati	s. I-II d.C.	+ 50 Cu	
Na Redona	s. I d.C. (?)	400 ? Sn	Lingotes Cu ?; a. salazones
Francia			
Port-Vendres 2	42-50 d.C.	4 Pb – 3 Cu – 26 Sn	a. Bética
Agde-Marseillan	s. I a.C.	6 (C)	
Riches Dunes 1/2	50 d.C.	7 estudiados sobre 15 Pb – 8 Cu (SM)	
Baie de la Roquille	s. I a.C.	2 Pb (C)	
Baie de l'Amitié	s. I d.C.	98 Pb (C)	Dr. 20
Colonie des Mouettes		2 Pb y más – 29 Cu (SH)	
Palavas	s. I a.C.	2 Pb (C)	
Stes-Maries-de-la Mer 1	s. I d.C.	99 Pb (G)	
Saint-Gervais 1	Adriano-Antonino (138-139)	4 Pb (B)	

Yacimiento	Fecha	Lingotes	Otras mercancías
Petit-Rhône		6 Pb (B)	
<i>Marsella (puerto antiguo)</i>	s. I d.C.	2 Pb (SM)	
<i>Plateau des Chèvres (Marsella)</i>		1 Pb	
<i>Pointe de Bonnieu (Martigues)</i>	s. I a.C.	1 Pb (C)	
<i>Fos/Mer</i>		1 Pb (G)	
<i>Fos/Mer</i>	Tiberio	Pb (G)	
Marseillan (au large de)	s. II d.C.	2 Cu (SM/PSO)	
Môle Richelieu (Agde)		3 Cu (SH)	
Epave du Rieu		4 o 5 Cu	Dr. 20
Corniche 6		11 Cu (PSO)	Dr. 20, Dr. 7/11 (1 ej.)
Aresquiers 5		5 Cu (SH)	
Maguelone 1	Fin s. I a.C. – 1a m. s. I d.C.	14 Cu (SMO)	
Petit-Travers		12 Cu	
<i>Stes-Maries-de-la-Mer 7</i>		2 Cu	
Mateille A	Inicios s. V d.C.	+ 6 Fe	a. africanas
<i>Palavas-les-Flots</i>		1 Fe	
<i>Palavas-les-Flots</i>		1 Fe	
Saintes-Maries 2	1er cuarto s. I d.C.	20 à 100 t Fe	a. Dr. 2-4 Tarraconense
Saintes-Maries 3	1a mitad s. I d.C.	Fe (sin evaluar)	
Saintes-Maries 6	2a mitad s. I a.C.	Fe (sin evaluar)	
Saintes-Maries 8	1a mitad s. I d.C.	Fe + 500	
Saintes-Maries 9	mediados s. I d.C.	100 à 150 t Fe	
Saintes-Maries 10	1a mitad s. I d.C.	5-10 t Fe	
Saintes-Maries 11		Fe (sin evaluar)	
Saintes-Maries 23	s. I a.C. – s. I d.C.	Fe (sin evaluar)	
Saintes-Maries 24	mediados s. I d.C.	Concreción 5 t Fe	
Saintes-Maries 25	s. I d.C.	+ 500 Fe	
Saintes-Maries 27	s. I a.C. – s. I d.C.	Fe (sin evaluar)	

Yacimiento	Fecha	Lingotes	Otras mercancías
Plage d'Arles 4	1a m. s. I d.C.	Num. indet. Cu	a. Bética
Planier 2	ca. 150	Cu 50, 3 estudiados (SH)	
Bagaud 2	1a m. s. I a.C.	45 (recup.) Sn	Barras de hierro
Cap des Mèdes	s. I a.C. ?	2 Sn	Barras de hierro
Dramont C		+ 50 ?	a. Dr. 1B
Cap Gros – Antibes		Desconocido	
Córcega			
Ile-Rousse	Calígula	1 Pb (G)	
Danger d'Algajola	s. I a.C.	41 Pb (C)	Dr. 1 (fgtos)
Sanguinaires B	s. I d.C. (?)	7 Pb (SM)	
Campomoro	s. I a.C.	5 Pb (C)	
Moines (îlots des)	s. I a.C.	3 Pb (C)	
Sud-Perduto 2	1-15 d.C.	48 Pb (SMO)	a. Bética
Lavezzi 1	30 d.C.	5 recup. Pb (SMO) - 20 recup. Cu (PSO)	a. Bética
Sud-Lavezzi 2	10-30 d.C.	100 Pb (SMO) - 300 Cu (PSO)	a. Bética
Gavetti (écueils des)	s. I a.C.	9 Pb (C)	
Moines 1 (îlots des)	s. I a.C.	1 Pb (C)	
La Grande Sanguinaire	s. I a.C.	1 Pb (C)	
Ventilegne (golfo)	s. I a.C.	1 Pb (C)	
Islas Lavezzi	s. I a.C.	1 Pb (C)	
Cap Sperone	ss I-II d.C.	2 Cu (PSO)	
San Baïnzo	ss I-II d.C.	1 Cu (PSO)	
Plage de Lozari	s. I d.C. (?)	5 Sn	a. Bética (Dr. 20)
Ouest-Giraglia	s. I d.C.	1 Fe	
Bonifacio		1 Fe	
Cerdeña			
Mal di Ventre A	Inicios s. I a.C.	1 recup. Pb (C)	
Mal di Ventre B	s. I d.C.	1 Pb (SM)	

Yacimiento	Fecha	Lingotes	Otras mercancías
Mal di Ventre C	s. I a.C.	983 recup. sobre 1000 Pb (C)	
<i>Cala Cartoe</i>	s. I a.C.	1 Pb (C)	
<i>Villasimius</i>	s. I a.C.	1 Pb (C)	
Punta Falcone	100-25 a.C.	16 Pb (C)	
Scoglio Businco	Mediados s. I a.C.	7 Pb	
Pistis (Arbus)	Adriano	40, 8 recup. Pb (Ce)	
Piscinas	s. I a.C. ?	4 Pb	
Capo Testa B	75-25 a.C.	4 Pb (C)	Barras de hierro
Rena Maiore	Augusto	62 Pb (G)	
Capo Bellavista	s. I d.C. (?)	32 Sn (6 conservados)	Barras de hierro
<i>Porto Ferro</i> (Nurra)		1 Sn	
Italia			
Punta del Arco (Ventotene)	s. I a.C.	14 (8 conservados) Pb (C)	Dr.1B
<i>Ischia</i>	s. I a.C.	2 Pb (C, SM)	
<i>Ischia</i>		2 Sn	
<i>Santa Severa (Pyrgi). Puerto romano</i>	Fin ss II-I a.C.	1Pb	
Comacchio	Fin s. I a.C.	102 Pb (C)	Diversos
<i>Fiume Stella (Aquileia)</i>	s. I a.C.	1 Pb (C)	
Cala Rossano	s. I d.C.	15 Sn	a. salazones béticas
<i>Gravisca</i>	s. I d.C.	5 Fe	a. salazones
Sicilia			
Capo Passero B	s. I a.C.	13 recup. Pb (C)	
Rasocolmo D	s. I a.C.	1 recup. Pb (C)	
Terrasini A	25-50 d.C.	4 publicados Cu	a. Bética
<i>Plemmirio B</i>	200	Fe 1 t	a. africanas
Africa			
Cherchel (port)	s. I a.C.	1 recup. Pb (C)	
Cap Spartel	100 a.C. – 50 d.C.	40 Pb	

Tabla 1. Yacimientos (pecios, restos de pecios y hallazgos descontextualizados) con lingotes metálicos del Mediterráneo occidental. La tabla comprende 115 yacimientos. Metales: Pb (plomo); Cu (cobre); Sn (estaño); Fe (hierro). Origen: C (Cartagena); SM (Sierra Morena); SMO (Sierra Morena oriental); PSO (minas piríticas del suroeste); SH (Sur Hispania); G (Germania); B (*Britannia*); Ce (Cerdeña). *Cursiva*: hallazgos aislados (fuera pecios).

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El comercio de cereal en el occidente del Imperio romano. Nuevas perspectivas desde la arqueología subacuática

The cereal trade in the Western of Roman Empire. New perspectives from Underwater Archaeology

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Resumen: en este trabajo analizamos las novedades arqueológicas relativas al comercio de cereal en el occidente del Imperio romano, centrando nuestra atención en la información que nos aportan los últimos estudios enmarcados en la denominada arqueología subacuática. Nos proponemos analizar las técnicas constructivas de las embarcaciones, así como el sistema y tipo de carga, a partir del estudio de los pecios romanos descubiertos. Estos datos nos permiten reflexionar sobre las limitaciones del comercio marítimo de cereal y sobre aspectos concretos como su almacenaje en el interior de los grandes navíos cargueros, así como las operaciones de trasbordo y descarga en los puertos y fondeaderos marítimos. Esta información se complementa con los datos obtenidos a partir de las muestras de restos vegetales y la información que nos ofrecen las fuentes literarias clásicas.

Palabras clave: economía romana, comercio marítimo, transporte, cereal, barcos.

Abstract: This paper aims at exploring recent archaeological studies carried out during the last years on grain sea trade in the Western Roman Empire. Our work focuses on the recent advances in underwater archaeology, as we analyze the construction techniques, loading system and cargo types of the discovered Roman shipwrecks. These data allow us to reflect on the limitations of maritime grain trade and on specific aspects such as storage inside the large cargo ships and trans-shipping operations associated with large cargo vessels used in Roman times. This information is backed up by data from samples of plant remains and classical literary sources.

Key words: Roman economy, maritime trade, transport, cereal, ships.

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Introducción

El comercio de cereales por vía marítima constituyó un procedimiento mucho más rápido, efectivo y menos costoso que el terrestre, de modo que los grandes navíos mercantes llegaron a ser el medio más utilizado para la exportación de alimentos y de otros productos a gran escala, con destino tanto en la población civil como en las tropas militares. El envío de productos alimenticios a puertos marítimos, bien comunicados con estuarios y rías, permitía además transportar los cargamentos por vía fluvial hasta el interior de ciertas regiones. Sin embargo, a pesar del enorme volumen de mercancías trasladadas por vía marítima, contamos con escasa información arqueológica sobre el procedimiento y el sistema de transporte de los cereales.

El principal problema arqueológico que encontramos para el estudio del comercio, traslado y aprovisionamiento marítimo es la desaparición de la mayor parte de la mercancía compuesta por alimentos, tanto los que constituían la dieta diaria de los marineros como el cargamento que se pretendía transportar a su lugar de destino. Los cereales y otros alimentos perecederos permanecen en numerosas ocasiones invisibles en el registro arqueológico, a diferencia de otros productos más reconocibles a partir de los envases y recipientes de transporte aparecidos en el fondo de los pecios encontrados, como el vino, el aceite o las salazones, incluso de otro tipo de mercancías de origen orgánico (pieles, tejidos, madera, etc.) u otros productos comercializados (obras de arte, objetos de vidrio, cerámicos, metálicos o marmóreos, etc.), además de los aparejos y herramientas de los marineros.

La arqueología subacuática y los análisis arqueobotánicos: investigaciones multidisciplinarias para el reconocimiento del comercio marítimo

La dispersión de la carga durante el naufragio, la acción de las corrientes marinas, el propio carácter perecedero de los cereales y las dificultades derivadas de los trabajos arqueológicos subacuáticos son factores que condicionan y limitan enormemente el reconocimiento del transporte marítimo de alimentos. No obstante, a pesar de estas dificultades inherentes a la mayor parte de las investigaciones referidas al análisis de los alimentos en la Antigüedad, determinados estudios de carácter multidisciplinar están identificando productos alimenticios, que seguramente debieron formar parte de la carga de los navíos cargueros. Aunque por el momento el número de pecios identificados como mercantes de cereal es bastante limitado (Fig. 1), los datos obtenidos a partir de los análisis arqueobotánicos de las muestras recogidas durante su estudio son lo suficientemente pródigos para reconocer especies concretas de alimentos e incluso variedades específicas de cereales.

La recogida y muestreo de pólenes o de macrorrestos vegetales se constriñe en la mayor parte de las ocasiones a los restos que quedaron adheridos a la pez con la que se calafateaban los barcos. En este tipo de muestreo reside la dificultad para determinar si el tipo de especie vegetal reconocido formaba parte de la carga o proviene de los lugares donde se procedió a la realización de este tipo de operaciones. Las variedades de especies vegetales documentadas, junto con el análisis del resto de la carga encontrada, principalmente de carácter tipológico o de las muestras cerámicas, nos permiten aproximarnos en último término al reconocimiento del lugar de procedencia de las mismas que puede corresponder al punto de partida del viaje realizado o a cualquier otro puesto de recalada de la embarcación.

Los análisis arqueobotánicos nos ofrecen también una gran posibilidad de estudio de los cargamentos de los barcos cuando se comparan con los datos de la vegetación del entorno en el que se han localizado. A través del estudio estratigráfico, geológico, el análisis de los sedimentos



Figura 1. Mapa de distribución de los pecios con posible cargamento de grano (cuadrado) y otros mencionados en el texto (círculo). Imagen: autor.

y de los macrorrestos vegetales y polínicos, se puede obtener una imagen muy certera del paleoambiente y analizar de una manera interdisciplinar el territorio en el que se desarrollaron las numerosas actividades antrópicas, del que las embarcaciones y el abundantísimo material arqueológico descubierto ofrecen importante información. Este muestreo y posterior comparativa ha permitido determinar, por ejemplo, que los restos de frutos comestibles y semillas encontradas en los barcos de Pisa, básicamente nueces, melocotones, uvas, aceitunas y ciruelas, pudieron formar parte del cargamento de las naves, pues no se han testimoniado en las muestras polínicas ni en los análisis de los macrorrestos vegetales del entorno, a diferencia del pino y las avellanas (Camilli/Remotti, 2005). De igual modo, en el puerto romano de Oiasso (País Vasco) se han identificado frutos domésticos que posiblemente fueron importados, probablemente por vía marítima, como aceitunas, ciruelas, guindas, higos, melocotones y uvas que, en algunos casos, constituyen los primeros ejemplares que se documentan en la cornisa cantábrica (Peña/Zapata, 2005: 173).

Los análisis de macrorrestos vegetales además nos permiten identificar en los lugares de recepción los tipos de granos y los insectos asociados, así como productos y alimentos exóticos importados. Cuando estos emplazamientos presentan unas condiciones geográficas concretas, en ámbito insular o en regiones alejadísimas de los centros de producción, nos permiten corroborar el transporte y comercio de dichos alimentos por vía marítima, un aspecto que hemos analizado de manera particular en trabajos anteriores (Salido, 2013: 159-171).

Mediterráneo occidental: transporte de cereal norteafricano hacia el sur de la *Gallia*

De los diferentes análisis multidisciplinarios realizados, debemos destacar sin duda el estudio de la embarcación *Saint-Gervais 2*, localizada en Fos-sur-Mer (Francia), que aunque se ha situado en una fecha muy tardía (siglo VII d.C.) (Jézégou, 1998: 343-345), es el único navío en

el que se ha podido confirmar fehacientemente el transporte de grano a bordo como cargamento o mercancía. Muy posiblemente el cereal se transportó en sacos en la parte posterior del barco y se dispersó durante el naufragio, adhiriéndose a la pez, lo que ha permitido su documentación. El cereal analizado corresponde a la especie *Triticum turgidum* L., característico de suelos pobres y climas cálidos (Bonifay, 2007: 253). Mezclado con este trigo, se documentó también *Agrostemma githago* L., así como otras plantas adventicias. Esta embarcación, con una capacidad de carga de aproximadamente 3000 modios (Jézégou, 1998: 345), además del cereal, transportaba la vajilla de la tripulación y un cargamento constituido por ánforas de origen africano.

En las proximidades de este pecio, se localizó en Martigues (Francia) la embarcación *Laurons 2*, de 13,30 m de longitud y 6 m de anchura, fechada a finales del siglo II d.C. (Fig. 2). También en este pecio fue posible documentar grano adherido a la pez (Ximénès/Moerman, 1991: 209-212, Fig. 3), producto que se conservaba posiblemente en un ánfora tripolitana (55a, tipo 19,2), antes de que esta se rompiese durante el naufragio (Bonifay, 2007: 253).

A partir de estas evidencias de grano y del origen de los recipientes transportados en ambos pecios, Bonifay (2007) determinó que tanto el pecio *Saint-Gervais 2* como *Laurons 2* transportaban cereal norteafricano con destino hasta, por lo que sabemos, el sur de la Galia.



Figura 2. Cargamento de ánforas, detalle del grano adherido a la pez del barco y localización del pecio *Laurons 2*. Imágenes (con modificaciones): Ximénès y Moerman, 1991: Figs. 2-3.

Mediterráneo central: evidencias directas e indirectas del comercio interprovincial

Los análisis de las muestras de la pez empleada para calafatear la embarcación *Cala Cupa*, fechada en los siglos I-III d.C. y localizada en la isla del Giglio (Grosseto, Italia), han testimoniado la presencia de restos de polen de *Cerealia*, además de insectos asociados a su almacenaje prolongado como el *Sitophilus granarius* L., el gorgojo de los granos, una de las principales plagas del cereal amontonado (Arobba *et alii*, 1983) (Fig. 3). Aunque no son concluyentes, estos testimonios podrían evidenciar el transporte de grano en la embarcación.

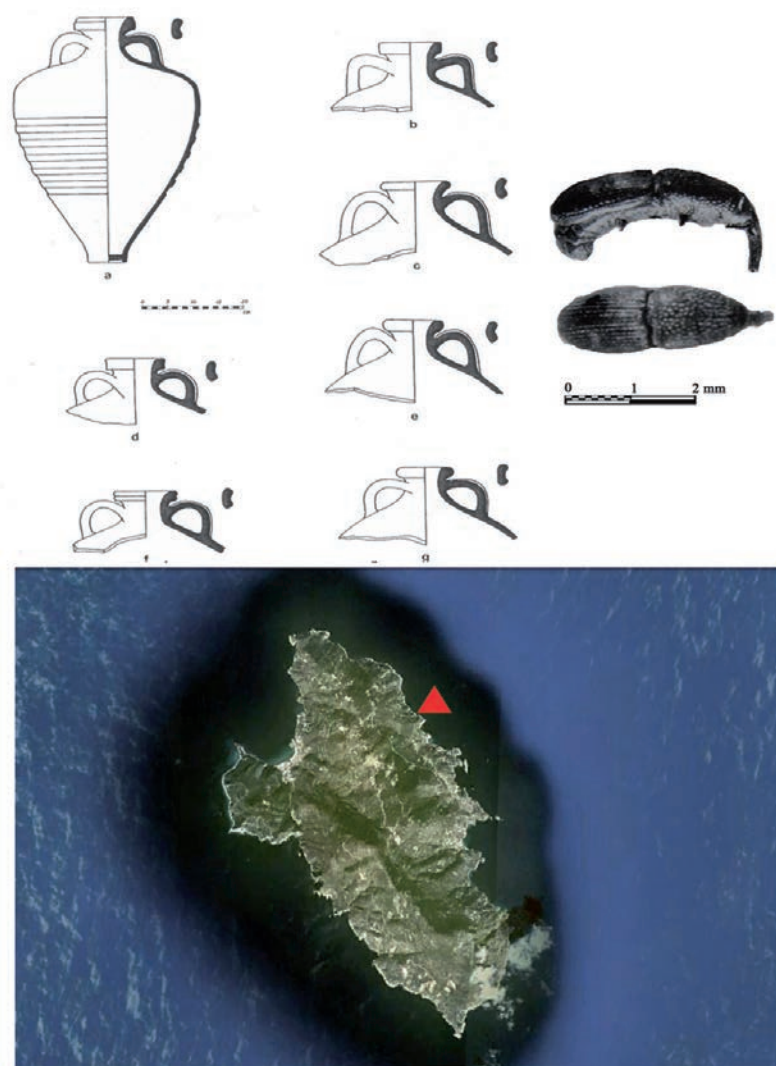


Figura 3. Ánforas —destaca una forma completa Pelichet 47— y *Sitophilus granarius* (gorgojo de los granos) documentados en el pecio *Cala Cupa* de la isla del Giglio; localización del hallazgo. Imágenes (con modificaciones): Arobba *et alii*, 1983: figs. 3 y 14.

También en Italia, concretamente en Bonifacio, al sur de las islas Lavezzi, entre Córcega y Cerdeña, se localizó un pecio, *Sud-Lavezzi 5*, fechado en el siglo II d.C. que podría haber transportado cereal a bordo (Fig. 4). Esta embarcación, que se hallaba a unos 72 m de profundidad, presenta mayores dimensiones que las anteriores, pues mide aproximadamente 30 m de longitud y 6 m de anchura (Delauze *et alii*, 2007: 94-96). Además de la carga de *sigillata* origi-



Figura 4. Carga del *Sud-Lavezzi 5* —ánfora Gauloise 5 y plato de *terra sigillata* de fines del siglo I d.C./inicios del II d.C.—; zona aproximada del hallazgo e imagen del pecio. Imágenes (con modificaciones): Delauze *et alii*, 2007: Figs. 84-86.

naria del norte de Italia, el barco precisaría de peso en la parte inferior de la nave para mantener su estabilidad, de modo que la ausencia de otro tipo de carga localizada durante su excavación podría informarnos indirectamente de un cargamento de cereales.

Además de la propia documentación del cereal, existen otras evidencias indirectas del posible transporte a bordo de los barcos, como la dispersión de la carga, prueba de la posible distribución de la estiba. Recientemente se ha dado a conocer un estudio de la carga de la embarcación *Levanzo I*, fechada en el siglo IV d.C. (Royal/Tusa, 2012). Este barco, de 20 m de longitud y 9 m de anchura, posiblemente partió del África proconsular, quizás de Cartago, en dirección a Italia, pero durante la travesía, por fortuna para los arqueólogos, naufragó cerca de la isla de Levanzo, situada al noroeste de Sicilia. Su cargamento, constituido por vajilla de mesa, ánforas, vidrio y material de construcción, nos informa de la redistribución y comercio de mercancías en el ámbito occidental-central del Mediterráneo, quizás en el marco de la *annona*. La carga estaba concentrada en dos espacios muy concretos, a los lados de la embarcación, de modo que el área central, a tenor de la distribución del material aparecido, estaba vacía o contenía alimentos perecederos, como el grano, que no se han podido documentar (Fig. 5). Aunque no existen más evidencias que la propia ausencia de información, podría tratarse de un mercante que transportaba grano norteafricano para la *annona* de Roma.

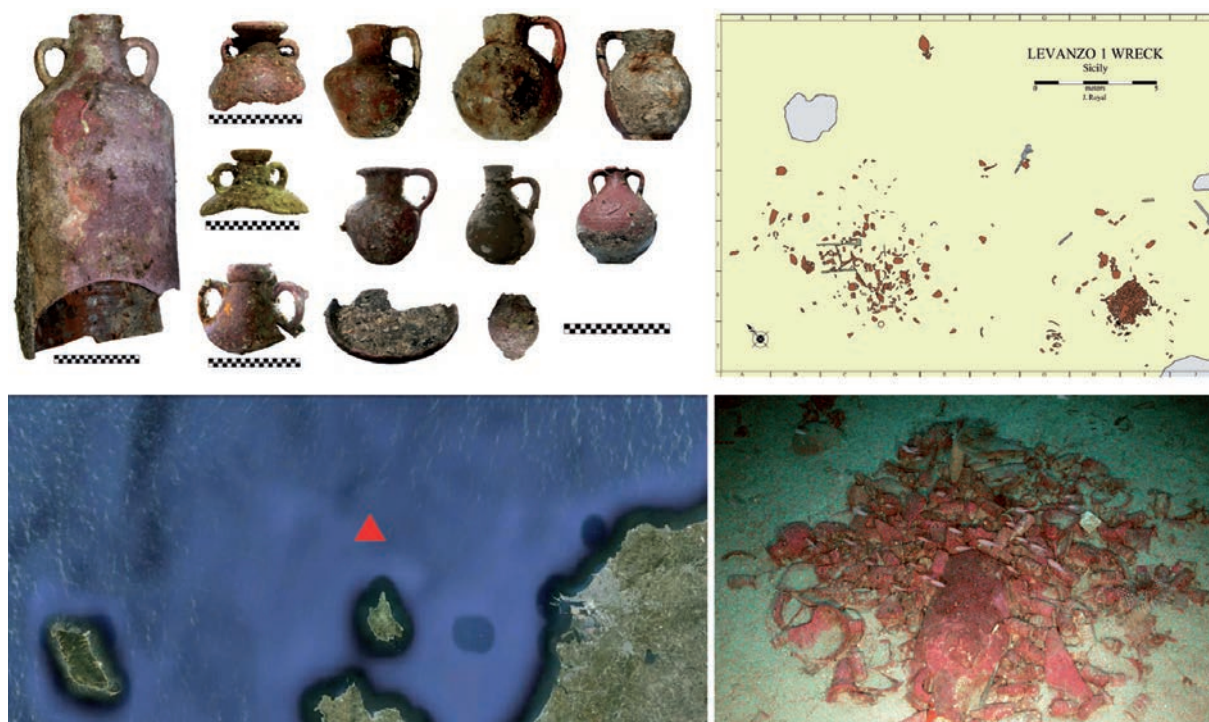


Figura 5. Ánforas, localización y distribución de la carga del pecio *Levanzo I* de Sicilia. Imágenes (con modificaciones): Royal y Tusa, 2012: Figs. 2, 3, 9 y 10.

Más allá de las columnas de Hércules: evidencias de comercio de cereal en el *Oceanus Atlanticus*

En el *Oceanus Atlanticus* o *Atlanticum mare*, también se han constatado embarcaciones que pudieron cargar cereal a bordo. La aparición de varios pecios en las islas del Canal de la Mancha nos informa de la existencia de un tránsito comercial considerable en este gran espacio comercial. Sin duda, uno de los descubrimientos más interesantes es el barco de *Saint Peter Port*, localizado en la entrada del puerto principal de la isla de Guernsey (Reino Unido) (Fig. 6). La embarcación, fechada por ^{14}C en los siglos I-II d.C., debió naufragar en torno a los años 280-290 d.C. El navío, de 25 m de longitud y 6 m de anchura, transportaba material de construcción, morteros, ánforas y barriles. El cereal documentado en el entorno del pecio, conservado en condiciones anaeróbicas o carbonizado, comprendía una gran cantidad de *Triticum spelta*, y algunos restos de *Triticum aestivum-compactum*. También en menor medida se testimonió *Hordeum* sp y *Avena* sp. Se identificaron además de manera muy residual plantas adventicias como la *Agrimonia* sp., *Euphatoria* sp., *Bromus secalinus/mollis*, además de *Agrostemma githago*. Los datos arqueobotánicos apuntan a que el cereal había sido completamente limpiado antes de ser embarcado, de ahí que podamos suponer que estos productos no formaron parte de las mercancías, sino de los alimentos de la tripulación (Green, 1993: 111). Además de cereales, se pudieron documentar restos de aceituna (*Olea europea*), nueces (*Juglans regia*), pepitas de uva (*Vitis vinifera*), frutos del género *Prunus* sp. y moras (*Rubus* cf. *fruticosus*). La localización geográfica del descubrimiento podría evidenciar un trasiego comercial importante entre la isla y la zona continental de Europa, así como con Britannia, a través del Canal de la Mancha. Hallazgos como el pecio de *Saint Peter Port* vienen a desmentir la idea tradicional de la existencia de un tráfico marítimo atlántico muy restringido. No obstante, las travesías en el océano debieron ser más lentas que en el mar Mediterráneo, puesto que las embarcaciones, ante los frecuentes y fuertes temporales, debían recalar forzosamente en los diferentes puertos de apoyo de las rutas que jalonan la vertiente atlántica europea. Esta mayor duración de los viajes limitaría enormemente

el trasiego de productos más difíciles de conservar a bordo de los barcos, como el cereal, debido a los problemas ocasionados por la humedad, lo que inevitablemente limitaba el radio de las rutas comerciales. Estas quedarían ceñidas básicamente a navegaciones marítimas de menor trayecto que enlazarían los territorios del arco Atlántico, destacando por su importancia la ruta que unían las Islas Británicas con la Europa continental, a través del Canal de la Mancha y el mar del Norte (Salido, 2013: 146). En este sentido, nos parece arriesgado pensar en la existencia de un transporte marítimo frecuente de grano por la fachada atlántica de la península ibérica con destino a las provincias septentrionales del Imperio, lo que nos debe hacer reflexionar en la importancia de la ruta circunatlántica para cuestiones de abastecimiento de grano, como la *annona militaris* para las tropas asentadas en el *limes* germano (Morillo, 2012: 422). Nos parece más coherente plantear una ruta mediterránea a través del sur de la *Gallia*, travesías que por otro lado están perfectamente constatadas por los pecios aparecidos y por la ubicación de los grandes centros de producción agrícola cerealística situados en la zona norteafricana, con puntos de partida en la ribera mediterránea central y oriental.

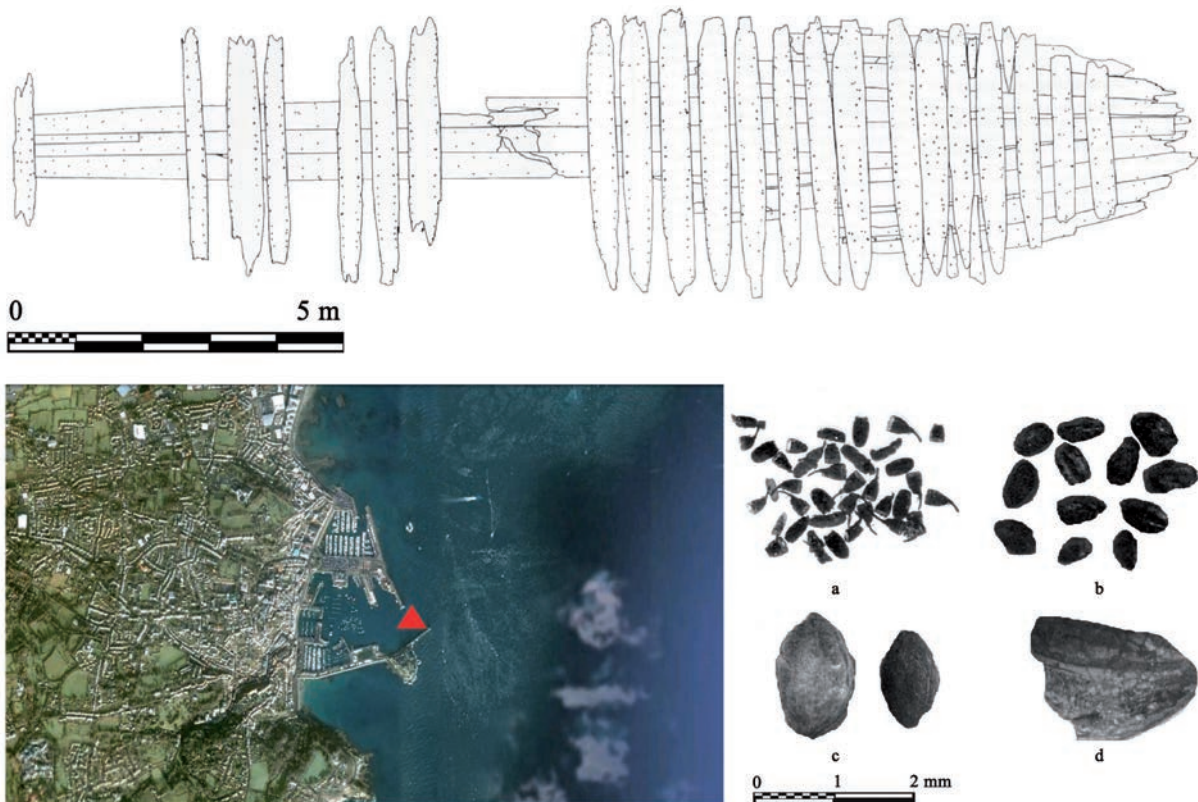


Figura 6. Estructuras conservadas y localización del pecio *Saint Peter Port* (isla de Guernsey). Parte inferior derecha: gorgojos del grano (arriba, izqda.), trigo espelta (arriba, dcha.), diferentes frutos documentados en el entorno del barco hundido (parte inferior). Imágenes (con modificaciones): Rule y Monaghan, 1993: Fig. 6; Green 1993: láms. 20-23.

Técnicas constructivas navales y sistemas de transporte de alimentos

Aunque las representaciones iconográficas y las fuentes clásicas, nos informan de la existencia de un transporte marítimo de grano a bordo de enormes navíos cargueros de gran tonelaje (algunos con una eslora de más de 50 m) (Salido, 2013: 148-149, Figs. 8 y 9), por el momento no se han localizado barcos de estas dimensiones. Los pecios de mayor tamaño descubiertos tam-

poco transportaban grano durante el momento del naufragio o dicha carga no se ha podido reconocer. Es el caso del *Madrague de Giens*, de 40 m de longitud y 9 m de anchura, localizado en la costa sudoriental de Francia, que presentaba en su cargamento ánforas de vino procedente de Terracina (Italia) (Tchernia *et alii*, 1978). El pecio *Albenga* (Liguria, Italia), de comienzos del siglo I d.C., con unas dimensiones 40 m de longitud y 12 m de anchura, cargaba mayoritariamente ánforas vinarias Dressel 1 antes de su hundimiento (Lamboglia 1962; Arobba *et alii* 2014).

A excepción de estas dos naves, los pecios descubiertos tienen un menor tonelaje. Algunos estaban posiblemente destinados a los servicios portuarios –además de otros usos, para el trasbordo de las mercancías de los grandes navíos a estas pequeñas embarcaciones– y otros corresponden a los barcos mercantes. Esto nos indica que muy posiblemente el uso de barcos cargueros regulares en funcionamiento, con un tonelaje comprendido entre 100 y 300 toneladas de carga, podría ser suficiente para aprovisionar mensualmente de grano a la población a nivel macrorregional e interprovincial (Salido, 2013: 149). Esta hipótesis se confirma si tenemos en cuenta que los pecios localizados con evidencias de posibles cargamentos de grano, anteriormente analizados, corresponden a este tipo de barcos mercantes de menor tonelaje. No obstante, en dos casos debió ser necesario el envío de grandes navíos cargueros: el abastecimiento de la ciudad de Roma, donde arribaban enormes barcos procedentes de las provincias frumentarias, especialmente en épocas de carestía (Rougé, 1966; Pomey/Tchernia, 1978: 237-243) y el aprovisionamiento a los asentamientos militares donde las tropas demandaban una ingente cantidad de grano (Morillo/Salido, 2010; Salido, 2011; 2013: 158-159, 161-169; 2014: 473-473).

Las innovaciones técnicas empleadas en la construcción de las embarcaciones de menor tonelaje, bien reconocidas a partir de los pecios recuperados, nos permiten presuponer su aplicación en la construcción de los grandes navíos de carga (Fitzgerald, 1990; Vinson, 1990; Tchernia, 2011). El desarrollo de la ingeniería naval romana comporta principalmente la construcción de armazones bien reforzados y afianzados, contruidos con cuadernas bien encajadas y perfectamente revestidas, mediante el uso de largueros, riostras y abrazaderas, así como de clavos de bronce y cobre. El montaje laminado de los cascos de los barcos de gran tonelaje, mediante la colocación de varias capas de madera, constituye una innovación técnica que reporta importantes ventajas como una mayor resistencia, consistencia, estanqueidad del armazón, reduciendo al mismo tiempo los daños causados por posibles colisiones con el fondo submarino o los lugares de atraque.

El sistema de almacenaje en el interior de estos barcos es otra de las cuestiones esenciales para la conservación del grano durante su transporte. El envío por mar obligaba a sujetar perfectamente las mercaderías a fin de evitar daños provocados por el movimiento del barco, de modo que la estiba de ciertos envases o embalajes debía ser cuidada, especialmente los envases cerámicos y de vidrio. En cambio, las mercancías más resistentes se colocaban sobre cubierta, preferentemente empacados, aunque algunos no precisarían ningún tipo de embalaje. En cuanto al grano, se transportaría principalmente en sacos, fácilmente manejables y adaptables, útiles especialmente para la diferenciación de los distintos tipos de granos (Salido, 2013: 151-152, Fig. 10), así como para las tareas de trasbordo, descarga y control de la carga. Los sacos se dispondrían sobre estantes de madera, de gran anchura, consistentes y bien fijados a las paredes del casco de los barcos. Para evitar la caída y el desplazamiento de los sacos, se compartimentaría el interior de la zona de carga con mamparos. De este modo, se reducía el riesgo de humectación del grano transportado, alejado de agentes nocivos para su conservación como la sentina alojada en el interior del barco. Las fuentes clásicas también nos informan del transporte de cereal a granel a bordo de los barcos en anaqueles (*tabulis*), en compartimentos separados por mamparos (*heronibus*), en barriles (*in alia cupa*), de modo que los diferentes tipos de grano estarían perfectamente diferenciados y separados (Dig. 19, 2, 31) (Casson, 1971; Rickman, 1980).

En el interior de los navíos, se procuraba evitar además lo mayor posible las filtraciones de agua y la acumulación de agua en el puente y en la bodega (Gassend *et alii*, 1984), donde inevitablemente se reúnen las aguas que, de diferentes procedencias, se filtran por los costados y cubierta del buque (Beltrame, 2002: 22-25). Aunque los avances técnicos en época clásica permitieron la construcción de barcos con cascos bien ensamblados, los recientes estudios de pecios han testimoniado el uso y reutilización de los textiles para el calafateo de los barcos (Médard, 2011), que permiten sellar los intersticios entre las cuadernas de madera para evitar la entrada de agua. También se han localizado imbornales en algunos pecios, es decir, agujeros o registros en los trancaniles que dan salida a las aguas que se depositan en las respectivas cubiertas (Steffy, 1998: 165-166). No obstante, la humedad, inherente en el ambiente, debió constituir de manera inevitable uno de los principales problemas para la conservación de los cereales, factor que favorece la plaga de insectos.

La infestación del grano se producía muy posiblemente en el interior de los *borrea*, debido a los largos periodos de almacenaje y las malas condiciones de conservación (Salido 2013: 153), pero no cabe duda de que la difusión de las plagas de insectos se agravaría en el interior de los barcos por la humedad, a pesar de que los trayectos no eran especialmente largos (Rougé, 1966; Erdkamp, 1998: 56). Los análisis de macrorrestos vegetales, polínicos y de los insectos realizados nos informan del mal estado de conservación del cereal transportado a bordo de los barcos. Anteriormente ya hemos mencionado la presencia de *Sitophilus granarius* L., el gorgojo de los granos, en el pecio de *Cala Cupa* (isla del Giglio, Italia). De igual modo, se ha podido comprobar el mal estado del *Triticum dicoccum* cargado en una pequeña embarcación del siglo II d.C. en el fuerte romano de *Laurium*, actual Woerden (Holanda) (Pals/ Hakbijl, 1992). En este caso se trata de una embarcación que remontaba corrientes fluviales, el Rin, desde Bélgica hasta Woerden en Holanda (Haalebos, 1986; 1997). También los análisis realizados en diferentes asentamientos británicos han determinado incluso la expansión y difusión de determinados coleópteros perjudiciales para el grano que se fletaron en los grandes cargamentos de las naves que atravesaron el Canal de la Mancha (Smith/Kenward, 2011). Estos problemas de infestación del grano aumentarían considerablemente si el cargamento no podía ser inmediatamente transportado a los *borrea* cuando los barcos finalizaban su trayecto y debían permanecer a bordo.

Los últimos análisis químicos, realizados en recipientes de pecios, también determinan que algunos recipientes transportados a bordo pudieron ser usados, o mejor dicho, reutilizados como envases de otros productos distintos a los que contuvieron originalmente. En otros casos, los recipientes vinarios y olearios romanos fueron reutilizados para el transporte de productos, que se embarcaban durante los viajes de retorno para rentabilizar el trayecto. Las ánforas Lamb. 2 de época republicana, después de contener vino adriático, fueron usadas como contenedores de frutos secos en la nave B de Pisa, puzolana en el pecio de *Chrétienne A* en Saint-Raphaël (Francia) o resina de pino en el derrelicto de *Cap Caveaux 1* próximo a las Ile de Pomègues en Marsella (Francia) (cf. Pérez Ballester, 2009: 560). También los sedimentos recogidos del interior de varias jarras de época romana, asociadas a los pecios encontrados en el lago Tantura (Dor, Israel), contienen polen de *cerelea*, de la familia de las *Poaceae*, gramíneas que pudieron ser transportadas en dichos envases (Gorham/Bryant, 2001: 289, Fig. 6). A pesar de estos hallazgos, no cabe duda de que el grano debió ser transportado principalmente en sacos y no en el interior de envases. Por cuestiones prácticas, se evitaría el traslado de cereal en envases más frágiles, que se reservaban para el almacenaje de productos líquidos o acuosos, resinas, etc.; por otro lado, siguiendo una lógica racionalización de la carga, se evitaba introducir material pesado y voluminoso para trasladar áridos que pueden ser perfectamente almacenables y acarreados en sacos.

Comercio, redistribución y fondeaderos marítimos

A partir del estudio de la tipología, las medidas y el tonelaje de los pecios aparecidos, así como de las dimensiones de los espacios transitables en los desembarcaderos y de las infraestructuras portuarias marítimas, nos podemos aproximar al conocimiento del sistema de transporte, atraque y descarga de los barcos.

En el caso concreto de la *annona* destinada a Roma (Rougé, 1966; Rickman, 1980; Sirks, 1991; Virlouvet, 1995; Tchernia, 2008), principalmente con grano procedente de las provincias frumentarias, antes de la construcción del puerto de Claudio y Trajano en Ostia, se enviaban los alimentos a puertos marítimos ubicados a cierta distancia de la capital, como Puteoli, que constituía un puerto de ruptura de la carga para su envío en embarcaciones de menor tonelaje a Roma (Zevi, 1994). La existencia de estos puertos para el posterior traslado por vía marítima y fluvial del grano supone, tal y como ha defendido Tchernia (2008: 58), un enorme inconveniente, ya que ralentiza el tiempo de llegada de los suministros con continuos cargamentos y descargas que pueden durar hasta una semana, con un considerable uso de mano de obra. Por otro lado, era necesario hacer coincidir los tiempos de llegada de los grandes navíos de carga con las pequeñas embarcaciones utilizadas para el transporte final, que no siempre estarían disponibles en un número suficiente para dar cabida al volumen de grano inicialmente traído. Esto obligaba a mantener almacenado una gran cantidad de cereal en grandes *horrea* situados en las instalaciones portuarias, con los consiguientes problemas de conservación del producto. Por ello, con el objetivo de que el flujo de mercancías portuarias fuera lo más rápido y eficaz posible, estas infraestructuras debían estar construidas siguiendo unos criterios bien establecidos, que comportan desde la ordenación de espacios e instalaciones, desde un punto de vista de su uso logístico, hasta la localización y reserva de áreas diferenciadas para el desarrollo de las distintas actividades y operaciones desarrolladas. También el personal encargado debía estar perfectamente coordinado y preparado para tales operaciones. De este modo, se podía optimizar tanto el tráfico de la mercancía como el flujo de información que acompaña a esta, así como armonizar entre los distintos eslabones de la cadena portuaria las operaciones de manipulación, transporte y almacenamiento de los productos, consiguiendo una integración entre los distintos agentes de la comunidad portuaria.

A partir de la construcción del *Portus*, la situación cambió, pues los grandes navíos cargados de grano y otros productos arribaban a un emplazamiento bastante próximo de Roma. Los últimos estudios geoarqueológicos realizados concluyen que el puerto de época de Claudio, protegido por dos espigones curvos del mar abierto, contó con una profundidad de aproximadamente 5-7 m para facilitar el atraque de los grandes barcos cargueros (Verduchi, 2004). Estos navíos de gran tonelaje podían atracar tanto en el puerto de Claudio como en el gran puerto hexagonal de la época de Trajano (Boetto, 2010: 122), aunque en el canal de acceso a este último, debían ser remolcados, pues era difícil el uso de velas. En cambio, tanto la dársena como el canal de acceso a la *Fossa Traiana* estarían limitados al uso de pequeñas embarcaciones. Por tanto, sería necesario trasbordar las provisiones de los grandes navíos a barcas de menor tonelaje (*naves caudicariae*), de una capacidad máxima de 200 t y una eslora de 27 m (Boetto, 2010; 2011), naves que también serían empleadas para el transporte de provisiones por el Tíber hasta Roma.

El aprovisionamiento en otras ciudades debió ser muy similar, con la construcción de puertos marítimos, donde llegarían los grandes barcos cargueros desde los que se trasbordarían las provisiones a barcas de menor tonelaje, empleadas para los trabajos portuarios (Rickman, 1980: 123). Los pecios encontrados en puertos antiguos, como Nápoles o Tolón, corresponden a pequeñas embarcaciones tipo *horeia* utilizadas tanto para la pesca como para los servicios portuarios (Boetto, 2009). Los numerosos pecios aparecidos en el Mediterráneo nos ofrecen un

panorama muy dinámico de la navegación en época romana con el traslado de provisiones y productos de regiones muy alejadas, pero las naves localizadas en los puertos de las ciudades romanas de Marsella (Pomey, 1995: 460-470), Lyon (Ayala *et alii*, 2005), Pisa (Bruni, 2000) y Olbia (Riccardi, 2002) también corresponden a estas pequeñas embarcaciones de medio tonelaje utilizadas para el tráfico portuario, además de para otros usos.

Respecto al aprovisionamiento militar, las fuentes clásicas nos informan del envío de grandes cargamentos de grano a bordo de *naves onerariae* (Salido, 2012; 2013: 158), para el abastecimiento de las tropas, de los que hasta el momento no se han documentado restos materiales. La recepción de las provisiones debió ser un procedimiento muy similar en aquellos campamentos militares dotados de puertos marítimo-fluviales, donde se transvasarían las provisiones a embarcaciones más pequeñas. Las grandes naves de carga que, en ocasiones sirvieron también para el traslado de las unidades militares, debieron encontrarse, en algunos casos, con grandes problemas durante las maniobras y las operaciones de descarga de productos en las cercanías de los muelles, lo que conllevó en algunas ocasiones verdaderos problemas logísticos. La inestabilidad provocada por las incursiones enemigas obligó además a controlar las costas mediante el uso de fuerza naval militar desplegada a lo largo de la ruta que iban a emprender los barcos de avituallamiento y transporte, de igual modo que se organizaban convoyes para evitar el abordaje enemigo (Salido, 2013: 159).

Consideraciones finales: el comercio de cereal en el occidente del Imperio romano

Los recientes avances de la arqueología subacuática y la realización de estudios arqueobotánicos (polínicos y análisis de macrorrestos) sobre las muestras recogidas en los pecios localizados nos ofrecen la posibilidad de explorar el posible cargamento de grano a bordo de navíos mercantes. Los últimos descubrimientos realizados nos permiten concluir que solamente en uno de los pecios descubiertos, datado en época muy tardía (*Saint-Gervais 2*, siglo VII d.C.), se ha podido confirmar el transporte de grano a bordo del barco. La identificación de grano adherida a la pez en el pecio *Laurons 2* y de polen de *Cerealia* en el *Cala Cupa*, son evidencias claras de un posible cargamento de cereal, pero a tenor de los restos documentados, no podemos confirmar con certeza su transporte en las embarcaciones, pues podrían haberse impregnado en la pez durante el calafateo del barco o durante la extracción de la misma. En el caso del pecio *Saint Peter Port*, los análisis arqueobotánicos determinan que el grano transportado debió destinarse a la alimentación de la tripulación y no formaba parte del cargamento o mercancías del barco. Más dudas ofrecen el posible transporte de grano a bordo de los barcos *Sud-Lavezzi 5* y *Levanzo I*, pues solamente la ausencia de información de la carga y su distribución en el interior de las embarcaciones son indicios del traslado de cereal. Por otro lado, hasta el momento no se han localizado los enormes navíos cargueros de gran tonelaje, con una eslora de más de 50 m, que conocemos a través de las fuentes clásicas y las representaciones iconográficas. Tampoco los navíos de mayores dimensiones aparecidos (*Albenga* y *Madrague de Giens*) contaron antes del naufragio con cargamentos de cereal, a tenor de los restos materiales aparecidos. No obstante, a partir de los datos que nos ofrecen los barcos aparecidos, hemos tratado de reconstruir el sistema de transporte y la construcción de los grandes navíos cargueros.

La mayor parte de la información de los pecios procede de las zonas bañadas por el mar Mediterráneo, donde sin duda existió un trasiego comercial muy dinámico. En cambio, en el océano Atlántico solamente contamos con los datos del posible transporte de cereal a bordo del barco *Saint Peter Port*, lo que nos debe hacer reflexionar sobre el alcance de las rutas marítimas en la fachada atlántica europea. Posiblemente la necesidad de recalar constantemente en los

diferentes puertos de apoyo en un mar abierto, que presenta muchas dificultades para la navegación debido a los constantes y fuertes temporales, prolongó la duración de las travesías, limitando la difusión de las rutas comerciales de productos perecederos como el grano. Si tenemos en cuenta que el grado de infestación del cereal estibado en los barcos es mayor cuanto más larga es la travesía, debemos pensar que las rutas comerciales serían más restringidas que en el mar Mediterráneo. Posiblemente en el océano las travesías se reducirían al tránsito comercial entre los territorios del arco atlántico, destacando por su importancia la ruta que unía las Islas Británicas con la Europa continental, a través del Canal de la Mancha y el mar del Norte. A tenor de estos datos, resulta difícil pensar en la existencia de un transporte marítimo de grano a través de la fachada atlántica de la península ibérica con destino a las regiones septentrionales del Imperio.

Además de los barcos mercantes con posibles evidencias de transporte de cereal, se han podido recuperar pequeñas embarcaciones utilizadas para los servicios portuarios, principalmente para el trasbordo de mercancías desde los grandes navíos cargueros para facilitar las operaciones de descarga en los puertos. Por el momento solamente contamos con información sobre dichas tareas en los puertos urbanos de algunas ciudades romanas del Mediterráneo occidental. Menos información, sin embargo, disponemos de las infraestructuras portuarias y pecios militares, aunque podemos suponer que el proceso de transporte y trasbordo debió ser muy similar.

En conclusión, aunque las fuentes escritas nos ofrecen información abundante del transporte de mercancías como el grano en toda la ribera mediterránea y en el arco atlántico, todavía son escasos los restos materiales que evidencian su traslado a bordo de los barcos. No obstante, los pecios descubiertos y el análisis de macrorrestos nos ofrecen la posibilidad de localizar evidencias de la existencia de un transporte y un comercio interprovincial de cereales por vía marítima entre las diferentes regiones del occidente del Imperio romano.

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Fishing from boats and ships depicted in Roman mosaics from the Mediterranean

Pesca y naves representadas en los mosaicos romanos del Mediterráneo

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Abstract: One of the most and frequent theme illustrated in Roman mosaics surfaces is water games and varied fishing activities. Such scenes do not represent recreational activities of the elite rather they show the everyday life of simple people living along the sea coast, rivers or lakes. These activities depict the gathering, commercialization and processing of the marine products, assumed to be concurrent to the mosaic surfaces brought into discussion. The present paper will bring into discussion varied fishing gears and techniques carried out from boats and ships. An attempt will be made to classify these vessels upon their building material, type, propulsion and sailing environment. The fishing scenes and the vessels depicted in these mosaics, dated from the 2nd century BCE to the 8th century CE, will be referred to ancient literature and nautical archaeology of similar preserved wrecks found in occasional underwater surveys and excavations.

Key words: Mosaics, fishing, boats, nautical archaeology.

Resumen: uno de los temas más frecuentes ilustrado en los mosaicos romanos es el de los juegos de agua y diversas actividades de pesca. Tales escenas no representan las actividades recreativas de la élite sino que muestran la vida cotidiana de la gente sencilla que vive a lo largo de la costa, los ríos o lagos. Estas actividades representan la recolección, comercialización y transformación de los productos marinos y pueden aparecer simultáneamente en los mosaicos analizados. En el presente trabajo se pondrán en discusión diversas herramientas y técnicas de pesca realizadas desde botes y barcos. Se hará un intento de clasificar estos buques según su material de construcción, tipo, propulsión y velas. Las escenas de pesca y las embarcaciones representadas en estos mosaicos, datados desde el s. II a.C. hasta el s. VIII d.C., serán referenciados en la literatura antigua y la arqueología náutica de pecios similares encontrados en prospecciones y excavaciones subacuáticas ocasionales.

Palabras clave: mosaicos, pesca, barcos, arqueología náutica.

Fishing Gear and Techniques

Some notes of the Roman laws concerning the seas, the rivers and fishing in such environments that were collected in «In the Digest of Justinian» (dated 533 CE) will be referred within the context of fishing from boats and ships depicted in the mosaics brought into discussion below:

Marcian: «Institutes, Book 3», stated that some things belong in common to all men by *jus naturale*, some to a community corporately, some to no one, but most belong to individuals. By natural laws the flowing water, and the sea, and there with the shores of the sea belong in common to all men: No one, therefore is prohibited from going on to the sea-shore to fish ... But almost all rivers and harbors are public property (Mommsen/Krueger/Watson, 1985: Book I.8.2, 4).

Gaius: «Everyday Matters or Golden Words, Book 2» stated:

The right to use river banks in public by *jus naturale* just is as the use of river itself. And everyone is at liberty to run boats aground on them, to tie ropes to the trees rooted there, to dry nets and haul them up from the sea, and to place any cargo on them, just as to sail up or down the river itself ... Those who fish in the sea are at the liberty to erect a hut on the shore in which to take shelter (Mommsen/Krueger/Watson, 1985: Book I.8.5).

One of the most significant ancient sources on finishing and processing the fish in antiquity is Oppian's *Halieutica*, dated to the 3rd century CE. He wrote that fishing was carried out in the following way:

In tiny barks they (fishermen) wander obsequious to the stormy winds, their minds ever on the surging waves; always they scan the dark clouds and ever tremble at the blackening track of the sea; no shelter have they from the raging winds nor any defense against the rain nor bulwark against summer heat. Moreover, they shudder at the terrors awful to behold of the grim sea, even the sea-monsters (*ketos*) which encounter them when they transverse the secret places of the deep (I.40-50).

Mosaics with fishing scenes were common decors within public buildings as well as in private domains, dating from the late 2nd century BCE to the 8th century CE. They are found in bathhouses, courtyards and private villas. Fishing scenes in mosaics comprise varied techniques and gears and they are carried out from boats and ships as well as from the sea-shores or river banks.

Fishing Techniques

The fishing scenes depicted in ancient mosaics do not represent recreational activities or water games of the elite rather they depict the occupation of the people living along the sea shores, lakes or rivers. The fishermen are not the elite but the common naked people or dressed in simple short tunics and wearing *petasoi* or conical hats to protect them from the sun. These fishermen practice their skills for their own food resource as well as an income by delivering the fish catches to the markets. Since antiquity the fishing activities were performed through several techniques that they still are practiced nowadays with little changes (in fabric products). Below are described varied fishing techniques that we find in ancient literature, e.g. Oppian in *Halieutica* III.72-82 and from ancient iconography, Egyptian to Roman wall-paintings, mosaics or graffiti. Oppian distinguished four types of fishing in the coastal waters (III.72-90): hooks and twisted line of horse-hair attached to long reeds, or a line attached to the hand, baskets, long pronged trident and nets. The fishing techniques will be description along with the vessel that such methods are carried out:

1. The simplest fishing technique is a line of horse-hair or flaxen cord that one end is attached to the hand and the other to a hook.
2. The fishing rod with a line tight to one end and a hook attached to the other end of the line is an improvement in fishing gear.
3. The spear is probably the oldest offensive weapon in fishing. A progressive weapon in fishing was provided by the harpoon, whereas when the head of the harpoon hit the target it was detached but it still was attached to the pole by a secure line tight around the wrist of the fisherman. The trident is known to be used since the Pharaonic Egypt.
4. The use of net in fishing is known since the Pharaonic Egypt. The generic name of net in Greek is *diktuon* and its use comprises several methods. The fish nets (*diktuon*) are distinguished in four types: the generic name for casting-net is «amphiblestron», a net cast by a single person and immediately withdrawn; draw-net or seine is known as *gripbos*¹ that were worked by one to fifteen men (Mair, 1963: xlv); bag-net known as «upoche» and was similar to the modern shrimp-net (Mair, 1963: xlv); large seine or draw-net known as *sagena* (Latin) or *saghenēh* (Greek), could be used for fishing as well as for hunting.
5. Beating the water with oars to drive the fish into the fishing nets.
6. Basket traps.

Catalogue of Fishing Techniques from Boats

The fishing scenes depicted in mosaics that are carried out from boats and ships take place in varied water environments: close to the sea shore, harbors, rivers or lakes. The mosaics brought into discussion comprise all the fishing techniques from boats that will be identified by their building material, size and means of propulsion.

The simplest fishing method is a line with a hook attached at its other end is similar to the fishing scene depicted in the mosaic floor of the frigidarium of the villa at Piazza Armerina, Sicily and dated to the 4th century CE (Carandini/Ricci/De Vos, 1982: Pl. LIX). The elongated hull with rounded stern is followed by the raised sternpost with a rounded tip and slightly inverted over the stern. The concave stem is followed by a short pointed cutwater extending forward at the water level. Two putti occupy the boat. The standing figure on the foredeck pulls the line from the water with the fish just caught in the hook at its other end (not shown). He reclines backwards due to the effort to pull the line with the heavy fish. The seated putto/helmsman on the quarter-deck works the port steering-oar to stabilize the boats. He holds the loom with both his hands. Two row-oars with a backward slanting are mounted to the port gunwale by a leather or flux grommet. They are indicated only by long rounded poles. The oar worked by the helmsman has a small blade that appears to be the widening of the lower end of the oar, thus distinguishing the steering-oar. The same oars arrangement was true on the starboard side, thus the boat was propelled by four row-oars and steered by two steering-oars.

Figure 1

The earliest fishing scene from a boat depicted in mosaics appears in the Nile mosaic from Palestrina, dated to the end of the 2nd century BCE. This mosaic is a visual evidence of varied

¹ The very large seine-net was called *anemotrata* and it was used from two boats always associated. The net was set out in early morning taking the advantage of the off-shore winds, which in summer blows during the night from the land. When the fishermen reach the open sea they cast the seine-net/*amenotrata*, moor their boats and wait till mid-day. When the landward breeze begins to blow, the two boats precede parallel one to another, drawing the net behind them towards the shore (Mair: xliii).



Figure 1. Fishing with rod from a papyrus boat; Nile mosaic from Palestrina, Italy (Photo: Zaraza Friedman).

sailing vessels. The only fishing activity is evidenced by the fisherman sited in a papyrus boat, close by the quay on the left; he fishes with a fishing rod over the bow of the boat. The elongated hull is made of papyrus stalks bundles tight together by thinner cords of papyrus. The fisherman sits on the flat deck that is coated with bitumen, deduced from the black coloring. Usually the bitumen coating was applied on the outer hull to make it watertight.

The Nilotic strip surrounding the main mosaic carpet in the nave of St. Stephen Church at Umm al-Rasas, Jordan, dated to the 8th century CE, is the latest example of fishing scenes depicted in mosaics (Piccirillo/Alliata, 1994: 142, fig. 33, the southern fame). The fisherman (defaced by the iconoclasts) sited on the thwart of a wooden papyriform boat fishes with a rod over the prow. The rounded stern with a pointed tip is slightly inverted over the quarter. The rounded stem with a pointed tip has a slightly outer extension. Two row-oars used to row or to steer the boat are mounted, one oar to either side of the aft-gunwale by a ring of metal or lather grommet. The figure carries a rounded elongated basket on his back to store in the caught fish. The fisherman fishes with the rod and he pulls out of the water the fish just caught in the hook at the end of the line.

Figure 2

Fishing with rods was carried out from sailing vessels as well. Two mosaics depicting such scenes will be brought into discussion. The first scene is depicted in a square mosaic panel originating from La Chebba, Tunisia (1 × 1 m; now is at Bardo Museum), dated to the 3rd-4th century CE that was excavated in 1902 (Blanchard-Lemée *et alii*, 1996: 288). A seagoing vessel is probably anchored, as deduced from its static position, though no anchor or mooring lines are shown. It is a wooden built with a broad hull and a very broad rounded upraised stern. The sternpost is

adorned by a phylasterion with three open branches and a ball like base. The shallow concave stem is finished with a projecting cutwater at the water level. The tip of the cutwater is adorned by a bronze coated wolf-like figurehead. The stempost forms the elongated and inner turned neck of a swan that its beak touches the prow gunwale. The rigging comprises two masts, the main mast is retracted and laid on the deck, with one end resting on the roof of the quarter cabin and the other end was supported by a forked stanchion (hidden by the fisherman on the foredeck). The artemon is still stepped on the prow with a slightly forward angle, and its lower end appears to lie on the head of the swan. Both masts lack the yard and the furled square sail that probably were stored on the deck or taken ashore. A wooden cabin with barrel roof is set between the quarter-deck and the sternpost. Eight row-oars with a backward slanting, project through oar-ports just beneath the port gunwale. The same arrangement was true on the starboard side, thus we may assume that the vessel was rowed by 16 oars (one oar per rower) when the winds were not favorable for using the sailing gear or when entering/leaving an anchorage/harbor. A pair of very large steering oars, one oar mounted to either side of the quarter form the steering gear. Their shafts project from behind the aft-wing of the outrigger plank. The elongated slim blades form almost the entire oars. Two standing naked men, each fishes with a fishing rod from the ship. The man on the foredeck facing the stern fishes over the starboard quarter, while the man on the quarter-deck fishes over the port gunwale. This arrangement of the fishermen



Figure 2. Fishing with rod from a Roman merchantman; La Chebba, Tunisia (after: Blanchard-Lemée *et alii*, 1996: 123, Fig. 82).

probably was meant to give some perspective to the scene. A third man sited on a rock fishes with a rod in the lower left-hand corner of the frame. The rich sea fauna is indicated by the large fish, one dolphin and a snake-fish or moray-eel.

A sailing vessel depicted within a rounded medallion in the northern aisle of the Church at Horvat Loya, Israel, dated to the 6th century CE, sails in open sea (Friedman, 2014: 505, Fig. 4). No seascape is depicted in the frame. The vessel appears to sail on wave waters, whereas seven fish swim forward beneath the bottom of the ship. The wooden hull is seen from its port side. It has a rounded upraised stern and adorned by a short block-like sternpost. The concave stem is ended by a short pointed cutwater. The top plank (probably the bulwark) appears to be supported from the outside by several short square stanchions. The sailing rig comprises a tapered mast stepped amidships. The mast is supported by a double-line backstay and one-line forestay. The yard is attached beneath the masthead. The head of the large square sail is mounted to the yard by several robands in head-and-lacing fashion. A ring-like parrel is attached over the yard and the masthead², thus suggesting its function. The vessel is steered by a pair of large steering-oars, one oar mounted to either quarter gunwale. Two men occupy the ship. The man sited on the prow and facing forward, fishes over the prow with a rod held in his right hand. A fish just catch in the hook at the end of the line is pulled out of the water by the fisherman. The second man sited on the quarter thwart works the steering oars. He appears to recline on the port oar, thus to steer the vessel on its course. Both men and the fish were «adjusted» (defaced) by the iconoclast but they still bear their original outline.

Fishing with a spear or trident was an advanced fishing technique that requires precision in throwing such a weapon especially when the boats is sailing. Oppian described trident fishing method in *Halieutica* III. 89-90: Others with the long pronged trident wound the fish from the land or from a ship as they will.

Figure 3

Boats with the transom prow are rare illustrations in any arts and especially in mosaics. One of the boats depicted in the fishing scene in the atrium of the villa at Piazza Armerina, Sicily is occupied by two putti. The Armerina boat has an elongated hull with rounded bottom and a transom stem. The transom board is decorated with a reversed arched frame and the stylized head of Oceanus or triton was rendered in the middle. The rounded stern is followed by upraised and slightly inner arching sternpost with a horizontal cut tip. The standing putto on the flat fore-deck and facing forward is in the process of throwing the trident (held in his right hand) into a fish swimming in front of the prow. A secure line attached to the tip of the trident shaft is coiled and held by the putto in his left hand. This line was used to recover the trident after being thrown and also to pull out of the water the caught fish. The sited putto on the quarter-deck works a pair of steering-oars mounted to the quarter gunwale. Only the shafts indicate the oars. The blades are submerged in the water. The helmsman is dressed with a short tunic. Both putti are adorned with a pair of wings on their upper backs. Two very large fish (probably tuna) are laid on the middeck. Three similar fish swim beneath the bottom of the boat.

The fishing method for catching palamida fish in antiquity (probably nowadays too) done by beating the water with the row-oar is described by Oppian in *Halieutica* IV.565-575:

² A rope with an eye at each end was passed round the yard and round the after part of the mast, then the ends brought back, one over and one under the yard, and subsequently the two eyes were lashed together (Dear/Kemp, 1997: 122).



Figure 3. Fishing with trident from a boat with transom prow; atrium, Piazza Armerina, Sicily (processed from postcard).

«The fishers set up very light nets of buoyant flax and wheel in a circle round about while they violently strike the surface of the sea with their oars and make a din with sweeping blows of poles. At the flashing of the swift oars and the noise, the fish bound in terror and rush into the bottom of the net which stands at rest, thinking it to be a shelter; foolish fishes which, frightened by the noise, enter the gates of doom. Then the fishers on either side hasten with the ropes to draw the net ashore.»

Figure 4

Such method is known not only from ancient literature but also from a rare depiction in the great Nile pygmy hunt mosaic originating from a Roman villa from Hadrumetum (Sousse), Tunisia; now located in the Archaeological Museum of Sousse. The mosaic was excavated in 1883, and dated to the 3rd-4th century CE. The wooden boat has a rounded hull with a broad upraised rounded stern. The tip of the sternpost is adorned by ball-like feature. The stem is almost horizontal and finished with a pointed cutwater. The shape of the stem is a misinterpretation. It should have been shaped as concave and finished by the projecting pointed cutwater at the water level. The top end of the sternpost has a small inner turned volute at the gunwale level. The bottom of the boat is depicted with black tesserae, thus indicating the bitumen coating to make the hull watertight. The port row-oar is mounted to the fore-gunwale and has a backward slanting. The standing fisher dressed with a short tunic and wears a hat/petatos for protection from the strong sun is standing amidships facing forward. The starboard oar is held in both his hands and he is in the process to hit the water to draw the fish into the net on the starboard side of the boat.



Figure 4. Beating the water fishing method; Sousse, Tunisia (after: Ben Aded Ben Khader and Soren, 1987; front cover).

Figure 5

Basket-traps were usually used to catch oysters, crabs or lobsters. Many fishing scenes in ancient arts show how the basket-traps were used. Two mosaics from Tunisia depicting basket-trap fishing will be described below. The first scene is depicted in the fishing strip (in reverse), in the lower part of the panel portraying Venus Anadyomene. The villa and the mosaic were excavated at Lepti Minus, or Leptis Minor, modern Lemta, which was the active port of Byzacium in antiquity (2nd-3rd century CE; Blanchard-Lemée *et alii*, 1996: 148). The left-hand boat is occupied by two putti, one working the basket-trap and the second is punting a long pole tough to steer the boat (Fig. 5). The boat is a smaller version of a seagoing Roman merchant vessel. It has an elongated and rounded hull. The concave stem is finished at the water level by a projecting pointed cutwater. The stempost is indicated by an inner-turned volute at the gunwale level. The port stem is adorned with a triangular frame that a hippocampus with coiled tail decorates the entire frame. The port wale placed just beneath the gunwale is outlined by one strip of white tesserae. The rounded bottom depicted with five rows of dark-brown and black tesserae, indicate the bitumen coating to make the hull watertight. The rounded stern is upraised. On the port quarter is a triangular decoration with an inscribed dolphin swimming forward. The same decorations of the stem and the quarter were true on the starboard side of the hull. The stern is fenced by a short lattice-screen with a backward extension forming the hanging poop. The head of a goose or duck looking forward is placed in the middle of the poop-deck. The retracted mast is lowered on the deck and its aft end appears to lie on the head of the water-bird on the poop-deck. The sail and the yard are missing, or probably are stored on the deck. A basket-trap that is ready to be dropped in the water or it is already filled with the fresh catch is hanging on the upper part of the mast over the poop. Both putti are naked. The putto on the foredeck facing forward is pulling the line of the large basket-trap full with the catch of fish, crabs or octopus from the port stem. Two large fish swim in opposite directions underneath the vessel. The second putto standing on the middeck also facing forward punts a long pole from the port quarter.

He probably steers the boat as it sails on wave waters. The scene probably takes place close to the shore where the depth was shallow and punting was possible. The Lemta fishing scene shows that single basket-traps probably were used for personal supply or for daily small commercial purposes. In the same frame is a second boat inhabited by three naked putti (Blanchard-Lemée *et alii*, 1996: 148, Fig. 106, 150, Fig. 108). This boat has a broad rounded hull with the stem angled from the chine and a rounded stern. Both stem-and-stern posts are upraised and the tips have a horizontal cut. This boat is leaving the anchorage as indicated by the putto on the quarter-deck untying the mooring line from the arched gate. The sited putto on the amidships thwart is sculling the port oar indicated by the thin tapered pole. The third putto standing on the fore-deck and looking over the shore holds the loom of the port row-oar in his left hand, thus he is preparing to work the oar. All five putti in the fishing scene have a pair of wings attached to their upper back. The bottom of both boats is rendered with dark-brown tesserae, thus indicating the bitumen coating.



Figure 5. Fishing with one large basket-trap; Lepti Minus/Lemta, Tunisia (detail after: Blanchard-Lemée *et alii*, 1996: 148, Fig. 106).

The second mosaic depicts a similar fishing scene with several smaller basket-traps tight on the same line. It comes from Hadrumetum, dated to the 3rd century CE, and now it is found in the Sousse Museum, Tunisia (Ben Abed, 2006: 32, Fig. 14). The small fishing boat is depicted from its starboard side and two fishermen occupy the boat. The rounded stem and stern are decorated with trapezoid frames outlined by two rows of white tesserae. The quarter and the fore decks are covered and slight raised above the gunwale. The shallow deck is just beneath the gunwale. Both men are naked. One man sited on the quarter-deck with his legs penetrating through a rectangular opening at the aft-deck platform is steering the boat by a pair of oars, one oar mounted to either side of the quarter gunwale. The second man slightly bent forward over the starboard stem is pulling the three basket-traps tight to the same line. Large fish swim around the boat. Fishing with several basket-traps tight to the same line indicates that this method was used for commercial fishing, and then the fresh catch was transported to the nearby fish market to be sold. In the same frame is a second boat similar to the fishing boat engaged in fishing with the basket-traps (Ben Abed, 2006: 32-33, Fig. 14). Two naked men inhabit this boat. The man standing on the prow is in the action of throwing a trident from his right-hand into the fish swimming close to the port prow; the secure line of the weapon's shaft is coiled in the man's

left-hand. The sited man on the quarter-deck steers the boat by two steering oars mounted to the quarter gunwale by a ring grommet. Both boats face each another and have the same hull shape, though the boat engaged in fishing with basket-traps is slightly longer. The dark-brown and black tesserae rendered on the bottom of both boats indicate the bitumen coating.

The most elaborate fishing from a boat or ship is by fish-net. This method comprises several types of net. The simplest is the cast-net held by a fisherman on his arm and ready to throw it into the water. Such an example comes from the fishing scene depicted in the atrium of the villa at Piazza Armerina (Carandini/Ricci/De Vos, 1982: Pl. XXXVII). The putto standing on the transom prow is in the process of throwing the cast-net over his right arm into the sea from the port stem. The secure line of the net is coiled in putto's left hand. Such a fishing method is only efficient for a small catch, probably for the family's fish diet or for a small profit by selling the fish to the nearby community market.

Commercial fishing with nets is carried out in teams of fishermen either from the same boat, or from two or more boats working at the same time. The net used for such fishing is called seine-net or dragnet (*griphos* or *sagena*). The team engaged in such fishing may comprise two, four or more men. A mosaic from a villa at Sidi Abdallah located on the Lake Bizerta, Tunisia, dated to the 5th century CE, shows the importance of the sea in the economy and the life of Roman Africa (Ben Abed, 2006: 37, Fig. 17). The inscription inserted at the bottom of the right-hand frame gives the name of the owner Sidonius, and his estate Fundus Bassianus. On the top of the frame are depicted varied structures, villas, the huts of the fishermen or tuna lookout shelters (*tunnoscopis*) (Ben Abed, 2006: 37). The fishing boat is depicted on the top right-hand frame. The prow is broader than the stern. The shallow concave stem is finished at the water level by a short projecting pointed cutwater. The stempost is finished by a small inverted volute above the stem gunwale. The slim upraised stern is followed by the short sternpost with a pointed tip. From amidships to the quarter gunwale on both sides are depicted several short bitts. They were used to tight around the lower ends of the tackle lines of the sailing rig and/or the lines of the fishing-net when it was pulled out of the water. The shallow deck is set just beneath the gunwale. The vessel lacks its propulsion and steering gear (mast, yard, sail, row-oars and steering-oars). Four fishermen are engaged in working the seine-net (*griphos* or *sagena*) full with fish from the port side. Two men standing on the foredeck pull the thick left-hand line of the net full with fish, while the other two men standing on the quarter-deck pull the thick right-hand line of the net. The men have to use some power to pull the very heavy net.

Figure 6

Another method of fishing with seine net is by using two boats. Each team in the opposite or nearby boats pulls the lines of the seine-net at the same time. Such a scene is depicted in the mosaic floor of Room 29 in the villa at Piazza Armerina, Sicily. The fishing takes place in a harbor with waterfront colonnade depicted in the upper register. Four boats, each occupied by three putti are engaged in varied methods of fishing: fishing-rod, trident, basket-trap, and the seine-net (*anemotrata*) worked from two boats. All the boats are similar with rounded hulls; the concave stems finish with a projecting pointed cutwater at the water level, whereas the upraised sterns are adorned by a vertical stempost with a small fishtail tip. The stemposts are angled forward and a small inverted volute forms their tips or a cut tip similar to fishtail. Each boat is steered by the sited helmsman on the quarter-deck who works a pair of steering-oars, one oar mounted to either quarter gunwale. The net (*anemotrata*) full with fish is worked between the top left-hand boat and the bottom left-hand boat. Two *putti* in each boat pull the line of the seine-net at the same time. Many fish swim around the boats. The fishing net also gives some kinetics to the fishing scene to break the static appearance of the scene.



Figure 6. Fishing with seine-net from two boats; Room 29, Piazza Armerina, Sicily (Carandini, Ricci, deVos, 1982, plate XXIII, Fig. 51).

Thick nets (*griphos* or *sagena*) were used for catching large and strong fish. Such nets are heavy and require to be operated by a team of two to six or even more fishermen. The fishing of tuna, palamida or other large fish was carried out from boats as well as from small to medium size ships (20-80 tons load capacity). In the mosaic from the House of Ulysses at Thugga/Dougga, Tunisia, dated to the 5th century CE (now in the Bardo Museum), depicting the Homeric scene where Baccus punishes the Tyrrhenian pirates are also found two fishing scenes (Blanchard-Lemée *et alii*, 1996: 119, Fig. 79). The fishing scene with a large and thick seine-net carried out from a ship depicted in the right-hand side of the Ulysses' panel is the subject of this paper. The ship is shown from its broad rounded prow and three quarters of the port side. It slightly tilted to its starboard side due to pulling of the heavy fish-net (*griphos* or

sagena) full with fish by both men from the port side of the vessel. The aft part of the ship is damaged and it is filled up with white plaster. We may assume that the stern was broad and rounded. The upraised sternpost has a fishtail tip. Only the tip of the sternpost is preserved. The lower part of the bottom is made with several rows of dark-brown and black tesserae, thus indicating the bitumen coating to make the hull watertight. The shallow deck is just beneath the gunwale. On the port fore gunwale several short bitts are depicted. The rigging comprises the tapered mast stepped amidships, downward arching yard mounted to the masthead and the furled sail beneath the mast. The angled lines on either side of the mast, stretching from the joint of the mast with the yard to the mid-gunwale may indicate the shrouds (actually they were meant to indicate the fore-and-back stays securing the mast in place; the mosaicist misplaced them, because he was interested to show the pulling of the fishing net by the men on board). The brails and the braces are tied to the yard with their lower ends hanging free. No row-oars or steering-oars are shown. The ship is occupied by three men engaged in fishing. The standing man on the prow is naked and he is in the process of throwing the trident from his right hand into a large octopus facing the prow. The other two men working the fishing net are dressed with short tunics. Both men are pulling each line of the thick seine-net full of fish. Beneath the bottom of the ship a dolphin swims alongside two fish which are damaged and only partially preserved.

Types of Fishing Vessels and the Archaeological Evidence

Fishing vessel may be divided in boats and ships. Their construction and shape is quite similar but they are distinct by size and propulsion. The vessels presented above will be discussed upon their building material, propulsion, size and type known from ancient literature, iconography and archaeological evidence.

The simplest building material for small boats is papyrus or reeds, which grow in abundance on the banks of the Nile and its Delta, or in similar surroundings of the Tigris and Euphrates. To build such boats does not require a shipshed or a shipyard rather an area big enough to accommodate the size of the bundle craft to be built. The only tool necessary to build a bundle boats is a simple knife of flint or metal to cut through the reeds or papyrus. The only technique needed was the rope-making and the ability to bind bundles of reeds or papyrus to tight them together and then to other bundles, using coiled basketry (McGrail, 2001: 21-22). The sequence of bundle boats building and the hull shape can be seen from many wall paintings from the Pharaonic Egypt. A details sequence of building papyrus boats comes from the tomb of Ptahhotep in Saqqara and dated to the fifth-dynasty (McGrail, 2001: 21, Fig. 2.7). Papyrus boats continued to be built throughout the history till nowadays. The fishing scene depicted in the Nile mosaic from Palestrina (end of the 2nd century BCE) is carried out from a papyrus built boat (Fig. 1). It lacks the propulsion gear. The boat appears to be anchored, though no mooring or anchor lines are shown; the static position indicates it's anchoring.

The wooden boats may be classified in two groups: 1) rounded hull and both rounded stern and stem; 2) the second group comprise boats with a broad hull, rounded stern and concave stem finished at the water level by a projecting pointed cutwater. This device is a constructional element of the elongated keel meant to give better hydrodynamics and hydrostatics to the vessel (Figs. 4, 5, 6). The propulsion of such boats is provided by two to six row-oars and a pair of steering-oars, one oar mounted to either quarter gunwale. The decks on the fishing boats presented above are flat, at the gunwale level or just beneath the gunwale. Apparently, some boats with the concave prow and projecting pointed cutwater may resemble a smaller version of seagoing Roman merchantmen. They were propelled by wind, as suggested by the retracted mast on the deck (Fig. 5). The hanging poop was fenced with a low lattice-screen and the pro-

jecting head of a water-bird (duck or swan) was set on the poop-deck. The stempost was adorned with a small inverted volute.

A rare depiction of boats with transom prow is evidenced by two boats shown in the fishing scene mosaic in the atrium of the villa at Piazza Armerina (Fig. 3). Such boats had a team of 2-3 men engaged in fishing with trident or cast-net, whereas one putto was the helmsman working the steering-oars to stabilize the boat on its sailing course. The fishing was carried out close to the shore in shallow waters or in an anchorage with seafront colonnades.

Only three fishing ships are discussed in this paper. Their constructions represent two categories, similar to the small boats: 1) broad hull with rounded stern and concave stem finished with a projecting pointed cutwater at the water level. La Chebba Ship evidences that the cutwater could be coated with a bronze figurehead of a wolf or stylized hedgehog (Fig. 2) to protect it against damages, or as apotropae. This device was not a ram rather it protected the cutwater from damages; 2) rounded broad hull with both rounded stem and stern (Blanchard-Lemée *et alii*, 1996: 119, Fig. 79). All the ships are rigged with sailing gear (tapered mast, yard and a square sail), as well as row-oars (Fig. 2); however the steering was performed by a pair of steering-oars, one oar mounted to either quarter gunwale. The lower shafts of both steering-oars cross the blades transversally. The ends of the elongated blades angle towards the shaft of the oar (Fig. 2). The upper shaft is mounted to the gunwale by a metal or leather ring strop or grommet or it projects through oarports beneath the aft-outtrigger. La Chebba Ship indicated a typical seagoing Roman merchantman, bearing the characteristic attributes of sea-bird figurehead on the stempost, a dolphin decoration on each upper side of the prow, two masts, the main mast and the artemon, as well as the aphaston adornment of the sternpost, and a cabin with barrel roof set on the quarter. Beit Loya Ship is a small sailing vessel propelled by one square sail supported by a tapered mast stepped amidships. The Dougga Ship depicted in the Ulysses' mosaic panel has a broad and rounded hull with broad rounded stem and stern. The fishing ships presented above indicate vessels of small to medium size load capacity (2-80 tons). They are merchantmen that also were engaged in commercial fishing, or they could carry passengers as well.

To understand types of fishing vessels depicted in varied arts and especially in mosaics, or their reference in ancient literature can't be complete without the archaeological evidences of found shipwrecks in occasional underwater excavations or surveys. Some wrecks are indeed related to fishing activities as evidenced by the fishing gear found on board or around the wreckage sites. Probably, the first case of a large ship used for fishing is indicated by the Byzantine Serçe Limani wreck, dated to the 11th century CE. The ship was not only engaged in fishing rather it was a merchantman transporting glass objects as well as glass ingots. The lead sinkers found in position probably belonged to three fishing nets, each c. 40 m in length (Marzano, 2013: 25 and note 51). Transportation of fresh fish presented a certain problem. Therefore the ancient fishermen solved partially this problem by building floating tanks that were towed by a ship. Such tanks were shaped like a boat with many holes drilled on the bottom of the hull, thus sea water could fill in and keep a continuous flow (Marzano, 2013: 296). A rare conclusive evidence of transporting the catch of fresh fish is provided by a small boat excavated in 1959 within the basin of Portus Claudius. The hull was salvaged in 1961, and after conservation it was exhibited in the Museum of the Roman Ships since 1979. The boat is known as Fiumicino 5, and was dated to the 1st century CE (Boetto, 2010: 245, Fig. 1). The preserved length of the boat is 5.2 m (originally 5.5 m), the width at amidships 1.5 m (originally 1.8 m), and the surviving height of the remaining hull is 0.55 m (originally 1 m). In the middle of the hull was built a troncopyramidal fish-well with a square base (1 × 1 m). The box was made of thick planks (5 cm) and assembled with mortise-and-tenon joints (Testaguzza, 1970; Scrinari, 1979; Boetto, 2006; 2010). The capacity of the tank was 300 liters of water (Boetto, 2010: 244). Nineteen holes, from 2.5 cm to 3 cm in diameter, were drilled on the bottom of the well that assured the continuous flow of

seawater. When filled in with water the holes of the tank were closed with plugs/treenails carved from stone pine branches and measuring from 10 to 14 cm in length (Boetto, 2010: 246). Other boats with a fish-well are known as Zwammerdam 1 and 5 pirogues, dating to the 2nd century CE were found in the Netherlands (Boetto, 2010: 248, Fig. 5).

Vessels with transom prow are not known only from iconography, especially both boats depicted in the fishing scene in the atrium of the villa at Piazza Armerina, Sicily (Fig. 3). Actually a Roman vessel with a transom prow was excavated in Naples, Italy in the late 1990's and early 2000's, during the construction of a new subway line. Napoli C vessel built with transom prow, has a preserved length is 13 m, a width 3.7 m and a depth of 0.8 m (Boetto, 2010: 291; Giampaola *et alli*, 2005: 72). The vessel has a chamfered keel which had been assembled to a rabbeted stern grip and a transom prow. Alongside Napoli C two other well preserved vessels were revealed on the floor of the ancient Neapolis harbor (Giampaola *et alii*, 2005: 61, Fig.1). This harbor was built in the 4th century BCE and remained active until the end of the 5th century CE when the harbor basin was completely silt up (Boetto, 2009: 209). Napoli A and B, were built with the conventional rounded and angles stem and stern. Other two vessels with transom prow were found in Toulon, France, during the construction of the modern commercial center in 1987, which is located within the Roman harbor in the ancient town Telus Martius (Boetto, 2009: 291). Toulon 1 and 2, were raised and are treated with PEG for their conservation. Toulon 1 has a preserved on a length of 8.5 m, a width of 3.1m and a depth of 0.35-0.45 m; Toulon 2 is preserved length of 6.3 m, a width of 2.2 m and a depth of 0.32-0.45 m (Boetto, 2009: 291, Fig. 4). The hull of both Toulon vessels with flat bottom is preserved to the height of the gunwale; they have a chamfered keel assembled to a rabbeted stern grip and to the transom prow. The Napoli C and both Toulon wrecks are dated to the 1st century CE. They were used to transport cargoes, whereas the Toulon vessels may have been use for port services or fishing activities.

Names of Fishing Boats and Ships

The generic name of vessels used to fish at sea or rivers is known as *pescatoria scapha*. Some names of fishing vessels are found in ancient literature, whereas the iconographic evidence of such vessels is mainly found in the «Catalogue of Ships» depicted in the Althiburus mosaic, Tunisia, dated to the 3rd century CE (Casson, 1971: Fig. 137). In this illustrative catalogue are depicted several vessels (over twenty boats and ships) followed by manes that may indicate their type. I will not list all the Althiburus vessels but only those which are relevant for this paper. The hull shape, propulsion and use of these vessels augment all the types brought into discussion in this paper. The boats have rounded hulls with rounded stem and stern, or a concave stem ending at the water level with a projecting pointed cutwater:

- *Musculus* (Latin)/*mydion* (Greek): literally means «little mouse»; it is a small boat with broad concave prow and a projecting pointed cutwater; the upraised rounded stern is adorned by inverted sternpost with a small rounded tip. The gunwale appears to have a backward extension. The row-oars were mounted amidships to either side of the gunwale. The stempost with a block or inverted small volute tip has an angled forward projection. This type of boat was used for fishing or carrying light cargo along the seashore or on rivers and lakes. The Umm al-Rasas and Sousse (Fig. 4) boats may be associated with the *musculus/mydion* type (Casson, 1971: Fig. 137/10).
- *Stlatta*: a river row-boat with projecting pointed cutwater. A line of verse underneath the boat depicted in the Althiburus catalogue refers that it was used on rivers: «From here the legion took care of transport over the stream by means of stlatta» (Casson, 1971: 333, note 26). The boats from Sousse (Fig. 4), Bizerta and Piazza Armerina (Fig. 6), may be also associated with *stlatta* type (Casson, 1971: Fig. 137/15).

- *Cydarum* (Latin) or *kydaron* (Greek): in the Althiburus mosaic is depicted as a two men fishing boat with concave prow and projecting pointed cutwater. Some Oxyrhynchus papyri attest that *kydaron* were used on the Nile and had varied load capacity; P. Oxy.1650.12 (1st-2nd century CE) and P. Oxy.1651.15 (3rd century CE) mentions a *kydaron* of three and three quarters ton (Casson, 1971: 331, note 11). The Bizerta and Armerina (Fig. 6) boats may be also associated with *kydaron* type (Casson, 1971: Fig. 137/19).
- *Horeia*: a fishing boat with a transom prow appears in the Althiburus mosaic with two sets of fishing nets on the fore and quarter decks. The fishing boats with a transom prow in the Armerina and Althiburus mosaics are rare depictions in any arts and specially in mosaics (Fig. 3; Casson, 1971: Fig. 137/20). The archaeological evidence of Napoli C and both Toulon vessels with transom prow (Giampaola *et alii*, 2005: 79, Fig. 32; Boetto, 2009: 292, Fig. 4) augment that they were used in harbors services, carrying cargo, or even engaged in fishing. Casson hypothesized that the transom prow had been developed for loading of cargoes in harbors where the boats could reach close by the quays (Casson, 1964:176). The transom prow would have enabled a small boat to tie up a flush at a dock or quay (Carlson, 2002: 213).

The iconography of ancient ships does not specially illustrate fishing ships. In ancient literature we find some names of vessels sailing along the Mediterranean coasts. They were rigged with one or two masts and row-oars as auxiliary gear (Fig. 2) that were used when the winds were not favorable for sailing, or when entering/leaving a harbor/anchorage. Thus we may assume that the crew of La Chebba ship comprised 18-20 men, 16 rowers, one captain, one helmsman and two more men engaged in auxiliary work on board. One name that may be associated to varied sizes of costal vessels is *actuaria* (Latin) or *akatos* (Greek). The *actuaria/akatos* was small enough for the oars to be skulled in pairs or as big as requiring fifty rowers; twenty five rowers, one man per oar per side (Torr, 1964: 106). Apparently the *akatos* type was plying between Ashkelon (Israel) and Alexandria (Casson, 1971: 338, note 52). In the Althiburus Catalogue the *actuaria* is depicted as a vessel with elongated hull, and propelled by a large square sail as well as row-oars (Casson, 1971: Fig. 137/13). One distinct name for a small fishing ship is «epaktra», that was suitable also in warfare (Torr, 1964: 112). We may assume that the ships associated with fishing techniques and presented in this paper may relate to *actuaria* or *epaktra* (Fig. 2; Friedman, 2014: 505, Fig. 4; Blanchard-Lemée *et alii*, 1996: 119, Fig. 79).

Concluding Summary

The mosaics brought into discussion (2nd century BCE to the 8th century CE) are the visual evidences of several fishing techniques that have not changed throughout the centuries and are still being used nowadays. The vessels used to carry out fishing activities and transporting the catch of fresh fish are known as *pescatoria scapha* or *navis vivariae*, boats with fish-well build amidships within the hull. They are supported by iconography representations, ancient literature and lately by the archaeological finds of the Fiumicino 5 Boat, Napoli C and both Toulon vessels with transom prows. The small fishing boats may be associated with a more specific type known as *musculus/mydion*, *stlatta*, or *cydarum/kydaron*. The Armerina boats with the transom prows may represent *horeia* type. These types are evidenced by the Ships Catalogue in the Althiburus mosaic, Tunisia, dated to the 3rd century CE. The sailing vessels depicted in the mosaics from La Chebba, Tunisia, Beit Loya, Israel and Dougga, Tunisia are shown with their sailing rig (mast, yard, sail) and steering gear. La Chebba ship shows that row-oars were found on boats and used when the wind conditions were not favorable for sailing or when entering/leaving a harbor/anchorage (Fig. 2). These vessels may indicate *actuaria* or *epaktra* type, which were not specifically meant for fishing rather they were small to medium size merchantmen that sailed along the Mediterranean coasts or on rivers (Nile, Tiber). Napoli C vessel with transom prow (13m

long, 3.7m wide at amidships and 0.8 m deep) may have been used for harbor services, carrying cargo (probably up to 20 tons) as well as for fishing along the western coast of Italy. Both Toulon vessels (8.5 m long, 3.1 m wide, 0.35-0.45 m deep; 6.3 m long, 2.2 m wide, 0.32-0.45 m deep) most probably were used for fishing along the southern coast of France during the 1st and the 3rd centuries CE.

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Identifying ancient commercial Greek harbours (8th-4th B.C.)

Identificando los antiguos puertos comerciales griegos (VIII-IV a.C.)

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Abstract: Studies concerning Greek commercial harbour areas are far from extensive. The reasons lie in the general trend of avoiding large scale harbour works, in modern settlements which lie over ancient πόλεις, in changes in sea level and in the human intervention, which changes the appearance of the coasts to comply with the needs of the tourism industry or fish farming. From this general outline it is evident that a new and updated examination of the subject is needed and the first thing to do is certainly to identify the active ports between the 8th and 4th cent. B.C. This poster aims to present part of a project directed to collect pre-hellenistic Greek ports: this collection is being organized in a database that, when completed, is expected to be publicly visible.

Key words: Greek, sea, harbour structures, harbours, database.

Resumen: los estudios realizados sobre las áreas portuarias griegas luchan por abrirse paso. Las razones se tienen que buscar en la tendencia a evitar grandes obras portuarias, en la existencia de asentamientos modernos, en la localización de las πόλεις antiguas, en los cambios del nivel del mar y en la intervención humana, que cambia la configuración de las costas para cumplir con las necesidades de la industria del turismo o de la piscicultura. Con este cuadro general es evidente la necesidad de una puesta al día del tema y la primera tarea que se debe llevar a cabo es identificar los puertos activos entre los siglos VIII-IV a.C. Este póster presenta parte de un proyecto dirigido hacia la recolección de los puertos griegos pre-helenísticos: los resultados se están organizando en una base de datos que, una vez completada, se hará pública.

Palabras clave: griegos, mar, estructuras portuarias, puertos, base de datos.

IDENTIFYING ANCIENT COMMERCIAL GREEK HARBOURS (VIII – IV b. C.)

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GENERAL BACKGROUND AND AIM

Studies concerning Greek commercial harbour areas are far from extensive. The reason lies in the general trend (popular at this period) for avoiding great harbour works, choosing to intervene with improvements only if the **morphological characteristics of the area would itself guarantee a strong natural harbour**. There is, therefore, relatively little archaeological evidence for harbours at this period. Secondly, modern settlements lie over the sites of ancient πόλεις which prevents close examination: modern harbours are often located on the same spots as ancient ports.

Following this general scheme it is clear that an update of the topic is necessary. For this reason, **my purpose is to create a framework for the study of commercial harbours in pre-hellenistic Greece by identifying active ports.**

THE PROJECT: A DATABASE TO COLLECT COMMERCIAL GREEK HARBOURS (VIII-IV b.C.)

This collection is being organized in a database that, when completed, is expected to be **open access**. I am running a MySQL database over a WampServer: a standard and reliable combination of instruments for manage ability and possibility of building open access web interfaces. The database collects the names and the **main characteristics of harbours/anchorages** spreaded all over Greek and Asian coastscape. Each data sheet will records ancient and modern toponymous, location, present situation of the harbour, anchorage areas, periods of use, functions, literary sources and bibliography.

Once completed, the database will register ancient active commercial harbours between VIII and IV b.C.

DATABASE MENAGEMENT SYSTEM



Fig. 1-2: Screenshots of the Database Menagement System

GRAPHIC INTERFACE



Fig.3: Homepage



Fig. 4: Internal search engine



Fig. 5: Data sheet. Ex: Oeniade

FUTURE DIRECTIONS

At present the database **contains complete records of around 161 ancients ports**. The records are mainly based on ancient literary source, modern authors and archaeological data.

Further analysis of database information will provide us with more accurate and in depth knowledge of Greek harbour history, but even these initial data give us a fantastic insight for future research. In fact, although artificial harbours seem to be a VI cent. b.C. general achievement, the harbours areas must have been active from a previous era. The fact that, between the VIII and the VII cent. b.C., harbours were natural does not mean that they were not important: on the contrary, **ports were – from the beginning – a basic aid to navigation and trade**. From the VI century b.C. we see a gradual increase of the size and the infrastructures of artificial harbours: the sea and the coastline underwent an **anthropization phenomenon** by which each city has been provided with its own sea access, and, sometimes, even more than one.

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Port professions: organization and working processes of a Roman harbor

Profesiones portuarias: organización y procesos de trabajo de un puerto romano

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Abstract: The aim of this poster is to show an introduction to the PhD called *Portus Tarraconis. The harbour of Tarraco during the Late Republic and the Early Empire. Literary sources, historiography and archaeology* (Universidad Rovira i Virgili, Tarragona). The poster is focused on a legal and economic framework, whose final aim is to extract a reliable but ideal image of the working processes of harbours in the roman period. We present through an image selection, the itinerary of the goods on a commercial ship from its arrival in the harbour to its distribution to shops or warehouses. We specially take into account the harbour professions and we represent the harbour management thanks to the documentation of classics, epigraphy and iconography. This theoretical tour is documented in many harbours of antiquity; thus, we will select the most representative samples to display this part of the trade.

Key words: Roman harbour, epigraphy, iconography, trade, harbour management.

Resumen: el objetivo de este póster es mostrar parte de la tesis doctoral *Portus Tarraconis. El puerto de Tarraco en época tardorrepública y altoimperial. Fuentes, historiografía y arqueología* (Universidad Rovira i Virgili, Tarragona). El póster se centra en el marco económico y jurídico y el objetivo final es extraer una imagen ideal pero fidedigna de los procesos de trabajo que se llevaban a cabo en los puertos en época romana. Presentamos a través de una selección de imágenes, el itinerario que recorrían las mercancías desde que llegaban a puerto hasta su distribución en los almacenes o tiendas. Se hace hincapié en las profesiones portuarias y en la representación de la gestión de las mercancías en las fuentes clásicas, la epigrafía y la iconografía. Este tour teórico se encuentra documentado en muchos puertos de la Antigüedad y, por consiguiente, se han seleccionado los ejemplos más representativos para mostrar esta parte del proceso comercial.

Palabras clave: puerto romano, epigrafía, comercio, iconografía, gestión portuaria.

Port professions: organization and working processes of a Roman harbour

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Objective

The aim of this poster is to show an introduction to the PhD thesis developed at Universitat Rovira i Virgili (Tarragona) named *Portus Tarracensis. An approach to the port of Tarraco during the roman period. Literary and archaeological sources.* The thesis is focused on the study of three aspects of the harbour of Tarragona during the late-republican and imperial period. The project studies the archaeology remains, legal and economic framework, ancient sources and epigraphy in order to establish an approach to its economic and physical infrastructure. The project is inscribed in the project HAR2012-37405-C04-01 Roma, Las capitales provinciales y las ciudades de Hispania: difusión de modelos en la arquitectura y el urbanismo romanos. Subproyecto Tarraco (Ministerio de Economía y Competitividad).

Development

We present thorough an image selection the itinerary of the goods on a commercial ship from its arrival in the harbour to its distribution to shops or warehouses. We specially take into account the harbour professions and we represent the harbour management thanks to the documentation of classics, epigraphy and relief iconography. We deal here with the organization and working processes of a Roman harbour together with its definition and main architectural structures. A part of the thesis is focused on a legal and economic framework, whose final aim is to extract a reliable but ideal image of the working processes of harbours in the roman period. In this way, the trade patterns, the commercial management and the economic function will be explained and understood.

1) Harbour arrival

When a merchant ship arrived to a harbour, there were two cargo unloading options. Goods could be offloaded directly from the ship by dockers such *saccarii* (Fig. 1) or *phalangarii* or by using engineering machines like cranes or tackles.



Fig. 1. Relief in the cathedral of Salerno, III A.D.
A small cargo vessel is being offloaded by a saccarius (Casson 1994: 126), who carries heavy sacks.
Source: <http://www.romaeuropa.org/>

2) Transfer boats

If the seabed was insufficiently deep, the bargeman had the duty of cargo transport between the vessel, which remained anchored near the harbour and the boats (Fig. 2). Plenty of documentation about these professional figures hereby referred to can be found through epigraphy thanks to their belonging to a guild, especially in river zones such the Tiber (CIL XIV, 309, 252, 409). These professional boatmen were the *scapharii* (people in charge of a skiff), *pleronarii* (they performed a function in the operation of ferries), *lenuncularii* (ferryman or watermen) and *caudicarii* (lightermen) (Rougé 1966: 192-200).

In other river zones like in Marseilles, there were specific hauling river-boats to upstream the goods to the river harbour (Fig. 3).



Fig. 2. Mosaic in Foro delle Corporazioni, Ostia. Ca. A.D. 200.
A saccarius transfers a cargo of amphoras from a sea-going vessel (right) to a navis caudicariae (left).
Source: <http://www.app-haefen.de/de/die-projekte/der-dusshafen-von-ostia/>



Fig. 3. Relief at Cabrières-d'Alès, Musée Calvet, Avignon, III A.D.
A navis caudicariae is being hauled by a towline. Three men are hauling the barge loaded with wine-casks up a river, probably the Durance (Johnstone 2004: 158).
Source: <http://www.marine-antique.net/>

3) Maritime customs payment and storage

Once the ship entered the harbour, a maritime custom called *portorium* had to be paid. The tax was not only applied to goods transported in maritime routes (Ulp. D. 50.16.59), but also taxed the good transport by land.

The *publicani* (tax collectors) collected the *portorium* thanks to a tax declaration (Zamora Manzano 2009). In the harbours, this goods's declaration had to be verified by state functionaries. These people were the *tabularii* (Fig. 4) and their assistants or *auditores*.



Fig. 4. Relief of the tabularii of the Trajan harbour, Ostia. Torlonia collection, Rome, 2nd/3rd Century A.D.
The relief shows the control of offloading amphoras by saccarii (left). The three seated figures on the right may be a tabularius with two auditors. They are located behind a desk recording the cargo on wax tablets in the form of a book (Bach 1987; Poiney 1997; Meiggs 1973).
Source: <http://www2.rgzm.de/Navis/Musea/Ostia/Homepage/Tabularii.htm>

Jobs related to storage are well-known. We can identify the *horreaarii* or people responsible for guarding the warehouses and the *mensores* (Fig. 5), who guaranteed the volume and weights of the goods.



Fig. 5. Roman painting of the Isis Giminiana, Vatican Museums, 2nd/3rd Century A.D.
The ship, named Isis Giminiana, has on board the captain or magistrate called Farnaces, the owner Atascantus, and two saccarii carrying sacks. In the middle there is a mensur measuring the grain with a nute-lum.
Source: <http://www.ostia-antica.org/dict/plnec/plnec.htm>

4) Administration staff and surveillance personnel of harbours

Each harbour needed functionaries' corpora in order to control, administrate and maintain the harbour. Both sources and epigraphy show different professional categories in Ostia. Dio Cassius (55.4.4.) describes the figures of *quaestores Ostienses* during the Augustan period with military and financial duties (Rougé 1966: 201) and maybe judicial responsibilities (CIL XIV, 3603). During Claudius's time, these *quaestores* are replaced by the figure of the *procurator* (*procurator portus Ostiensis* (CIL XIV, 163) and other inferior staff assistants (Houston 1980: 157). Harbour security was also very important in order to avoid piracy attacks and other exceptional problems. Well-known are also the *stationarii*, who supervised the coast and the entrance to the harbour, or the *custodes litorum* (Rougé 1966: 210). In our study case of Tarraco, there was the figure of *praefectus orae maritimae*, who was responsible to look after the coast among enemies (RIT 164, 166, 169, 165, 301, 289, 288, 171, 316, 162).

5) Repairing vessels

Shipbuilding was a high specialised job, so it needed personnel only for this duty: the *fabri navalis* or *architectus navalis* (Fig. 6). Thanks to the *Edictum de Pretis* of emperor Diocletian, we know his loan (Diosono 2008) as well as the fact that his job was one of the most well-paid. Furthermore, epigraphy shows architects related to the navy of Misenum and Ravenna (CIL XII, 723; X, 5371, 3392). The stuppatores were responsible of caulking the ship. They were organised in corporations in Ostia (CIL XIV, 44) in relationship with the *fabri navales* and the boatmen *caudicarii* (CIL VI, 1649). On the other hand, Vegetius relates in his work *Epitoma rei militaris* (II, 3) that the unclores were people who caulked the outer side of the vessel in order to protect it (Rougé 1966: 188-191).



Fig. 6. Funerary stele of Longidienus, fabri navalis. National Archaeological Museum, Ravenna, 2nd/3rd Century A.D.
Publius Longidienus (CIL XI, 129) was a shipwright. The relief shows him working with the ascia in a ship. On the right we can read: Longidienus pushes on with his work.
Source: <http://ancientrome.com/art/artwork/eng.htm?id=4899>

Livy (44. 10. 3) explains that king Perseus threw his treasure to the sea to hide it from his enemy. Time after, he asked the *urinatorum* (Fig. 7) to recover it from the bottom of the sea. These scuba divers were people who worked in harbours in order to recover the goods that accidentally fell off from the ship during the offloading. Moreover they could repair some leaks. Some inscriptions show that they were organized in guilds in the Tiber zone (CIL VI, 1872, 1080, 29700 and 29701) and in Ostia (CIL XIV, 303), although they were supposed to exist along all the ports of the Roman Empire.



Fig. 7. CIL XIV, 303. Corpus urinatorum. Roman inscription located in Ostia.
Source: Epigraphik. Datenbank. Claus / Slaby

6) Traders

The last step of the goods was its sale and distribution in shops. The people who did business were the *mercatores*, *negotiatorum* and the ones related to ships, the *navicularii* (Fig. 8). A mercator was a trader who sold and bought products not for profit but also to obtain benefits. The negotiator was the one who dedicated himself to the negotia, big enterprises both maritime and terrestrial. (Tac. Ann. 12.51.). The *navicularius* was a person who developed any maritime activity. There were two categories: the *navicularii amnici*, who sailed in rivers or the *navicularii marini* or shipowners (Casson 1960). Thanks to epigraphy we know they organised themselves in guilds (de Salvo 1992).



Fig. 8. Funerary stele in Solona, Museum Spalato, I A.D.
The funerary stele shows the bust of the deceased. The man, called C. Utius, was a trader or a navicularius, because the inscription talk about his travels in the sea and the relief shows a commercial ship. (Rostovtzeff 1937; Plate XLIV, II, Jug-03, 02203).
Source: Epigraphik. Datenbank. Claus / Slaby



Fig. 9. Mosaic of the statio 18, Foro delle Corporazioni, Ostia, 2nd/3rd Century A.D.
In this forum were located fifty eight offices or stations were the traders and navicularii worked. Every floor of the statio is decorated with marine scenes. Almost all stations had a poster with the name of the company, for example the navicularii Turritani, Miseneses, etc.
Source: <http://www.ostia-antica.org/piazzale/corp.htm>

7) Transport and sale

The final arrivals of the goods were the, located near the port area. In other cases, when the final distribution shop was in a city inland, road transport was necessary. There were a lot of different types of carriage and professionals who drove them: muliones, lumentarii, carrucarii, cisarii and vecturarii (Pisani Sartorio 1988: 23).



Fig. 10. Relief of a trader selling fabric in his shop. Galleria degli Uffizi, Florence, I A.D.
(Liberti & Bourbon 2005; Rostovtzeff 1937; Plate XXXII (2)).
Source: <http://www.sofiaoriginals.com/m/a12232.jpg>

This poster is the result of the Master's thesis called *El puerto romano de Tarraco. Una aproximación a su funcionamiento a partir de los oficios portuarios* (2012) URV/ICAC

Multidisciplinary approach in the example of ancient port in Zaton near Zadar

Enfoque multidisciplinar en el ejemplo del antiguo puerto en Zaton cerca de Zadar

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Abstract: In Zaton in ancient times there was a harbor as a commercial port of the nearby *municipium* of Nin (*Aenona*). The port was discovered in the 1960s, and from 2002 to 2013 the excavations were carried out systematically, what has allowed us a detailed insight into the chronological issues. The material found in the cultural layers shows that the beginnings of the port reach back into the 1st century AD. The port was used till the end of the 3rd century AD, and its end can probably be dated to the beginning or half of the 4th century AD. During excavations, for better understanding of the functioning of the port and life itself in the harbor, a cooperation was developed with many other scientists from different fields of research like geology, aerophotography, 3D laser scanning, multibeam sonar, geophysics, biology and zoology. The poster is showing the results of those cooperations.

Key words: Zaton, ancient port, multidisciplinary.

Resumen¹: en la Antigüedad, en Zaton había un puerto comercial cerca del municipio de Aenona (la actual Nin). El puerto se descubrió en la década de 1960 y desde el año 2002 a 2013 se han llevado a cabo excavaciones sistemáticas que nos han permitido una visión detallada de su cronología. El material encontrado muestra que el comienzo del puerto corresponde con el siglo I

¹ Translation from English to Spanish by José Manuel Matés Luque.

d.C. El puerto se usó hasta finales del siglo III d.C y su fin se puede datar probablemente al comienzo o mitad del s. IV d.C. Durante las excavaciones, para un mejor entendimiento de las funciones del puerto y de su vida, se cooperó con muchos otros científicos de otras disciplinas, tales como la geología, la fotografía aérea, el escaneo láser en 3D, el sónar de barrido lateral, la geofísica, la biología y la zoología. El póster muestra los resultados de esas cooperaciones.

Palabras clave: Zaton, antiguo puerto, multidisciplinar.

MULTIDISCIPLINARY APPROACH IN THE EXAMPLE OF ANCIENT PORT IN ZATON NEAR ZADAR



AEROPHOTOGRAPHY

In addition to archaeological research various archaeological features can be identified on aerial photographs. In several occasions aerial shots were taken of the site itself, and also of the surrounding area, on which we can see the remains of an approximately 200 meters long ancient breakwater. The remains of walls on land and partly in the sea, which were part of buildings that are likely to belong to the ancient port complex of buildings, are also visible.

GEOLOGY

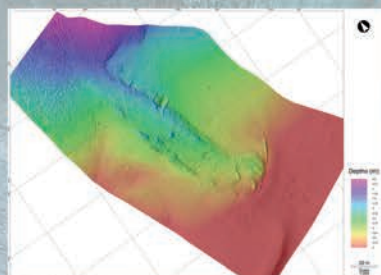
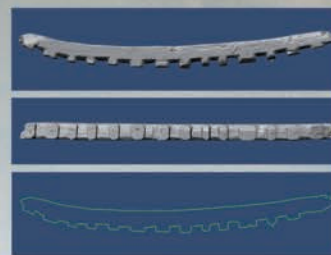
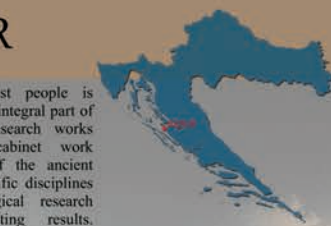
Besides various cultural materials, a large part of different types of stone was also found. Microscopic thin sections were made, which have given us a better insight into the type of rock and fossil content. Samples were determined from a lithological viewpoint and from micropaleontological content. The fragments and massive blocks of limestone are of the Cretaceous and Eocene age, originating from around the Zaton area and neighbouring islands. The monolith of chalk breccia is from the Tertiary period originating from Krk (Baška), perhaps Pag (Novalja, Lun), or from the coast of Velebit. The talutina of magmatic (daciti) and metamorphic rocks (paragnays, slate, and marble) are not found along the Adriatic coast, but are found in Calabria and Sicily.



Archaeological excavations for most people is the first association of archeology. An integral part of archaeological research are also research works preceding the excavation and cabinet work following them. In the example of the ancient port in Zaton there are several scientific disciplines that were involved in archaeological research and which gave very interesting results.

3D LASER SCANNING

3D laser scanning is a modern method of fast and accurate gathering of large amounts of spatial data. With this method, we decided to make the documentation of ship 2 from the ancient harbor in Zaton, which will then be conserved. We scanned the frames, plating, and the keel. For scanning, we used the handheld Z-scanner 800, that uses the photogrammetric and laser method of mathematical triangulation with the help of cameras and laser beam projection.



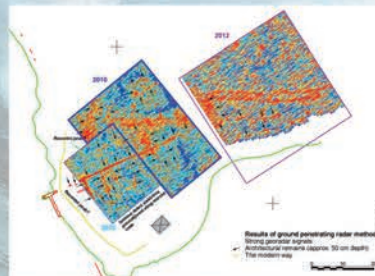
MULTIBEAM SONAR

The purpose of bathymetric survey with the help of multibeam sonar was to determine the size and protrusion of the remains of the ancient breakwater. Depths were surveyed with multibeam echo sounder (MBES) R2Sonic 2022, with frequency of 200-400 kHz and with a 500 meter range. The deepest point of the survey coverage was along the southern edge (5.8 m)

and the shallowest part was at the northern corner (0.5 m). After processing the raw data the final result was a digital bathymetric model (DBM) that contained 3 035 027 individual depths with a 0.1 meter horizontal resolution. The model shows the extent of the Roman breakwater structure which is over 150 m long and up to 35 m wide. On the middle part of the inner edge of the structure there is a clear deeper rectangular depression which probably represents the remain of an archaeological trench made during several years of excavations.

GEOPHYSICS

The area was explored with geophysical methods on several occasions, and so far the total explored area reaches approximately 2000 m². Three different geophysical methods were used: 1. Method of geoelectric resistivity mapping (Geoscan RM15), 2. Ground penetrating radar method (GSSI SIR3000, 400 MHz monostatic antenna), and 3. Magnetic method (Geometrics G-858). The results of the geophysical surveys will definitely need to be checked with archaeological trenches, especially in areas where, because of the proximity to the sea, the results of these studies are not completely reliable or are deficient (sea water has a negative impact on the results of measurements using the ground penetrating radar and geoelectric resistivity method, while the magnetic method is not sensitive to moisture). However, the nondestructive methods led to valuable information about one of the architectural complex that belonged to the ancient harbor.



PLANT REMAINS

With archaeobotanical analyzes we obtained data about which agricultural species were grown in the past and what were the eating habits of people. During the excavations, a sample of approximately 1 dm³ was taken from each layer. All samples were floated through three sieves with different mesh diameters (2.5, 1.0, and 0.315 mm). In the analysis, 54 different taxa were identified. The most frequently recorded plant remains are typically Mediterranean: fig (*Ficus carica*), olive (*Olea europaea*), grapevine (*Vitis vinifera*), and stone pine (*Pinus pinea*). The most interesting finding was the radish seed (*Raphanus sativus*) from layer 3, dated to the second half of the 2nd century AD, and it represents the oldest



ANIMAL REMAINS

The analysis of the collected samples has shown that snails are represented by 15 maritime and 2 land species, shellfish are represented by 22 maritime species, while cephalopods are represented by only 1 species, cuttlefish (*Sepia officinalis*). The most abundant species in the samples was the shell Noah's Ark (*Arca noae*). The shells found most often are oysters (*Ostrea edulis*), Mediterranean mussels (*Mytilus galloprovincialis*), and especially purple dye murexes (*Bolinus brandaris*), which obviously were an important segment of the diet of ancient sailors.



The bones of small ruminants prevailed, especially of sheep (*Ovis aries*) and goats (*Capra hircus*). Very small number of bones belong to pigs (*Sus domestica*), cattle (*Bos taurus*), and deer (*Cervus elaphus*). Traces of cuts on the animal bones were found in 16 samples. Considering the site of discovery, a harbor, it is logical to expect a partial presence of seafood. According to jaw specimens, two individual types of fishes have been identified, gilthead (*Sparus aurata*) and moray (*Muraena helena*). The findings of bird bones are also interesting, and confirm the existence of two types of grouse, small and large grouse, and pheasants.

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ARCHAEOLOGICAL MUSEUM
ZADAR

Savudrija (Umag, Croatia): a research programme for the harbour and the coastal landscape in the Roman age

Savudrija (Umag, Croacia): un programa de investigación del puerto y del paisaje costero en época romana

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Abstract: The port in the Savudrija (Croatia) encompasses a complex consisting of different structures, some of which are visible along the shoreline, particularly in the southern section of the small bay. This terrace that was more protruding in ancient times hides a series of wall formations hypothetically attributable to substructure works. Furthermore, excavations have been carried out in correspondence of the breakwater and inner pier. The aim was to evaluate the height of the jetty and the depth of the local bedrock, to highlight the building steps and to define the time of construction and the chronological range of use. In addition, the researches have been aimed to contextualize this significant harbour (40 000 mq [Sq m/m²]) in the port hierarchy of the Istrian coastal landscape. The data, allow us to speculate about the ancient coastal landscape during the Roman Age, the settlement patterns and the relationship between this port and its hinterland.

Key words: Bay of Savudrija, Roman harbour, ancient landscape, sea level changes.

Resumen: el puerto en Savudrija (Croacia) incluye un complejo de diferentes estructuras, algunas de las cuales son visibles en la costa, especialmente en el sur de la bahía. Esta terraza que fue más sobresaliente en tiempos antiguos oculta una serie de formaciones de muros hipotéticamente atribuibles a trabajos de cimentación. Por otra parte, las excavaciones se han realizado en correspondencia con el rompeolas y el muelle interior. El objetivo fue determinar la altura del malecón y la profundidad de la roca madre local, a fin de determinar las fases de construcción, definir el momento de la construcción y el rango cronológico de uso. Además, las investigaciones se han centrado en contextualizar este importante puerto (40 000 m²) en la jerarquía de puertos del paisaje costero de Istria. Los datos nos permiten especular sobre el antiguo paisaje costero durante época romana, los patrones de asentamiento y la relación entre este puerto y su zona de influencia.

Palabras clave: bahía de Savudrija, puerto romano, paisaje antiguo, cambio del nivel del mar.

Savudrija (Umag, Croatia): a research programme for the harbour and the coastal landscape in the Roman age

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The harbour area of Savudrija/Umag, on the Istrian coast has been the subject of underwater archaeological research from 2011 to 2014, as result of a cooperation among Università del Salento – Dipartimento di Beni Culturali, Università di Trieste – Dipartimento di Studi Classici, Archaeological museum of Istria – Arheološki muzej Istra (AMI) and Museo Civico di Umag – Muzej grada Umaga.

The Savudrija/Umag site was mentioned for the first time in the Tabula Peutingeriana, with the toponym *Silva* but it is also mentioned in *Antonine Itinerary* (book IV) and in the *Geographia* of Ptolemy. The Roman harbour had already been described by *Plinius* (c. 100 AD) and is well known to many scholars in the 19th and 20th century, but the first systematic research took place in the 1980s of the last century.



The harbour basin: the complex of obstructions
Originally the basin comprised a series of infrastructures, and some of them are still in use, notwithstanding the state of preservation that is, at times, very compromised by the violent action of the waves. Its form was sub-rectangular, bordered by two piers or external breakwaters.

set against at the same height, the distance between the two piers defined an entrance about 80 metres wide, actually reduced to some twenty metres, and deep from 5.5 to 6 metres. The internal surface was about 60,000 sq. m. The north pier cannot be seen any more, while, in the period of Dugan's reconstruction, it was about 50 m long and constructed with square blocks measuring 0.80 m x 1 m x 0.40 m, it was incorporated into the modern one. Connected to the northern pier, there was a quay of about 70 m in length, of which only the foundation line, leaning on the rocky sea bottom, is preserved.

Along the shore line there are scuttles of pottery fragments and various structures, among which walls hypothetically attributable to substructure works (basilica), and a structure of rectangular shape extending N-S (about 10 x 11.5 m), originally an underground or basement space used as warehouse or depositary.

Structures preserved under sea level

The external part of the northern breakwater protrudes from the western cliff and develops rectilinearly for about 140 metres, while the original width is 11 m. The excavations have proved the construction sequence that involved the installation, through the progressive advancement, of a foundation made up of a grid of loose stones (large shaped blocks), about 1 m high, over this "foundation" the very concrete-structure runs, with the two sides made of large parallelepiped blocks overlapping and slightly staggered rows. That is a very interesting technique along the Adriatic coast, with variants adapted to the local needs, whose diffusion and frequent use is explained by the availability of the stone extracted on the spot. There were found three rows, the base one is the most projecting, with large blocks sometimes chiseled in shape long from 2 to 4 metres, about 20 cm thick, and wide up to 1.50 m, the third row is used to place any more, and can be seen only in some points. The two "vertical" contained an internal filling, nowadays for the most part washed off by the sea.

The eastern blocks are arranged in longitudinal direction, with the exception of the final section of the northern side that shows an interesting technical solution: long and narrow blocks laid in alternation, in order to better break the wave motion.

The inner pier – the so-called "platform" – protrudes at 42 m from the coast (where you can see the paleo-shoreline) corresponding to the rectangular structure on the shore, spreads in the direction north-south for 20 metres, while the width is 14/0/15 m. The building typology and technique are identical to the ones of the northern breakwater: the pier also lies on a strong foundation, about 1.20 m high, made of a sequence of landfill layers poured one after the other: the only difference is in the

richness of organic and inorganic materials, in this case mixed with the stones: tiles, amphorae (DN: 54, DN: 68, Adriatic Red bottomed amphorae), Italian sigillata and common tableware and kitchen pottery, few fragments of glass, numerous weights for fishing nets, numismatical remains and a few faunal remains.

The base layer, 35 m thick, is made of silty sand, very fine, greyish, very organic and compact, almost sand, containing a very high percentage of stones, mostly *Heugthis Truncata* and to a lesser degree *Balanus* *frustula* (the spiny species, still appreciated as food), together with other shellfish. The shell of the murex are cut in their wider section, at the glaze from which ropes used for various purposes were extracted. This indicates that that was a dump of processing scraps, cut with the stones during the construction of harbour facilities.

The western side of the inner pier is connected to a quay, spreading in the direction E-W for about 15 m, of which a discontinuous part is preserved. Scattered blocks lie near by. The quay is made of blocks laid for the most part in rectangles. Close to the quay the depth increases, and there is the best sheltered and deep point – probably, in addition to the head of the inner pier where the depth is less, usually some metres. The blocks of the same year and the contiguous quay follow precisely the isoline -0.60, as well as the bottom of the base of the slope inside up by the collapse on the natural dune is at between -2 and -2.80 m a.s.l.

The Roman harbour

Various findings on the mainland lead us to think that in that zone a number of buildings, both residential and manufacturing, were built, already active in the first half of the 1st century A.D. The construction of harbour facilities can be dated to the same phase, evidently result of a single intervention. Harbour dump materials cover a chronological period from the 1st to the 7th century A.D. The last phase is probably connected to a late medieval settlement detected on the peninsula.

The basin comprises a considerable surface, with imposing installations, that show the largest harbour in Istria, excluding urban centres like Parenzia and Pula and the remains along the shoreline – partly disappeared – suggest that there was a quite "dense" residential and productive settlement. It should, therefore, not be considered a simple "port of call", but a base toward which a highly industrial and exploited territorial sector gravitated, consisting of one or more properties. In the morphology of Savudrija, both along the coastline and in the hinterland, there are various relics, but probably the population density is higher than the one already contemplated.

Variations regarding the sea-level

The two submerged structures, actually visible, external breakwater/southern pier and inner promontory indicate a sea level and a coastal profile deeply modified. With a functional height for the large protective structure presumed to be 1 m above sea level and 0.60 m for the internal one, we can confirm, according to what discovered in other sites of northern Adriatic, a sea level rise of 1.30 m, with a reduced error bar (the elevations and age values) thanks to the better understanding of the functionality of these structures. Even berthing of mean tonnage vessels was possible since the rocky bottom on which the foundation layer was based is now at 3 m and in ancient times at -1.5 m: the draught of a vessel 10 metres long, 5 metres wide, was about 1.2 m and functioned perfectly compatible to the arrangement proposed in the reconstruction.



Augusta Taurinorum and the relationship with its rivers. Topographic reflection after the excavations outside the city walls

Augusta Taurinorum y la relación con sus ríos. Reflexión topográfica después de las excavaciones fuera de los muros de la ciudad

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Abstract: *Augusta Taurinorum* was surrounded by two navigable rivers, which seem to have played an important role in defining the organization and the spatial planning of the city, by the application of precise planning standards. In particular, the wide area included among the city walls and the Dora seems to be, from the early phases of the settlement, part of an urbanization project which included the organization of a manufacturing or commercial district in this area, deeply connected both with the city and the river. The lack of remains of manufacturing areas within the city, together with the identification of tombs of the Roman period exclusively north of the Dora, might require to reflect on the extent of Turin's *pomerium*, traditionally considered coincident with the walls, but probably defined by the river in the northern side of the city.

Key words: River, topography, *horrea*, *pomerium*, commercial area.

Resumen: *Augusta Taurinorum* estaba rodeada por dos ríos navegables, lo que parece haber desempeñado un papel importante en la organización y planificación espacial de la ciudad con unas normas de planificación precisas. Una zona amplia entre las murallas de la ciudad y la Dora parece ser que formaba parte de un proyecto de urbanización que incluía la organización de una especie de distrito comercial y manufacturero en este lugar bien conectado con la ciudad y el río. Los pocos restos de las áreas de fabricación dentro de la ciudad y la identificación de las tumbas de época romana exclusivamente al norte de la Dora, podrían hacernos reflexionar sobre el grado de extensión del *pomerium* de Turín que en la tradición se consideraba coincidente con las murallas, pero que probablemente estaba definido por el río en el lado norte de la urbe.

Palabras clave: río, topografía, *horrea*, *pomerium*, zona comercial.

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STUDIUM S.N.C.

Turin, the roman Augusta Taurinorum, is surrounded by two navigable rivers: the Po, which connects the city with the Po Valley and the Adriatic Sea, and the Dora Riparia, which descends from Segusium (Susa Valley).

The connection with the rivers seems to have played an important role in defining the organization and the spatial planning of the city, by the application of precise planning standards which can be compared with the ones used in other Roman centres, especially those of Emilia Romagna.

The placing at the confluence of two rivers, that border the city in the Oriental and the Occidental side, is a recurrent element that has been supposed to derive from a specific choice made at the moment of the foundation.

This element suggests to assume the existence of a theoretical model, that would be based on the presence of running waters along the perimeter of the urban area, formulated on the route of one or more main water courses bordering the city, and integrated by transversal canals crossing the town (ORTALLI 2005, p. 177). The presence of waterways inside Turin is at the moment just suggested, outside the town, by the presence of the medieval ones which follow intermed branches of the Dora, while the hypothesis of an internal canal in the roman period is a yet unproven through the archaeological record, but it is to be considered a suggestion for future research.

The location of a city between two rivers, which had a purely defensive value in the oldest colonies, has had a functional meaning connected with the use of water as driving force in the production field or for the agricultural and manufacturing activities in the colonies founded from the end of the first century B.C., as the one we are examining.

The two rivers were both certainly used for the navigation: the Dora for trades in surroundings and the Po, which according to Plinius (II, 20) was navigable, for wider ranges.

The ceramic assemblage from the city, most of all amphorae, from the Tyrrhenian coast, is dominating compared to finds from the Adriatic coast. It confirms the importance of the river as a primary commercial artery compared to the overland ways which connected Turin with the closer, but harder to reach, Ligurian territory.

Stone building materials from the Susa Valley, on the other hand, were carried along the Dora. Between them was the Gneiss of Vase, largely used in town for road paving and, later, for the baroque columns as well (GABUCCI, PEIRANI 2009, p. 235). Even if no remains of the harbours have been identified, the presence of a building interpreted as horreum in Piazza Vittorio (6), by the Po, in the Eastern part of the town, indicates that there had to be at least a quay in the neighborhood. It is a building with an elongated plan divided in three naves by rows of pillars, that presuppose a cover with four arching vaults. Consequently it corresponds to a typology largely diffused in the Roman world and fully adherent to the scheme of the public horreae connected with the river ports, able to store goods of various kinds (PEIRANI BARICCO, SUBBRIZIO 2007, pp. 111-121).

In the Northern part of the town, the organization of space was instead more complex. Despite the fragmentation of the urban research, this area has retained a large number of finds, mostly of the Roman age, that reveal the presence of many buildings with a commercial and industrial destination (1-3).

The excavations by the ex firefighters station (1) has a particular importance in understanding the examined district, both for its extent and its collocation in axis (160 meters far) with the Porta Palatina.

The research demonstrated an intensive flooding episodes from the Dora before the Roman phase, but which was prevented after the Roman period through drainage activities over the excavated area. This hydro-geological program continued to prove effective in later periods. It is in fact documented that a massive system of drainage and embankment was located slightly further North-West (4); the system which protected this important block from the fluvial erosions was composed by an earthen dam uncovered in the XX century (PROMIS, 1969, p. 162). The earthen dam, put upside-down and filled with clay, were located two metres deep in the ground; they were arranged in one or two layers and covered an area 250m by 500m wide.

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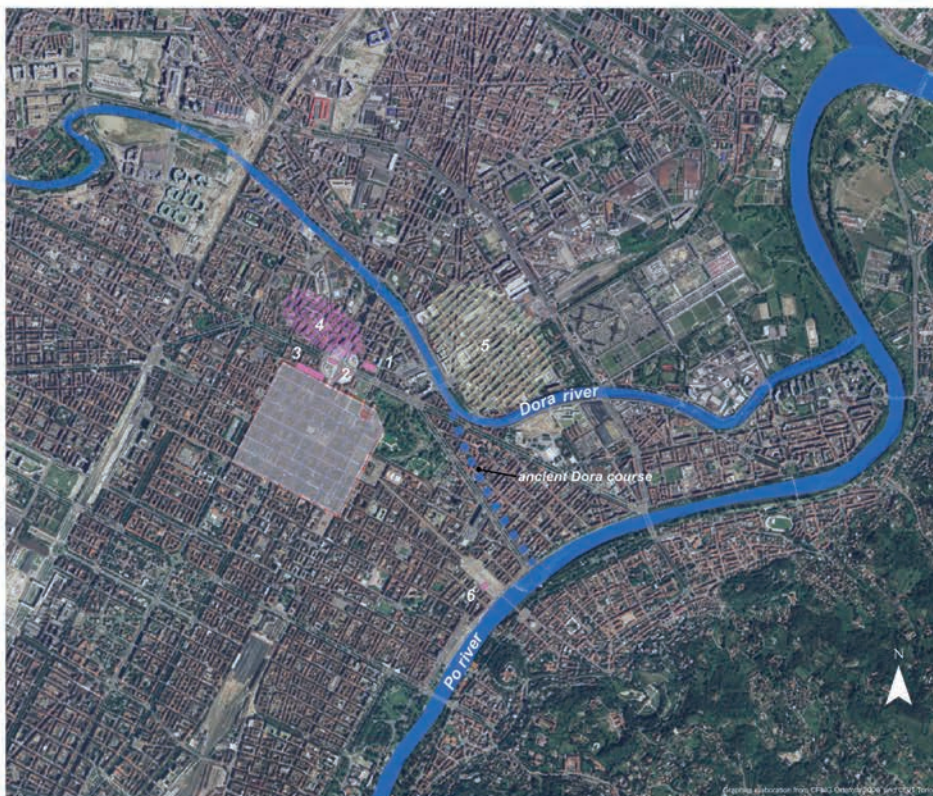
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In the Eastern sector on the contrary, the presence of rooms that had to be provided with craticum walls and with suspended wooden floors, with empty interspaces beneath them, led to the conclusion that they were uplified barns. In this case the preservation had to be a short term one. It was not possible to precisely understand the nature of the stored goods, which could be different in the two areas, nor if the building was a private or a public one. In such a scheme it appears very much plausible that the area located North the walls was part of the urbanization projects since the foundation phases, providing the construction of an industrial or commercial district strictly connected to town, bordered north by the river, where the harbour was probably located.



Plan of Turin at the end of the XV century. In evidence the Northern side. Archivio di Stato di Torino, Carta. Architetture Milanesi, vol. 5, 1491 ff. 1, 108.

It doesn't seem accidental that the examined area wasn't affected by the process observed in the peri-urban zone of many Emilian cities or in Mediolanum, where industrial areas stopped their activity to leave space to the expansion of the city.

Has been underlined before, indeed, that the walls were just one of the elements defining the topographic limit of the town with the streets and, above all, the streams.

The lack of remains of manufacturing areas within the city, together with the identification of tombs of the Roman period exclusively north of the Dora (5), might require reflection on the extent of Turin's pomerium, traditionally considered coincident with the walls, but probably defined by the river in the Northern side of the city.

An examination of the role covered by the two rivers in the determination of the town's territorial disposition, necessitates consideration of the alignment of roads with the two waterways, also considering the Dora's winding shape that keeps however an East-West orientation.

This hypothesis is supported by the fact that the city is not perfectly oriented according to the cardinal points, but it's rotated 27 degrees towards East.

As no morphological conditionings have been identified so far, maybe the cause of this slight slant, is actually the presence of the rivers.

The positioning of the wall's North-east corner as well, which is certainly determined by the territory's conformation, maybe traced in the past the course of Dora, which possibly flowed in the Po in Corso San Maurizio's area.

1. I used this observation in Dr. Elena Quil, which I think.
2. The correspondence between waterways and roads is a recurrent element in the cities built on rivers, ORTALLI 2005, pp. 171-181. A correction hypothesis on the conformation system, finalized to the alignment with the fluvial axis, has been proposed also for Colonia Concordia, BORADA 2000, pp. 244-245.

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Archaeological finds in the area between the city walls and the Dora. Graphic: elaboration from PNG Octobio 2006 © and SIT Setio ©

Graphics: Dr. Micaela Leonardi
Translation: Dr. Micaela Leonardi

Villa Maritima of Licosia on the Tyrrhenian coast

Villa Marítima de Licosia en la costa del mar Tirreno

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Resumen: la fuente más antigua relacionada con esta porción de territorio, el área de Licosia, es Licofrón quien en su obra la *Cassandra* o *Alexandra*, se refiere a las sirenas, y al Promontorium Enipeum o Posideion. En la tradición helenística el sitio de Licosia está conectado con Leucosia, una de las tres sirenas, muerta delante del cabo y cuyo nombre se mantiene en la isla. Las estructuras fijas visibles están situadas en el promontorio y en la isla. Son los restos de dos *cetariae*, situados en dos niveles, presumiblemente con una planta rectangular. Tal vez estas estructuras están relacionadas con algunos otros artefactos como mosaicos geométricos verdes y blancos, y una serie de viveros para el cultivo de peces, que se encuentran en el acantilado occidental de la isla. La investigación tiene como objetivo, también a través del estudio de la geomorfología, entender la función de tales evidencias.

Palabras clave: Licosia, Castellabate, sirenas, *cetariae*.

Abstract: The oldest source relating to this portion of territory, the area of Licosia, is Lycophron who in his work the *Cassandra* or *Alexandra*, refers to the mythical Sirens, and to Promontorium Enipeum or Posideion. In the Hellenistic tradition the site of Licosia is connected with Leucosia, one of the three sirens, who died in front of the cape and whose name remains on the island. The structures still visible are situated on the promontory and on the island. They are the remains of two buildings, located on two levels, presumably with a rectangular plan, known as *cetariae* and characterized by a thick coating of *cocciopesto*. Maybe these structures are related with some other artifacts as green and white geometric mosaics, and a series of nurseries for fish farming, located at western cliff of the island. The research aims, also through the study of the geomorphology, to understand the function of such evidence.

Key words: Licosia, Castellabate, Sirens, *cetariae*.

Villa Maritima di Licosa on the Tyrrhenian coast

Salvatore Agizza

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The oldest sources relating to this portion of territory, relating to Licofrone, who in his opera the Cassandra or Alexandra, refers in one case to the mythical figures of the Sirens (Alex. 712-731), and in another case to Enipeo (Alex. 722-725) a thessalian sea goddess, leading back to in the pantheon greek-italic at Poseidon. It is typical in the Hellenistic tradition that *Promontorium Enipeum Poseidon* is connected with Leucosia, one of the three sirens, rejected on the same hill, whose name remains in toponymy in front of the island. The reference to Licofrone (Alex. 724) one hieron could bring the area to a site where there was a place of worship or a sacred area. The name Leucosia also recurs in Strabo [6.1.1 C252, 6. C258 6. 2.C123] when the description of this stretch of coast says "... sailing from Poseidonia outside the Gulf, you reach the Island of Leucosia, a short distance from the continent: it took the name from one of the two Sirens who fell, as the story goes into the deep sea. Opposite the island rises the promontory of Sirenusae, which forms the Gulf of Posidonia....".

The term *leucos*, white and laden with a strong suggestion inserted into a context that makes reference to the ancient navigation and the mythological and sacred implications that it had. The same term in fact often applies in the identification of the coastal points of reference used in the navigation routes.

The white coloration of rocks and promontories of the Mediterranean may explain a series of connected recurrent toponymy associated with the calcareous nature or such sandstone of the rocks that assume a bright aspect when they are struck by the light of the sun or the moon. They represented valid references to steer oneself on the sea both in daytime and nighttime navigation and they resulted in being of particular aid in avoiding coastal shoals and difficult promontories.

The routes that led towards Magna Grecia and Sicily were also marked by recognisable points of notable distances in the open sea. They are examples, in this case represented by the "white rocks" of *Capo Leucata* (S. Maria of Leuca), *Leucopetra reggina* (Reggio Calabria) or *Punta Licosa*, that represented the luminous cliffs, whose passage gave sense to the sailor of overcoming danger.

In such a way the Mediterranean becomes the scenery of the "white goddess", she who evoked the overcoming of death and danger to the sailor, the light after the storm. In southern Italy, as in the rest of the known sea, the promontories represented difficult moments in navigation, near which sanctuaries were installed, almost functioning like lighthouses for the ancient sailors.

It would be a casual reference, in the context of Licosa, to the Sirens and the sphere of the sacred in a scene where such mythological figures are proposed as undisputed protagonists of the ancient Mediterranean. The shine, the light were connected to a mystical dimension, component in the Greek mythology of the landscape of the afterworld and at the same time the white rocks call the phosphorus divinity, bearers of light such as the *Dioscuri*, *Apollo Agiotes*, *Athena*, *Artemide*, *Aphrodite Euploia*. At the same time for the Greek the white rocks were shaped as sacred religious places. It doesn't seem casual, therefore, the building of places of cult, altars or temples places on promontories in whose proximity there were landings known to the ancient sailors.

The islet of Leucosia is inserted in the delineated picture since some seams of historical and literary tradition bring the myth according to which the body of the siren Leucosia had been transported onto the islet by the tides coming from the *Sirenusae* and buried here.



Fig. 3 Plan of the structures on the island and cape of Licosa

Underliably the mythical story relates to an environment characterised by white coloured rocks, Leucosia or also the rock-cliff of *Sinurus surrentinus* and of which the exact location is not known, and connected to the divinity from which she took the name, venerated both in *Velia* and *Neapolis* as noted by *Plinius* (Nat. Hist. 3.83).

The more complex search for the name Leucosia in antique maps, first of all the *Tabula Peutingeriana*. Here (Segmenta V-VI), the Western

Lucania is represented with the natural boundaries of rivers

through the description, in this case the *Sele*, *Silorum*. Strabo in Ge-

ography says: "Μετά δὲ τὸ στόμα τοῦ Σιλάρου Ἀρκακία...", which left the river at 50 stage (about 9 km) is located the city of Posidonia. The Lucania is represented between the *Sele* and *Metaponto* including the Strait of Messina. In contrast to the *T. Peutingeriana* (Segment VI) it does not keep the memory of the ancient name Leucosia.

Since the end of the sixteenth century there are numerous descriptions of the area by travelers and local scholars (Antonini, Ventimiglia, Corcia, Giustiniani). In this same era one of the few ex-votos showed up in the sanctuary of *Madonna dell'Arca*, representing this stretch of coast with a scene of a rescue from a storm, situated in a geo-topography context in which appear "The Licosa" and viceregal coastal towers, which form the coastal defense system from the Norman age (Figure 1).

Numerous references to the island and the promontory can be found in chronicles from the seventeenth to the nineteenth century. A reference to the existence of buildings and "old buildings" in the channel separating the island from the promontory, is contained unpublished in "Il Cilento illustrato" explained by F. A. Ventimiglia. At the beginning of the twentieth century also Mommsen describing the ruins on the island identified them as relating to a public building, adding that "they are also in the sea along the beach" and referring in this case, probably, to the west side of the island (Mazzotti 1904, 42). Most of the archaeological evidence is located on the east side of the islet (Figure 2, 3). The structures still visible are related to a building dating from the end of the Republican and early Imperial era, which among other things, is part of a mosaic floor with two-colored geometrical pattern (Figure 4), relating to a sloping ambient towards the sea.

Immediately below the mosaic fragment was recovered pottery dating from the late 6th and early 5th century BC, demonstrating that over a period of frequentation in this island, also testifies to the continuity of use of the islet, far more evident in the later stages.

On the west side, on the cliff face of the island there are remains of a fish farm. During the whole survey have been five evidences have been identified, lists in base to different building technique. The history of the structures could be correlated with the reference contained in a nineteenth-century historical text (Ventimiglia 1827),

which refers to the presence of ceramic and marble elements in the area of Licosa also epigraphy, worthy of the age of Augustus.

These include a marble slab, with a dedication to Ceres, probably from Elea/Velia or Paestum; reused in late antiquity as an inscription on the back with the certificate of public works by the *corrector vir clarissimus Lucanianus Britius Praesens*, quite probably governor of the *Regio III*, probably 364 to 375 AD. In the present state of research the archaeological landscape offer by the whole island/cape is rich with ideas and suggestions. Underwater searches in the channel between the island and the Cape have been identified in some structures of which operates a cement plant in a quadrangle (Figure 5), perhaps attributable to a small anchorage. A survey conducted in 2004 to the north of the promontory of Licosa, has identified, in an area in front of the tower, the remains of a number of tanks (Figure 6, 7); they are the remains of two tanks located on two levels presumably rectangular, made using the morphology of the coast. The tanks preserve the walls and floor with *cocciopesto*, bounded on two sides by a perimeter *pulvinus*. The configuration of the structures and the comparisons detected could lead back to evidence of installation plants or *pars (cetariae)* of a seaside villa no longer visible. Despite its incompleteness, the installation of the *cetariae* at Licosa for the structural characteristics and their location would be compelling findings with similar findings in Italy: the Torre del Campese (Rendini 2001, 177) on the island of Giglio, the Cape of St. Irene in Bristice, the Islet of Santo Janni in Maratea (Bottini and Freschi 1991), Lampedusa and Portopalo and Isola delle Femmine other sites in the Mediterranean basin as Punta de Arenal (Martin and Serres 1970), Punta Camarinal near Boalo Claudia (Bernal Casasola et al., 2007).

As it is known, the choice of a site intended for a fish processing plant, was necessary, in addition to raw material, in this case small fish (anchovies, sardines), the presence of fresh water and salt, for washing and further processing of the catch. The presence of fresh water in the area is guaranteed by a series of wells and springs indicated by place names such as *Fonte di Acqua di Cesare*, just north of the Cape of Licosa. In particular, the island of Licosa, in the eighteenth century numerous chronicles tell of the existence of a freshwater source of which today, however, there has been no trace. The presence of a source is still possible for geological conditions of the island that do not exclude the presence of fresh water underground according to the geometrical and coefficient criteria relative permeability between the layers of the main geological formations. The farming system is built around a canal excavated on the island (Figure 8), which communicates with a pool (Figure 8) that in ancient times was used as a fish farm (*vivarium*). A few perimeter walls remain and substantial tracks visible in aerial photography (Figure 9). This could be used for the supply of fish, the system of tidal or wave motion, as suggested by the testimony of Lucullus, which shows the fundamental role of tides and currents necessary for regular fishing as noted by Columella (*De Re Rust.* 16,17). The channel of fresh water supplied the waterside, which then allowed the attraction of fish into the tanks, where they remained trapped and where there was a system for catching. The presence of fresh water constitutes an even more profitable element of the system reported by Cicero (*De Offic.* 3, 58) speaking from a villa near Syracuse, boast of the great prosperity determined by the presence of an *agnotio* (Cicero, *De Offic.* 3, 58) connected to the fish farm for pisciculture. The information available in the absence of a systematic excavation of the cape and the island, suggests the existence of a seaside villa with attached handling establishments and salting of fish dating back to the first century BC and the first century AD. The central body of the villa was probably located on the cape also the greater extension in respect to the island. On the latter probably was a *dépendance* annexed perhaps close to the surroundings with a mosaic floor and at the same time a productive *pars* identified on the headland and in the west side of the Isle of Licosa.

A mention should be made that the removal of salt, for which there is no archaeological evidence on the island, nor on the headland,

although there are on the coast surrounding place names that refer to the presence of salt.

The exploitation of fishing continues in subsequent eras from the Byzantine period and with the subsequent Lombard penetration the major navies of the Mediterranean Sea, like nearby Amalfi, carry trades related to the economy of their abbeys, including that of Cava dei Tirreni fishing rights exercised in nearby Vietri and around Cilento, while Puglia was the first centre for the production of salt (Centola 1998, 37). According to a statement in the first degree for the grant of the Abbey of Cava (1276) a tunny-fishing net (Figure 10) was built in Licosa and a modest *sborcatura* used for the loading and unloading of goods on the premises and surrounding villages. From the maps of the Murat age it is also possible to retrieve plans and projects of the defense works and installation of a *tonnara* in the north of the cape and some chronicles of the eighteenth century indicate that Licosa, as well as in Agropoli, Palinuro and Camerota, were fished "Tuna in great abundance, and even sardines" (Giustiniani 1797, 269) with a heavy fishing traffic to Salerno and Naples. The historic vocation to promote fish farming and processing of the catch of this region, could be recognized in the continuity of the type of fishing, specialized fishing in bluefish and tuna fishing still even today take place along the shores of the Cilento, or the famous anchovies in the famous Marina Pisciotta. Vocation in the Cilento and Amalfi coast for tuna fishing is also present in Cetara (Romito 1994, 47) whose name may come from *cetaria*.

Fig. 10: Punta Agropoli della punta di Licosa. Map of age Murat of Cape and island of Licosa with a tuna fishery (Biblioteca Nazionale di Napoli).

Fig. 11: Island of Licosa. Mosaic.

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Ancient Greek merchant ship «Zmiinyi-Patroclus» of the second half of 4th c. BC, Black Sea

Antigua nave mercante griega Zmiinyi-Patroclus de la segunda mitad del siglo IV a.C., mar Negro

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Abstract: The ship dimensions are $26 \times 8 \times 1.7$ m and it is situated in 34 m deep waters. The video-mosaic of the sunken ship was assembled from 2124 still images. On the basis of this video-mosaic the plan-scheme of the underwater site was modelled as well as the plan of the ship's cargo and equipment arrangement on the board was developed. The top layer of amphorae of Peparetos type was marked by labels (total number of them is 946). Basing on the preliminary data it was suggested that the vessel was loaded into four layers of 3000 pieces each; that corresponds 100 tons of overall weight of the cargo. Fragments of three wooden anchors –stocks and connection piece– were found among the amphorae. Collection of black-glazed pottery, pottery of crew members, marble statuette of the goddess Demeter and Kore are also the components of the findings connected with the sunken ship.

Key words: Ancient Greek, shipwreck, amphora, black-glazed ware, wooden anchor, marble statuette.

Resumen: la embarcación tiene $26 \times 8 \times 1,7$ m y está situada a 34 m de profundidad. El vídeo-mosaico del pecio se compuso a partir de 2124 imágenes fijas. Sobre la base de este vídeo-mosaico se pudo desarrollar un plano esquemático del yacimiento subacuático, del cargamento y de la disposición del equipamiento de a bordo. En el nivel superior fueron etiquetadas 946 ánforas del tipo Peparetos. Basándose en los datos preliminares se sugirió que la bodega fue cargada en cuatro niveles de 3000 piezas cada uno; que se corresponde con un cargamento total de 100 toneladas de peso. Entre las ánforas se hallaron fragmentos de tres anclas de madera –cepos y piezas de conexión–. También son parte de los hallazgos relacionados con el pecio: una colección de cerámicas de barniz negro, pertenecientes a miembros de la tripulación, así como estatuillas de mármol de la diosa Deméter y Kore.

Palabras clave: Grecia antigua, pecio, ánforas, cerámica de barniz negro, ancla de madera, estatuilla de mármol.



NAVAREX
underwater archaeological
expedition ONU

ANCIENT GREEK MERCHANT SHIP "ZMIINYI-PATROCLUS" THE SECOND HALF OF THE IV CENTURY BC, BLACK SEA

Oleksandr Tereshchenko, Department of Archaeology and Ethnology - Odesa I. I. Mechnikov
National University, Ukraine (navarex_patrokl@ukr.net)

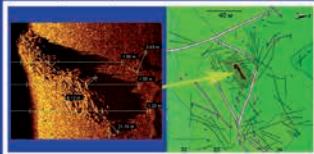
CARTAGENA 2014
IKUWA V
October 15-19, Spain

Object

The pile of amphorae in the shape of ellipse is situated at a distance of 650 m from the shore, at a depth of 34 m, the water temperature 7-9 °C, illumination and visibility depend on the current of the Danube River.

Method and Methodology

M1. The sonar scanning and creating a lay out area of the site (770 kHz)



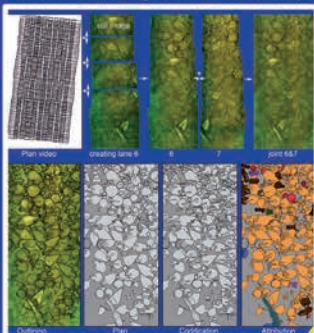
M2. The grid installation and video with a laser scale



M3. The codification of artifacts and repeated video



M4. The creation of video-mosaics, plan, application of codes, attribution, making the underwater tablet squares



M5. The metal detection and searching by metric probe



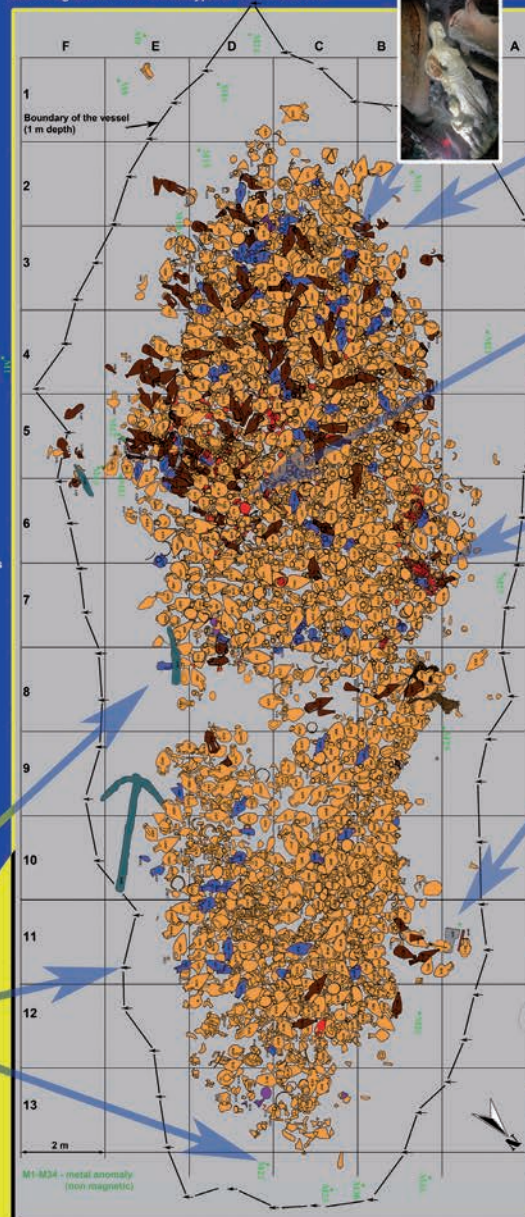
M6. Reconnaissance excavations



Results

The making out the video-mosaics, the plan of the site. The merchant ship «Zmiinyi-Patroclus» has dimensions 26x8x1,7 m. The detection of the bounds of the shipwreck location under the ground at a depth of 1 m. The discovery of the anomalous points of non-magnetic metals. The marble statue of the goddess Demeter with the young Kore was found at the stern of the ship (sq. C3). The identification of the trade articles was taken. The amphorae produced in the Peperethos island. The proposal to convert the amphorae of pseudo-Chersonesean type into Peperethos I type. The location of the galley (sq. D6). The merchant ship was bearing the variety of black-glazed pottery for selling. There were discovered the marks «KTH» and «Φ» in some articles. It was noticed that the kantharoses were used to set on a table in an original way. The dating was based on studying of the black-glazed pottery and it goes back to 350-325 B.C. The outside bottom of the ship was covered by the leaden plating with the help of wide hat rolls. The fragments of the wooden anchor together with the wooden-lead stock, fasten rope and black-glazed kantharos were found under the layer of sediment (sq. Z11-12). The model of a quadrangle arrangement of the amphorae in four layers was designed according to the preserved hold packing on the stern. The 946 amphorae marked in the upper layer. Supposedly the number of the transport amphorae makes up 3000 pieces at 100-ton ship. In 1st IV century BC the merchant ship stowed by wine, olive oil and black-glazed pottery left the Peperethos island (Skopelos) to the North-Western Pontic region. But after completing more than 1,000 km the ship was wrecked during the storm near the island Levke (Zmiinyi) in the Black Sea.

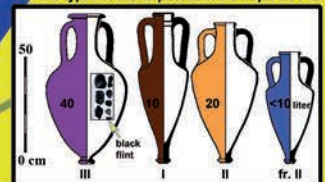
R1. The plan of the wreck articles and goods location according to the material and type of ceramic items



R2. Marble statuette of the goddess Demeter and Kore



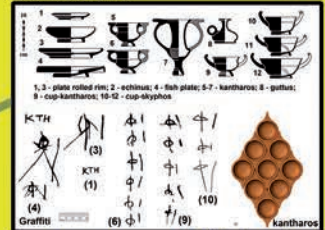
R3. The types of the amphorae of the Peperethos isl.



R4. Cooking ware



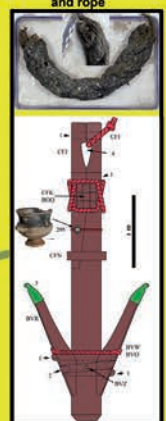
R5. Black-glazed ware



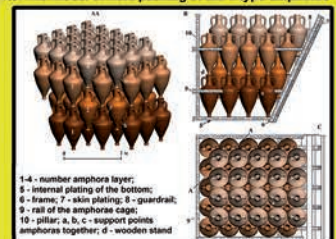
R6. Lead sheathing



R7. Wooden anchor and rope



R8. The model of hold packing of the II type amphorae



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A ship's timber from D. Luis I Square (Lisbon, Portugal): rare evidence of a Roman ship in the Portuguese coast?

La madera de un barco procedente de la plaza D. Luis I (Lisboa, Portugal): ¿rara evidencia de un barco romano en la costa portuguesa?

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Abstract: This paper presents the preliminary results of the survey and evaluation of a ship timber, identified during an archaeological excavation at D. Luís I Square, in Lisbon. The timber was found in a harbor context, along with other Roman artifacts, ranging from the first century B.C. to the fifth century A.D. The mortise-and-tenon joinery and timber measurements suggest that this was part of a classical antiquity ship, probably a longitudinal piece, like a keel or plank. In the absence of other contemporaneous ship remains in the Portuguese coast, this timber is a singular artifact, with a high scientific value.

Key words: Lisbon, Roman Period, keel/plank, mortise-and-tenon, Atlantic.

Resumen: se presentan los resultados preliminares del registro y evaluación científica de un elemento de madera, recuperado durante los trabajos de excavación de la Pza. Don Luis I, en Lisboa. Esta pieza fue hallada en un contexto arqueológico portuario, donde también se registraron materiales de época romana, con una cronología entre el siglo I a.C. y el siglo V d.C. La morfología y el sistema de unión (mortaja-espiga-clavija) confirman que este elemento pertenecía a la estructura de un navío de la Antigüedad clásica, correspondiéndose con una pieza longitudinal: una quilla o una tabla del forro. En ausencia de otros buques coetáneos en la costa portuguesa, este elemento de madera es una pieza singular, de gran valor científico.

Palabras clave: Lisboa, época romana, quilla/tabla del forro, mortaja-espiga-clavija, Atlántico.

A ship timber from D. Luís I Square (Lisbon, Portugal): rare evidence of a Roman ship in the Portuguese coast?

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Introduction



Fig. 1 - Site location (extracted from C.M.P., sheet 431, I.G.M.E., Lisbon topographic survey).

Between February and March 2013 the Portuguese Centre for Global History (CHAM) performed the recording and scientific evaluation of a timber identified during the archaeological excavation held by ERA-Arqueologia, S.A. at the D. Luís I Square, where a car park was being built. The D. Luís I Square is located in the riverside area of Lisbon (fig. 1).

Tree-species identification

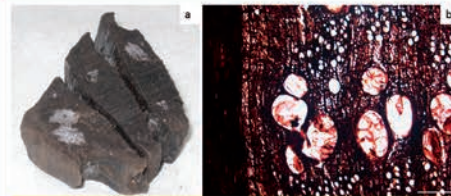


Fig. 5 - Quercus sp. (7) timber sample (a); cross section observed under the microscope (b), scale = 400µm.

Tree-species analyses revealed that *Quercus* spp., probably *Q. faginea* or *Q. pyrenaica*, have been used; these species can easily be found in the Iberian Peninsula (fig. 5).

Contextualization and description

This timber was found in a context related to port functions, c. 3.7 m below the mean sea level. All materials (mostly amphorae) recovered in this context date from the Roman period, between the 1st century BC and the 5th century AD (Pereira et alii, 2013; fig. 2, 3 and 4).

The timber measured around 9.36 m in length, had an upper section of 33.5 x 14 cm (fig. 6) and was broken into two main pieces and other small fragments of limited relevance.

These archaeological remains must have suffered the effects of complex and intense hydrodynamics. In fact, this context only reached sedimentary stability after the fifth century AD, at a time when this area most likely wasn't regularly used. In the 17th century, the construction of a tidal grid, also recorded during the archaeological intervention, may have been a decisive contribution to their stabilization and preservation.



Fig. 2 - Detail of the archaeological context.

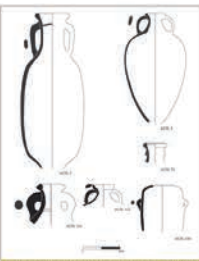


Fig. 3 - Recovered amphorae (Pereira et alii, 2013: 152).

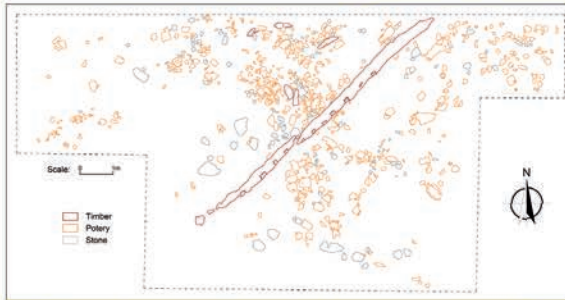


Fig. 4 - Plan of the Roman archaeological context from D. Luís I Square (extracted from rectified photographic setting held by ERA-Arqueologia, S.A.).

Shipbuilding techniques

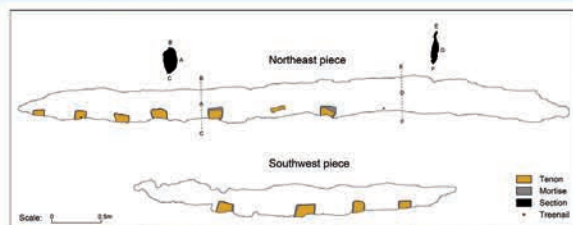


Fig. 6 - Drawing of the two wood pieces, showing shipbuilding system details: mortise-and-tenon joints and wooden materials.



Fig. 7 - Tenon joints - detail of the tenon blocking the tenon joint.

The timber was connected to other parts by means of a system of mortise-and-tenon joints, in some cases with wooden treenails. The distance between tenons (measured center-to-center) is irregular, ranging from 42 to 63 cm. The tenons' width also varies, mostly between 11 and 14 cm. The length is likely to exceed 11 cm and the thickness reaches 2.8 cm. Only two treenails were observed, measuring 1.7 and 1.8 cm in diameter (fig. 7).

The morphology and the nailing system confirm that this element was part of a ship's structure, and might correspond to a longitudinal piece: a keel or plank. The first hypothesis is the most likely, considering the dimensions of large roman ships, such as Madrague de Giers, where the garboard average thickness was around 12 cm (Pomey et alii, 1978: fig. 10), and thus less than the D. Luís I Square timber (about 14 cm).

The fastening pattern dates this element to classical antiquity. This type of fastening was used throughout the Mediterranean world in vessels of different sizes. In shell-first tradition, the hull planks and the keel were systematically connected with mortise-and-tenon joints, which were blocked with treenails placed perpendicularly to the timbers.

The distance between the fastening components suggests a later chronology. In fact, if at an initial phase the tenon joints were distributed in a regular way, the system changed substantially during the Roman period (Pomey et alii, 2012: fig. 90). The progressive size reduction of the tenon joints is related to an increase of the distance between each connection point. This development is currently explained by a gradual transition from a shell-first to a skeleton-first technology, which occurred during the 1st millennium. At a more detailed level, this timber has another important characteristic: only two connection points feature wooden treenails to block the tenons, which also indicates later chronologies.

Concluding remarks

In fact, the fastening system of the timber recovered at D. Luís I Square has parallels in ships from the final phase of the Roman period. However, it features a rather unique characteristic: the large size of the tenon joints. This particular feature might be related to the issue of roman shipbuilding adapted for Atlantic navigation, for which no archaeological contexts are currently known. Despite its poor condition, it is a singular remain, with an exceptional scientific value. Its study just confirms the present lack of knowledge about ships and Atlantic navigation in classical antiquity.

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Mediterranean Sea trade networks between 4th and 3rd centuries BCE. Amphorae from Rocca Nadore, West Sicily (excavation 2004)

Redes comerciales en el mar Mediterráneo entre los siglos IV y III a.C. Ánforas de Rocca Nadore, Sicilia occidental (excavación de 2004)

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Abstract: The site of Rocca Nadore is located in a strategic area along the southern shore of Sicily. The stratigraphic sequence stretches from the Bronze Age to the Late Medieval occupation, but the most significant evidence dates to the period between the 4th and the 3rd century BCE when an important settlement was built, probably sponsored by Carthage. The importance of the site results from its position: it controls a large portion of land between the poleis of Selinunte and Eraclea Minoa on the shore and the routes across the inland. The short life of the Punic site represents an important closed context which allows us to put forward new ideas about the dating of some classes of materials in particular the amphorae. In this paper a preliminary picture of the development of the Sea Trade Networks between 4th and 3rd centuries BCE will be outlined based on the amphorae found in the 2004 excavation.

Key words: Amphorae, West Sicily, Punic Sicily, Mediterranean Sea trade, Middle Punic Period.

Resumen: el sitio de Rocca Nadore está situado en una zona estratégica a lo largo de la costa sur de Sicilia. La secuencia estratigráfica abarca desde la Edad del Bronce hasta la Baja Edad Media, pero la evidencia más importante data del periodo entre el IV y el III siglo a. C. cuando un importante asentamiento fue construido probablemente patrocinado por Cartago. La importancia del sitio se debe a su ubicación: controla una gran parte del territorio entre las polis de Selinunte y Eraclea Minoa en la orilla y las rutas por el interior del país. La corta vida del sitio púnico representa un contexto cerrado importante que nos permite proponer nuevas ideas sobre la datación de algunas clases de materiales, en particular, las ánforas. En este documento hay una idea preliminar del desarrollo de las redes de comercio marítimo entre los siglos cuarto y tercero a. C. basada en las ánforas encontradas durante las excavación de 2004.

Palabras clave: ánforas, Sicilia occidental, Sicilia púnica, comercio marítimo mediterráneo, época medio púnica.

Mediterranean Sea trade networks between 4th and 3rd centuries BCE

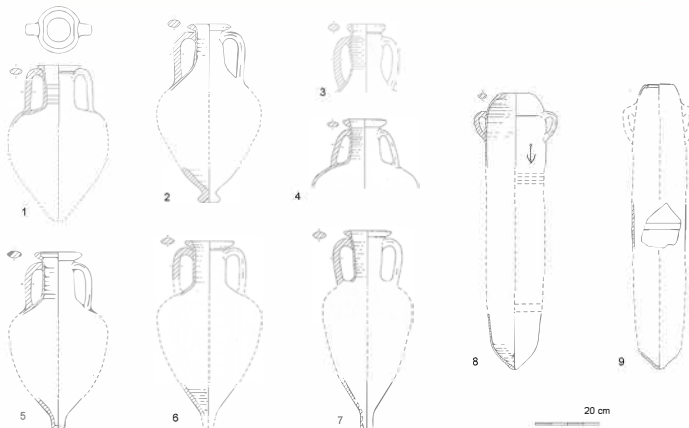
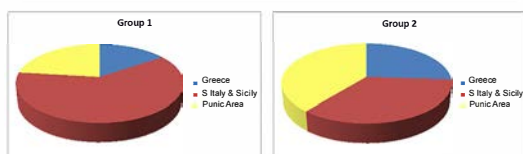
Amphoras from Rocca Nadore, West Sicily (excavation 2004)

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The site of Rocca Nadore is a few kilometres north of Sciacca, in an important strategic position on the southern coast of Sicily between the Belice and Platani rivers. From its summit a large strip of land between Selinunte and Eraclea Minoa is visible. The studies carried out by the Superintendency of Agrigento and the University of Palermo have revealed some sectors of a large fortified settlement which appears to have been abandoned between the late 4th century and the early 3rd century BCE (Allegro 2014). In the C1 trench some domestic areas belonging to one or more houses have been identified, built against the steep slope of the mountain. The levels of abandonment closed by structural collapse conserve a great deal of everyday objects while fine-ware was considerably rarer.

The excavation revealed a discreet number of amphorae which we here divide into two groups: the first is made up of amphorae which can be completely or partially reconstructed. These were in the rooms at the time of the site's abandonment. The second group is made up of fragments of rims, handles and feet found in less significant strata which attest to the presence of amphorae in the area. For the first group, an amphora of the Corinth B type from the Ionic-Adriatic area (1) was found in room I (Bechtold 2008). An example of a Solokha I type amphora was found in room VIII (2), produced in eastern Greece and widely found in the western Mediterranean. The type is characterised by a mushroom rim, a long cylindrical neck, an ovoid body and a foot shaped like a truncated cone. The exact place of production is uncertain: hypotheses include Rhodes, Samos, Naxos, Paros and Kos (Lawall 1995). The most commonly found amphorae are those known as MGS manufactured especially in an area between Campania, southern Italy and eastern Sicily. An example of type II of C. Vandermersch's classification was found in room VIII (Vandermersch 1994); the oldest of the amphorae in this group (3). In the stratigraphies of Velia, one of the places of manufacture of this type of container, phase C1 (400-360 BCE) is characteristic, but is attested to a lesser degree until phase D1 (300-275 BCE, Gassner 2003; Gassner, Trapichler 2010). Two different pieces are identifiable with the MGS III type which characterises phase C2 (360-330 BCE) at Velia: the first is pertinent to a type considered to be an evolution of the MGS II amphorae (5); the second, on the other hand, is the prototype of the so-called "amphorae with a spiky rim" (4). The classic form of these amphorae, MGS III/IV (6), is attested to by two examples found in room VIII and is generally dated to the last quarter of the 4th century BCE. All of these containers seem to have similar fabrics, characterised by a red/bright orange colour and by a thin dark slip on the surface. Three amphorae of the MGS IV type, contemporary with or slightly more recent than type III/IV, however, are of different fabric (7). Two amphorae of type 4.2.1.2 (8) and one of type 4.2.1.5 (9) of J. Ramon Torres' classification are attributable to production in the Punic area. In Carthage these types characterise the Middle Punic II period (430-300 BCE) and the beginning of the Late Punic I period (300-200 BCE, Bechtold, Docter 2010).



For the second group, three fragments pertain to amphorae of Corinth A type of Aegean or Ionic-Adriatic production. The MGS amphorae are attested by six rims respectively identifiable to types III, III/IV and IV. Five rims cannot be clearly identified owing to their poor condition: One fragment appears to belong to the Corinth A type rather than the MGS V type; two rims may refer to the Corinth B type; others seem identifiable with the MGS III type. Nine fragments of Punic type amphorae also belong to this second group: one rim is identifiable as being of the Ramon Torres 4.1.1.3 form; three rims and perhaps one foot belong to the Ramon Torres 4.2.1.2 type; others to Ramon-Greco 4.2.2.7; only one fragment is identifiable as being of the Ramon Torres 7.1.2.1 type of production in Western Sicily. Only two fragments with stamps and inscriptions have been found: the first case concerns a Punic amphora handle with a square stamp within a cartouche and inside two letters which are not legible (Ramon Torres 1995: serie 605-610). A neck fragment with the letter "A" carved into the wet clay is identifiable from its fabric as an amphora MGS II or III or III/IV. Some amphorae of the Punic type have graffiti on the body: the most interesting bears an anchor.

The amphorae of Rocca Nadore are datable to the second half of the 4th century - early 3rd century BCE. Simultaneously amphorae generally considered to pertain to other time periods have been found in the strata of abandonment/destruction: from the first half of the 4th century BCE (MGS II), the mid 4th (MGS III), until the last quarter of the 4th - early 3rd centuries BCE (MGS III/IV and IV). Amphorae types definitely identifiable to the first half of the 3rd century BCE have not been noted, it is thus most likely that the abandonment of this sector of the settlement took place in the early years of the century. In the first group, amphorae produced in southern Italy and Sicily are more prevalent than those from the Ionian-Aegean and Punic areas. In the second group the frequency indices between three areas are very similar. Many of the amphorae found at Rocca Nadore are also found at the wreck of El Sec which was carrying cargo from the Aegean and which had certainly reached the ports of Sicily before sinking in the Balearic Islands (Arribas et al. 1987). In particular these include the following types from the first group: Corinth B, Solokha I, MGS III/IV, Ramon Torres 4.2.1.5. However the MGS IV and Ramon Torres 4.2.1.2 types, very common at Rocca Nadore, have not been found in the El Sec wreck.

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Massae plumbeae from *Carthago Nova* to Italy. New data on lead ingot trade on the basis of epigraphic research

Massae plumbeae desde *Carthago Nova* a Italia. Nuevos datos del comercio de lingotes de plomo sobre la base de la investigación epigráfica

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Abstract: Thanks to the documentation provided by the ancient shipwrecks, we can count on a big number of lead ingots from *Carthago Nova* and, for later periods, from other Iberian and not Iberian mines. These artefacts can be studied through three approaches: a typological one, considering the fidelity and the variations with respect to the standards; an epigraphic one, focused on the inscriptions; a chemical-isotopical one, retracing the origin of the metal through scientific measurements. Laboratory-based analyses are giving us some interesting new data, but a traditional epigraphic approach still has a lot to say: by crossing the indications present on the ingots with the Latin epigraphic data from the Iberian and Italian Peninsulas, we can provide a more precise and better documented answer to the question of the origin of the *gentes* involved in lead ingot trade. We can therefore confirm the idea of a strong presence of people from Campania in the mine's exploitation.

Key words: Lead ingots, Roman maritime trade, epigraphy, *Carthago Nova*, metal trade.

Resumen: gracias a la documentación aportada por los antiguos naufragios, contamos con un gran número de lingotes de plomo de *Carthago Nova* y, de periodos posteriores, de otras minas ibéricas y no ibéricas. Estos artefactos se pueden estudiar a través de tres enfoques: uno tipológico, según la fidelidad y las variaciones con respecto a las estándares; otro epigráfico, centrado en las inscripciones; y otro químico-isotópico, volviendo al origen del metal a través de mediciones científicas. Los análisis de laboratorio nos dan algunos nuevos datos interesantes, pero una

aproximación epigráfica tradicional todavía tiene mucho que decir: cruzando las indicaciones presentes en los lingotes con los datos epigráficos latinos de las Penínsulas Ibérica e Italiana, podemos ofrecer una más precisa y mejor documentada respuesta a la pregunta sobre el origen de las gentes que participan en el comercio de lingotes de plomo. Por tanto, podemos confirmar una fuerte presencia de personas de Campania en la explotación de las minas.

Palabras clave: lingotes de plomo, comercio marítimo romano, epigrafía, Carthago Nova, comercio de metales.

Massae plumbeae from Carthago Nova to Italy New data on lead ingot trade on the basis of epigraphic research



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The mining district of *Carthago Nova* was one of the first, major poles of attraction for the Italics that reached Iberia after the end of the Second Punic War. Its incredible richness was one of the reasons for the rapid recovery of Carthago's economic situation after the end of the first war against the Romans and the heavy conditions imposed by the treaty of Lutetia in 241 BC.

When, in 209 BC, Hasdrubal's *Qart Hadashat* in Iberia was conquered, Rome took possession of an extraordinary wealth: first of all, an amazing booty, as reported by Livius (26.47).

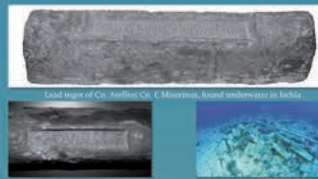
In a very short time, the Romans started to exploit the mines, and export the metals, especially silver and lead, through the excellent triple-basin natural port of the city, as Polybius wrote, reported by Strabo (3.2.10), the mines had a diameter of four hundred *stadia*, with a daily profit of twenty five thousand *drachmae* and more than forty thousand people involved in the work.



Another ancient source, the historian Diodorus (5.36), adds an important detail to our knowledge of this matter, that is the massive arrival of people from Italy to exploit those mines: **'after the Romans had made themselves masters of Iberia, a multitude of people from Italy have swarmed to the mines and taken great wealth away with them, such was their greed.'**

On the basis of the epigraphic documentation, and, in some cases, of the archaeological data, it is possible to reconstruct the stories of many of these people, not just those involved in the exploitation of mines, but also those who had come to take advantage of the other resources, retracing origins and destinations, ports of departure and ports of arrival, having a deeper understanding of such a complex historical phenomenon.

This is the subject of a doctoral research, started in 2009, at the University of Naples 'L'Orientale', under the title *'Navigando verso Occidente. Commerci e commercianti sulle rotte tra la Campania e la Penisola Iberica tra il II secolo a.C. e il I secolo d.C.'*. Some preliminary results of this work were published in the past years (Stefanile 2009, 2011, 2013, 2014), others are forthcoming.



Lead ingot of Carthago Nova. Lead ingot of the Aqueduct of Carthago Nova. Lead ingot in the shipwreck of Mal di Ventre, Sardinia.

Thanks to the documentation provided by the ancient shipwrecks sunk in the Mediterranean, in which, as it is well known, the metal cargoes, and especially the lead ones, can easily survive underwater, we can now count on a large number of ingots from the mines of *Carthago Nova* and, for later periods, from other Iberian mines. These ingots, since the Romans began to manage the export of metals from *Hispania*, were characterized by a more or less strong standardization of types, shapes and weights, and by the presence of seals impressed on the surface bearing the names of individuals or societies. Sometimes other inscriptions testify further steps in the export of the ingots.

The origin of this *massae plumbeae* from *Carthago Nova*, has been verified not only on the basis of the typological or epigraphic information available, but also through accurate isotopic and tomographic analyses.

Much has been written so far regarding these singular cargoes, and some very exhaustive works on that subject have seen the light over the last fifty years. Nevertheless, apart from the works by Domergue on individual families of great interest as the *Planii*, there is no real prosopographic study on the topic. Domergue's indications on the possible origins of the *gentes*, that in most cases are just simple suggestions based on a first reading of the names, were frequently taken up in the later literature, but almost always in an uncritical and passive way. By crossing the information present on the ingots with the Latin epigraphic data from the Iberian and Italian Peninsula, it's now possible to provide a more precise and better documented answer to the question of the origin of these *gentes*, obtaining data that confirm the idea already widely accepted of a strong presence of people from Campania and allowing to determine more nuclei of origin in that region.



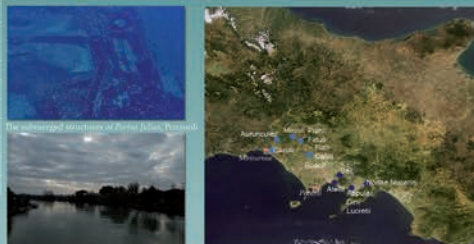
Gens	Origin
APPII	unknown
APPVLEII	Gulf of Naples
AQVINII	Other
ATELLII	Gulf of Naples
AVRNCVLEII	Northern Campania
CALVII	Northern Campania
CARVLII	Northern Campania
CORNELII POLLIONES	Northern Campania
DIRII	Gulf of Naples
FIDVII	Northern Campania
FVRII	Northern Campania
GARGILII	Unknown
IVNII	Unknown
LAETILII	Unknown
LVCRETII	Gulf of Naples
MESSII	Northern Campania
NONAE NVNERII	Gulf of Naples
NONII ASPRENATES	Other
PLANII	Northern Campania
PONTILII	Other
RAII	Other
ROSCII	Northern Campania
SEII	Gulf of Naples
TVRVLLII	Other
VARRII HIBERI	Unknown
VTII	Gulf of Naples

With the exception of isolated cases as the *Pontilii*, from the *Picenum*, or the *Raii* from the Lower Adriatic regions, or the *Turullii*, perhaps from the territory of the *Marsi*, the majority of the families arrived in *Carthago Nova* from two areas of Campania: on one hand, the Gulf of Naples and the cities surrounding it, on which there is a lot of documentation provided by the Vesuvian sites; on the other hand, the territory between Capua and Southern Latium, and especially the core of it, *Calles* – *Teanum*, in Northern Campania.

We may imagine that while for the cities of the Gulf of Naples the port of departure was *Patrici*, for those in the North it may have been *Minturnae*, this city, at the mouth of the Garigliano river and on the border between *Latium* and *Campania* is the ideal starting point for the whole of Auruncan territory, for the area of *Calles* – *Teanum*, and for the towns of Southern Latium, along the river *Liri*.

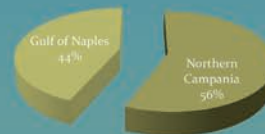
The rich epigraphic evidence of Late Republican *Minturnae* in some cases can confirm this hypothesis, enlarging the focus not only on lead producers but on all Campanian people in *Carthago Nova* and surroundings, many are the cases in which it is possible to find clear evidence of a strict relationship with this city.

The histories of people and families that only epigraphy is able to render, give depth and colour to archaeological data and tables of parallels and comparisons: *opus signinum* floors, so similar to those of contemporary Campania, suddenly appearing around the mines of *Carthago Nova*, funerary monuments recalling those of Capua, Formia or Quarto Flegreo, manworked stela and Galenian pottery acquire that way a deeper and more fascinating meaning.



The harbour of *Minturnae*, at the mouth of the river Garigliano. The origin of the gentes attested on the export of lead ingots from *Carthago Nova*.

Origin of the Campanian *gentes* attested on lead ingots from Carthago Nova



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Cepos de plomo en el noroeste de la península ibérica

Lead stocks in the northwest of the Iberian Peninsula

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Resumen: en todas las aguas que han sido navegadas en época romana existen restos arqueológicos que dejaron a su paso, a través de siglos de constantes singladuras comerciales y contactos con las poblaciones costeras. Las costas atlánticas padecen una menor afluencia de datos, lo que nos hace poner especial atención en cada resto arqueológico de época romana y el contexto en el que aparece. Los cepos de plomo de época romana son más o menos comunes en ambientes subacuáticos mediterráneos, en muchos casos vinculados a fondeaderos, yacimientos costeros o posibles pecios. Su huella parece difuminarse al llegar al océano Atlántico, con muchos menos datos o elementos arqueológicos que permitan comprender o reconstruir la navegación romana en estas aguas. Con este póster se realiza una recopilación de los localizados hasta la fecha en Galicia, atendiendo al objeto y a su contexto, para intentar comprender su relación histórico/arqueológica con su entorno de aparición.

Palabras clave: cepos, plomo, Galicia, anclas romanas, océano Atlántico.

Abstract: In all waters that have been sailed in Roman times there are archaeological remains left on their passage through the centuries of constant trade voyages and contacts with coastal populations. The Atlantic coasts have a less amount of information for this period, which makes us pay special attention to every archaeological remains from Roman times and the context in which they appear. Roman lead stocks are more or less common in Mediterranean underwater environments, often linked to anchorages, coastal sites or possible wrecks. Their footprint seems almost disappear into the Atlantic Ocean, with far fewer remains of archaeological evidence to understand or reconstruct the Roman sailing in these waters as it was. In this poster we include all the roman lead stocks now localized in Galicia (Northwest Spain), considering the archaeological object and its context, and trying to understand their historical/archaeological relationship with his environment appearance.

Key words: Stocks, lead, Galicia, Roman anchors, Atlantic Ocean.

CAPTAGENA 2014
IKUWA V

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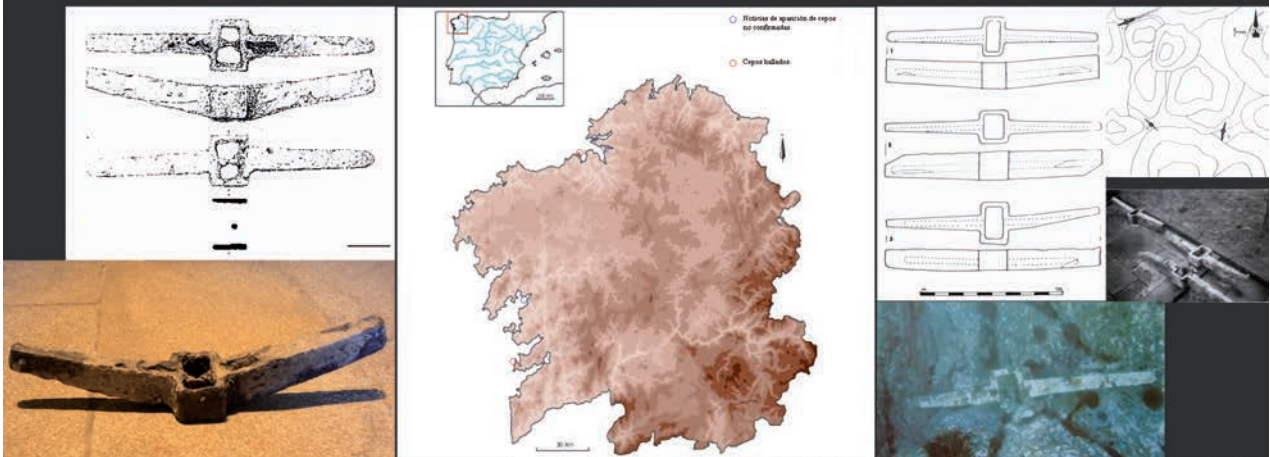
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Cepos de plomo en el Noroeste de la península ibérica.

Las especiales condiciones del Noroeste condicionan no solo la conservación de los restos arqueológicos, sino también su detección por parte de los arqueólogos subacuáticos. Y a ello debemos añadirle las dificultades de visibilidad, corrientes y rápida sedimentación de los espacios marinos atlánticos. En Galicia, independientemente de algún hallazgo esporádico de naufragio (Cabo de Mar, Vigo, Punta Fadrino, Cortegada...) son escasas las localizaciones de restos arqueológicos de época romana que sirvan de testimonio directo o indirecto de la navegación por la Ruta Atlántica. De todos ellos, uno de los característicos de la navegación son los elementos de fondeo, y por cuestiones de conservación, son bien conocidos, sobretudo en el Mediterráneo, los cepos de plomo de anclas de madera de época clásica. El uso de estos cepos empieza a generalizarse en las anclas compuestas entorno al siglo IV a.C. (Alves 1984) y comienza a decaer su utilización tras el siglo I d.C., abandonando progresivamente su uso a favor de las anclas de hierro (Kapitan 1984). El fin de su uso parece estar entorno al siglo IV d.C. (Haldane 1984).

Su función sería análoga a la de los modernos cepos de las anclas de hierro, sirviendo para que estas trabajen bien, ganar estabilidad y fijación en el fondo y evitar el garreo. Normalmente este tipo de piezas aparecen aisladas, sin contexto arqueológico y habitualmente en espacios de fondeadero histórico, como parece ser el caso gallego. Aunque luego nos referiremos a los recuperados, existen algunas noticias no confirmadas acerca de la existencia de más hallazgos de otros ejemplares, repartidos en el Golfo Artábrego y la Ria de Arousa, espacios fuertemente romanizados, dotados de sendos *portus*, y con gran ocupación y explotación del espacio marítimo en época romana.

Llama la atención y contrasta la gran cantidad de cepos de plomo localizados en las costas portuguesas, pasando del medio centenar a finales de los 80 (Alves et al. 1988) y hoy día superando el centenar (según el último artículo de J. Freire,), mientras que en su continuación natural Norte de la ruta Atlántica, las aguas gallegas, apenas tengamos una representación testimonial, cuatro ejemplares, de los cuales tres de ellos, como veremos, parecen pertenecer al mismo contexto arqueológico. La explicación a esta escasez puede deberse a múltiples factores: expolio, ocultación de información, factores intrínsecos a la navegación por estas costas y sobretudo a condicionantes geográficos: las rías gallegas, espacios idóneos para el fondeo en las singladuras atlánticas y sus yacimientos marítimos de época romana, se suelen encontrar en contextos que sufren una fuerte sedimentación de arena y/o fango, ocultando el acceso a los hipotéticos restos arqueológicos, en este caso cepos y otros objetos arqueológicos pesados que allí podrían estar.



Aparecido a 5m. De prof. En fondo de arena, durante una prospección arqueológica subacuática en el espacio portuario de La Coruña (antigua Brigantium), dirigida por Mignel San Claudio (2003). Su aparición se debe a que procesos de compensación de sedimento por un dragado cercano. No apareció asociado a materiales arqueológicos de su cronología, aunque se ubica en un espacio con abundantes restos anfóricos y probable ubicación del fondeadero romano del *vicus romano*.

Dimensiones: 64,5 cm. De long y 20 kg. De peso. Tipo IIIc Kapitan.

Interpretación: Probablemente perteneciente a una embarcación de pequeño tamaño (5-10 m. eslora) de cabotaje o navegación entre rías en el propio Golfo Artábrego.

Origen: San Claudio Santa Cruz 2003. Foto: autor.



Localización del cepo del Parrote, La Coruña.



Reconstrucción de un ancla con cepo de plomo, según L. Cuevas.

Localizados por José María Mosquera casualmente a 7 m. de profundidad, en fondo de roca. Rescatados por el SAS Grupo García Alén (Patiño Gómez 1985).

Dimensiones: 155x18 cm., 150x19 cm., y 151x14 cm. De long. y más de 200 kg. De peso cada uno. Tipo IV de Kapitan. Su composición es de un 99,80% plomo y pertenecerían a anclas de más de 3 m. de long.

Interpretación: Cronología del S. I-III d.C. Probablemente perteneciente a una embarcación de mediano tamaño capaz de efectuar navegación de altura. Se ubican cerca de una zona denominada Papatimóns, lo que unido a las características del yacimiento y de las piezas, podría pertenecer a un naufragio rescatado o a un pique de fondeo en condiciones difíciles, al no existir cerca más restos de cronología romana asociados.

Origen: Foto y planimetría. Foto: Mosquera 1985.



Localización de los cepos de Cabo Udra, Boia.

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PERIODO MEDIEVAL

MEDIEVAL PERIOD

The Byzantine shipwreck of Cape Stoba (Mljet, Croatia), preliminary report

El pecio bizantino de cabo Stoba (Mljet, Croacia), informe preliminar

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Abstract: The shipwreck at cape Stoba lies on the seabed of the island of Mljet in Croatia, about 22 NM northwest of Dubrovnik. The site lies at a depth between 21 and 28 meters, and it was investigated for the first time in 1975 (by the Maritime Museum in Dubrovnik). The Department for Underwater Archaeology of the Croatian Conservation Institute continued the research in 2009 and conducted excavations until 2012. Since 2012 the research on this site has been conducted in cooperation with the Department of humanistic studies of the Università Ca' Foscari. The cargo is composed of nine amphora types dated to the 10th and 11th centuries AD, and various glassware finds.

Key words: Byzantine shipwreck, Croatia, nine types of amphorae, middle Byzantine amphorae, glass finds.

Resumen: el pecio frente al cabo Stoba yace en el fondo marino de la isla de Mljet en Croacia, alrededor de 22 MN al noroeste de Dubrovnik. El sitio se encuentra a una profundidad entre 21 y 28 metros, y fue investigado por primera vez en 1975 (por el Museo Marítimo de Dubrovnik). El Departamento de Arqueología Subacuática del Instituto de Conservación croata continuó la investigación en 2009 y llevó a cabo las excavaciones hasta 2012. Desde 2012, la investigación de este sitio ha sido realizada en colaboración con el Departamento de Estudios Humanísticos de la Università Ca' Foscari. La carga está compuesta por nueve tipos de ánforas que datan de los siglos X y XI d.C. y por diversos hallazgos de cristalería.

Palabras clave: pecio bizantino, Croacia, nueve tipos de ánforas, ánforas del bizantino medio, hallazgos de cristalería.

Introduction

The shipwreck at Cape Stoba is located on the seabed of the island of Mljet in Croatia, about 22 NM northwest of Dubrovnik. The site lies at the depth between 21 and 28 meters (Fig. 1). During four archaeological campaigns at the site, conducted between 2009 and 2012, over a hundred amphorae were recovered. According to the available information, the site was discovered by sport divers in the 1960s, when the removal of amphorae and other valuable material started (Kisić, 1988: 158-162). The existence of the site was reported to the authorities, and the first archaeological intervention was carried out in 1975, by the Institute for Protection of Cultural Monuments and the Maritime Museum in Dubrovnik, under direction of Josip Luetić, Zdenko Brusić and Anica Kisić. Considering that more than thirty amphorae had previously been removed from the site and most of the remaining material was in fragments, they concluded that the site was almost completely devastated. But, based on the material recovered on this occasion and amphorae that were previously removed from the site (and are now a part of a private collection) along with other known eastern Adriatic amphorae from the same period, Z. Brusić classified the Byzantine amphorae found in eastern Adriatic into five groups (Brusić, 1976: 37-49).

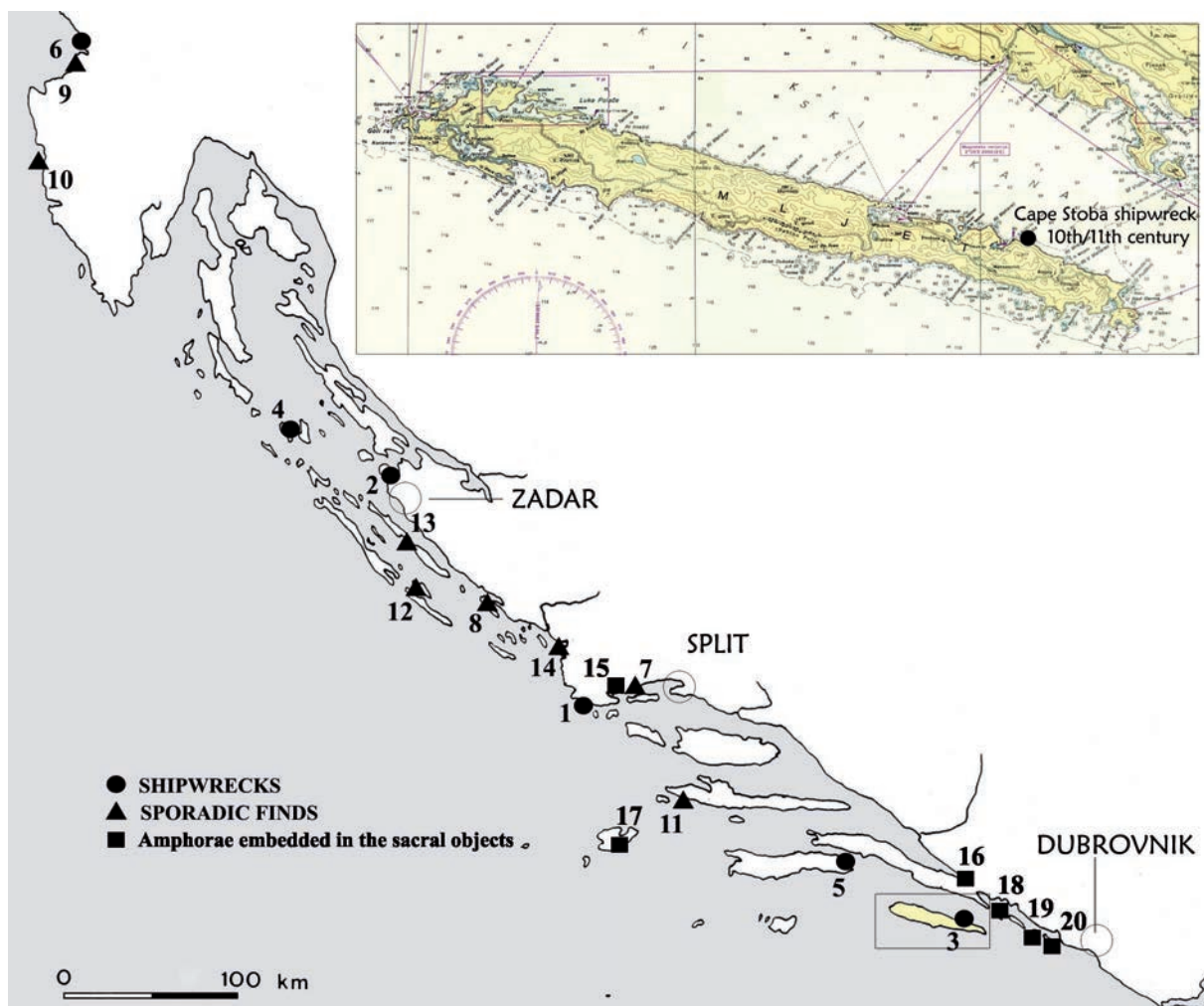


Figure 1. Medieval shipwrecks and sporadic finds of Middle and Late Byzantine amphorae in the waters along the eastern Adriatic coast; position of the Cape Stoba site on the map.

History of research

A short inspection of the site was carried out in 2009 by the Department for Underwater Archaeology of the Croatian Conservation Institute. The inspection uncovered a whole amphora sealed with a wooden stopper, which confirmed the existence of an intact layer of archaeological material at the site.

Thanks to the support of the Ministry of Culture of the Republic of Croatia, the first campaign started in the 2010. An iron anchor (measuring 160 cm of length) was found at the depth of 21 m, on the edge between the rocky bottom and a sandy plateau. Since the arms of the anchor were broken, it was difficult to determine its type. Three archaeological trial trenches, 4 m² each, were made in the sandy plateau in front of the anchor. Seven whole amphorae were found beneath a thick layer of sand inside trenches, at a depth of 24 m. The amphorae were probably in the same position in which they were stacked in the hull. Furthermore, two entirely preserved small amphorae, several fragments of amphorae and one rounded ceramic jug was found in the surface layer outside the trench. During that campaign a total of twenty amphorae were found, nine of which were whole (Zmaić, 2015: 1043).

In the campaign conducted in 2011, the excavated area was extended towards the northern part of the site at a depth of 25 to 28 meters. A documentary grid composed of twelve 2 × 2 m squares (48 m²) was set up across a thick layer of amphorae. The depth of the surface layer, which consisted of interwoven roots and sand, varied between 10 and 30 cm. The second layer was about 50-80 cm deep, composed of dark sand, remains of amphorae and fragments of glassware. Twenty two whole and partially preserved amphorae were found within that layer (Zmaić, 2012: 473).

The research continued in 2012, in collaboration with the Dipartimento di Studi Umanistici of the Università Ca' Foscari di Venezia. The sandy bottom around the shipwreck area slopes northwards, making the northern part of the site about 3 m deeper than the southern part; therefore the grid was constructed in two levels, at a depth of 25 and 29 m, all in purpose of detailed documentation through photogrammetry. This layer (excavated in the previous campaigns) yielded another 48 amphorae, along with numerous glass fragments (Fig. 2).

There is no evidence of the ship's hull up to date. A fragment of wood was found between the amphorae and a microscopic wood identification¹ has shown that the sample belongs to *Ulmus sp.* (elm), but the fragment is too small, so no conclusions about the hull could be based on it.

The amphorae cargo

The shape of all amphorae from the Cape Stoba site belongs to the Middle Byzantine tradition with a distinctive ribbed body, a short neck, massive, elongated handles and a slightly flattened, rounded or a concave base. While it is almost impossible to trace the development of medieval amphorae in the western Mediterranean, the situation is quite different on the Eastern part of the Byzantine Empire, especially in the coastal side of Marmara and the Black sea, where workshops continued to produce commercial transport amphorae throughout the Middle Ages. A similar situation can be traced in the waters along the eastern Adriatic coast, where this kind of trade

¹ Microscopic wood identification was performed in the Oddelek za lesarstvo, Biotehniška fakulteta Univerza v Ljubljani (Slovenia).



Figure 2. Cape Stoba: map of the site with archaeological trenches during the four archaeological campaigns (drawing: V. Zmaić Kralj).

continued in the 13th and 14th centuries. This is confirmed by more than six known medieval shipwrecks with Middle Byzantine amphorae cargo and dozens of sporadic finds. Along with underwater finds, there are several Byzantine amphorae incorporated in dome – construction of early medieval churches, as elements for improving acoustics (Fig. 1). This secondary but widespread re-use of vessels was extended to the entire territory of the Byzantine Empire and significantly helps the dating of those amphorae, since the date of the monument or the date of its repairs also gives a relative chronology of vessels built into them (Bakirtzis, 1989: 77; Jurković/Turković, 2012: 133-139).

The study of medieval Byzantine clay containers began in the second half of the 20th century, and resulted in certain classification and typologies (Demangel/Mamboury, 1939: 148-149; Bakirtzis, 1989: 73-77; Günsenin, 1989: 267-276) based on findings from the aforementioned area. However, University of Lecce discovered the kilns for amphorae production in Otranto and revealed the existence of such production sites on the Apulian coast during the Middle Byzantine periods (Arthur/Auriemma, 1996: 14-17). Almost all amphorae from the shipwreck at Cape Stoba can be divided into nine main groups with some variants and subtypes, and can be compared with the aforementioned typologies (Fig. 3).

About thirty vessels can be attributed to the Group I of Byzantine amphora (Brusić, 1976: 38) (Fig. 3.1). They have a wide emphasized shoulder and a slightly funnel shaped neck. The body is 40 cm in height and gradually narrows after the point of maximum diameter of 30

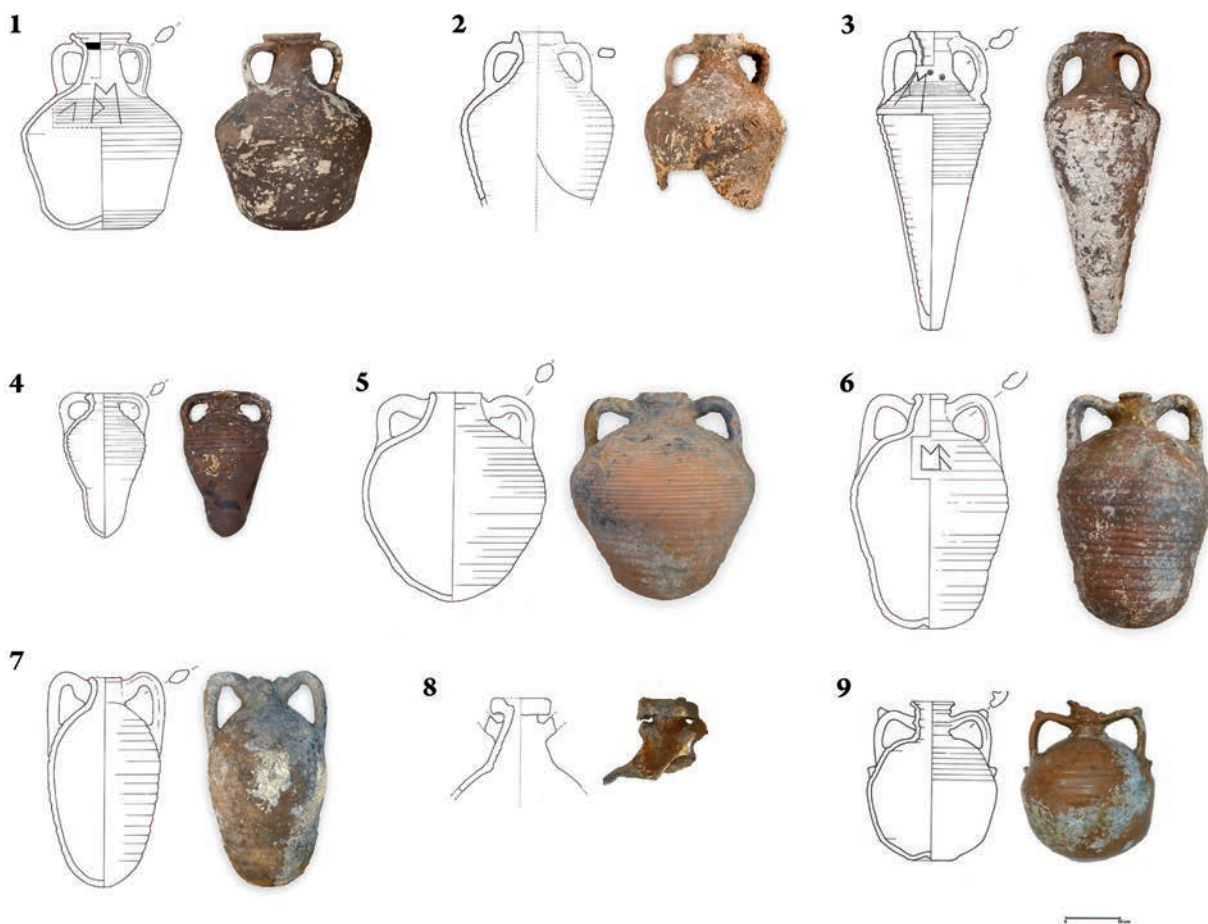


Figure 3. Cape Stoba: types of Middle Byzantine amphorae from the site (drawing: V. Zmaić Kralj, photo: I. Miholjek).

cm, to the flat base with a concave centre. According to E. L. Garver's chronological division of Byzantine amphorae from the Bodrum Museum of Underwater Archaeology, this one belongs to Type 8, and is dated to the period from the 9th to the 11th century, based on analogies with amphorae discovered during a renovation of buildings at Mangala in Istanbul, built in the time of Basil I (867-886) at the end of the 9th century (Garver, 1993: 152). The best known analogies are six amphorae found on the Serçe Limanı shipwreck, dated to the 11th century (Van Doorninck, 1988: 22-23). More close analogies can be found at Butrint site in Albania (Vroom, 2012: 291, fig. 7), at the Agora of Athens dated to the 9th and 10th centuries (Robinson, 1959: 120 pls. 34, 58) and on the Sarayhane site in Istanbul in the layer dated to the 11th century (Hayes, 1992: 75, figs. 25, 15). There are certain indications that these vessels may have belonged to the southern Mediterranean production, in the northern African region (Auriemma/Quiri, 2007: 33, tav. 2:9).

The type of amphora corresponding to Group II (Brusić, 1976: 39-40), represented by only five specimens from the site, has a very similar body to those belonging to the first group, but with some difference on the upper part (Fig. 3.2). The closest parallels are amphorae from the Mangala site in Istanbul (Demangel/Mamboury, 1939: 148-149), Cherson in the south western part of Crimea, Serkal on the Don (Jakobson, 1951: 333, fig. 6/25-27) and from Preslav in Bulgaria. In the St. Sophia church at Ohrid thirteen amphorae attributed to that type were found built into the vault, in order to provide better resonance (Aleksova, 1960: 202-203; Brusić, 1976: 39). According to numerous similarities with the first type, these amphorae can also be of the same southern Mediterranean provenance.

The Group III amphorae (Brusić, 1976: 38) are the most common type on the site (Fig. 3.3), and until now over 49 examples were recovered. These amphorae have a similar upper part to those belonging to Groups I and II, while the body, varying between 45 and 60 cm in height, is tapering towards a cone shape, like the earlier Late Roman «carrot» amphorae. Several variants of this type were found and the differences between them are related to dimensions and volume. The closest parallels to this type are four amphorae built into the construction of the vaults in the Church of John the Baptist in Kerch, dated to the 9th-10th century (Jakobson, 1979: 75, fig. 43). Few similar examples were discovered at Dinogetia in Romania (Barnea/Comsa/Comsa, 1967: 267, fig. 159/3) and at Preslav, dated to the 10th-11th century, and also at the monastery complex near Karaach Teke in the east part of the heartland of the medieval Bulgarian state (Todorova, 2012: 18-19, 23). It seems that this amphora type represents a kind of reminiscence of the famous Sinopean «carrot» amphora, which was manufactured from the 4th and throughout most of the 5th century AD (Magomedov/Didenko, 2010: 480). Most of these amphorae occur across the whole Black Sea littoral during the Late Roman period, particularly along the northern and western coast, where these forms were adopted by some Heraclian and Chersonesian workshops (Opait, 2010: 373). The shape, size and capacity of the Byzantine amphorae from the Cape Stoba wreck are significantly different from the Late Roman types, particularly with their distinctive massive handles attached close to the rim, a shorter neck and a flattened base (Fig. 3.3).

Three whole small pear shape amphorae were found at the site. They are 30 to 32 cm high, with a stubby neck and oval handles reaching from the rim to the shoulder where the amphora is the widest, about 17 cm in diameter (Fig. 3.4). This type belongs to the Brusić Group IV (Brusić, 1976: 41), while N. Günsenin included them in the group 11 of the Byzantine amphorae, and dated them to the 10th and 11th centuries (Günsenin, 1990: 39). The closest parallels are the amphorae found on the Serçe Limanı, the 11th century shipwreck, in the Agora of Athens, where they were found in the stratum dated to the 10th and 11th centuries. The same date is given for this type of amphora found in Bulgaria at Preslav and in the monastery complex near Karaach (Todorova, 2012: 19, 23).

Only one amphora from the site can be connected to a time and place of production. It has a wide piriform body, no toes at the bottom, it is 37 cm in height and 33 cm in diameter, with a stubby neck and small oval handles reaching from the rim to the shoulder (Fig. 3.5). N. Günsenin included them in the group I of the Byzantine amphorae, and dated them to the period from the 10th to the 12th century (Günsenin, 1998: 269-271). The same author connected them with the production of wine in the Ganos monastery, an area of wine production on the Marmara Island (Günsenin, 2000: 147). During surveys of that region in the 1990s, several sites with amphorae kilns that produced Ganos amphorae were discovered on the Marmara Island, and on the north coast of Marmara, outside the immediate Ganos area (Günsenin, 1999: 19). At the same time, underwater surveys along the Marmara islands resulted in eleven Byzantine shipwrecks and eight of these were carrying the Ganos amphorae. The same type of amphorae can be found in almost all parts of the Empire and beyond the Byzantine Empire, which suggests that Ganos was a part of a large scale trading network: along the coast of Byzantine Asia Minor (on the Serçe Limanı shipwreck), on Crete and Cyprus. Internationally, they reached Egypt, the Levant, southern Italy, countries bordering the Black Sea, and inland to Sarkel, north into Russia and Sweden (Günsenin, 2000: 152).

Twelve piriform amphorae were recovered from the site. They have a rounded base, a short neck, thinly rolled rim and tick, oval handles that in some cases slightly overpass the rim. Dimensions of vessels vary from 40 to 45 cm in height and 25 to 35 cm in diameter (Fig. 3.6). Several variants of this type have been found at the site, and the differences between them can be observed in the position and height of the handle, the diameter of the body as well as in the capacity of the vessel. According to available data, this is the best represented type of Middle Byzantine amphora on the entire Mediterranean. These vessels belong to the Brusić VA Group (Brusić, 1976: 41), in Bakirtzis Type I, dated to the period from the late 9th to the 11th century (Bakirtzis, 1989: 74-77) and according to Garver's classification they belong in Class 5 and are dated to the period from the 9th to the 13th century (Garver, 1993: 129-136). Similar amphorae have been found in pottery kilns in the Kherson on the eastern Crimea, an important commercial centre of the Byzantine Empire on the northern coast of the Black Sea, and on other sites on the northern coast of the Black Sea in Kerch and in Sarkel on the Don (Jakobson, 1979: 71-73), suggesting a Crimean provenance. But the possibility that they were produced elsewhere along the Mediterranean coast cannot be excluded, since a similar type can be found at numerous sites that cover a vast area. Three such amphorae are stored in the Bodrum Museum and analogous specimens were discovered in Istanbul, at the Agora of Athens, on the island of Samos, and in the harbour at Antikythera in Greece (Garver, 1993: 135; Coldstream/Huxley, 1972: 269-270, fig. 87:18), on the Svichtov site in Bulgaria, Dinogetia and Capidava in Romania, in the Church of St. Sophia in Ohrid, and also in Kostol and Beograd in Serbia (Bjelajac, 1989: 113). There are many parallels on the eastern Adriatic as well: on the shipwreck in the vicinity of Nin, near the islet of Ošljak in the Zadar Channel, in the Port of Hvar, in Umag and in the bay of Pijan in Istria (Brusić, 1976: 41; 2010: 246). Some similar vessels were found at San Francesco del Deserto and at Torcello island in the Venetian Lagoon (Toniolo, 2007: 103).

The ovoid amphora with a stubby neck and a massive high-placed handles that slightly overpass the rim is represented by a single specimen from the site. The amphora is relatively small, only 37 cm in height and 20 cm in diameter (Fig. 3.7). These amphorae belong to Brusić's group VA (Brusić, 1976: 41), and according to Günsenin classification in Type XV (Günsenin, 1990: 308, pl. LXXXIV/3, 313, pl. LXXXVI/1). The closest parallels are amphorae embedded in the vault construction of the church of St. Barbara in Trogir, from the 60s of the 11th century (Brusić, 2010: 249; Jurković, 2012: 137) and amphorae found in Albania at the site Butrint, in the city of Durrës (ancient Dyrrhacium), in Greece at the island of Cefalonia (Scognamiglio, 1997: 18) and at the Agora in Athens in the layer dated to the 11th and 12th

centuries (Günsenin, 1990: pl. LXXXVI/1). Some amphorae of similar shape were found on the opposite coast of the Adriatic, on the area off SE Apulia at Mola di Bari, in Brindisi and at Capo San Vito near Taranto (Volpe *et alii*, 2007: 363-364). Excavations at Otranto and the site of Quattro Macine, Antifano, monastic sites of S. Giovanni Malcantone and Le Centoportie as well as surveys of the underwater sites around Apulia during 1980's and 90's have revealed an abundance of amphorae made from a distinctly local Apulian fabric, in contexts dating from the 10th-11th to the 13th century (Arthur/Auriemma, 1996: 16). Since medieval kilns for producing local types of medieval amphorae in Apulia were also found (*ibid*), a future analysis of the clay of Cape Stoba amphorae and a comparison with the clay from local deposits could indicate the origin of these products. Production of the Middle Byzantine amphorae in that area can be explained by the fact that in the second half of the 9th century Apulia was returned to the Byzantines, who kept it for nearly two centuries and where they initiated the revival of many cities, up until the arrival of Normans in 1043. It seems that the production and exportation of surplus agricultural products was relatively abundant in that period and the port of Otranto was a major Middle Byzantine town (Arthur/Auriemma, 1996: 14) from which the goods were leaving Apulia and supplying other parts of the Byzantine Empire on the East.

Among the amphorae, one fragment of a neck was found, with a base part of the handle and a distinctive broad angular rim (Fig. 3.8). Only a small part of the handles was preserved, but it is suggested that they extend above the rim. Amphorae with these characteristics belong to a type of pear shaped vessels with bowed handles. This type was very common and well represented on the Eastern Mediterranean and the Black Sea basin from 10th to 12th century, but it is a very rare find in the Adriatic region, and it seems that this is the sole example of this amphora found so far on the eastern Adriatic coast. According to the N. Günsenin typology that amphora belongs to the group II b (Günsenin, 1990: 31-34) and in the Bakirtzis classification in Type IV (Bakirtzis, 1989: 74-75). Westernmost similar examples were discovered in Tessaloniki and at the Agora in Athens, furthermore, this type can be traced along the Black Sea basin in Cherson, Kerch, and inland up to Sarkel on Don (Jakobson, 1979: 109-110), in Tulcea, Dinogetia and Capidava in Romania (Barnèa, 1989: 133-134). These amphorae were found at the Mangala site in Istanbul (Demangel/Mamboury, 1939: 198-1), in Sinop, in Şarköy on the north coast of the Marmara Sea, and here we will also mention vessels recovered from the area around the coast of Byzantine Asia Minor, stored today in the Çanakkale Museum collections (Günsenin, 1989: 270-271).

A small vessel of a specific form was found in the last campaign in 2012. It has a wide, round or slightly polygonal body, 30 cm in height and 24 cm in diameter, a profiled neck with a funnel shaped rim and a flat surface with a concave center at the bottom (Fig. 3.9). It has four small triangular horns, two at the crease of the handles and two below the point where the handles are merged with the body. The analogy for this type of vessel has not been yet found.

An entirely preserved rounded ceramic flask was found among the amphorae. It is 18 cm in diameter, with two strap handles, a short neck and a funnel shaped rim. Instead of a bottom, it had a standing flat surface on one side of the belly (Fig. 4). Similar flasks were found on sites along the Crimea. A clay mould for the production of such flasks was found among amphorae kilns in the Trudoljubovka site on the south-west Crimea. In a few examples the convex side of the belly was decorated with a red pattern painted applied with a thick brush. Such decoration is not familiar on the Crimean area, but it can be compared with the decoration on vessels from the tomb of Alans at the northern Caucasus, so it is possible that such forms represent reflections of the nomadic way of life and suggest cultural connections between Byzantium and nomadic populations from the north east (Jakobson, 1979: 38-39).



Figure 4. Cape Stoba: rounded ceramic flask (photo: R. Moskovicić, drawing: V. Zmaić Kralji).

Of more than 100 amphorae recovered, seven had wooden stoppers. The stoppers of biconcave or trapezoidal shape with a small hole in the centre were covered with a layer of resin to seal them in place (Fig. 5). After two sealed amphorae were opened it was found that they were filled with sand. Considering that stoppers were covered with resin, the sand in the amphorae could not have breached in during their time at the seabed. The amphorae were intentionally filled with sand and sealed, which points to the possibility of re-use of the amphorae as containers for loose ballast like sand.

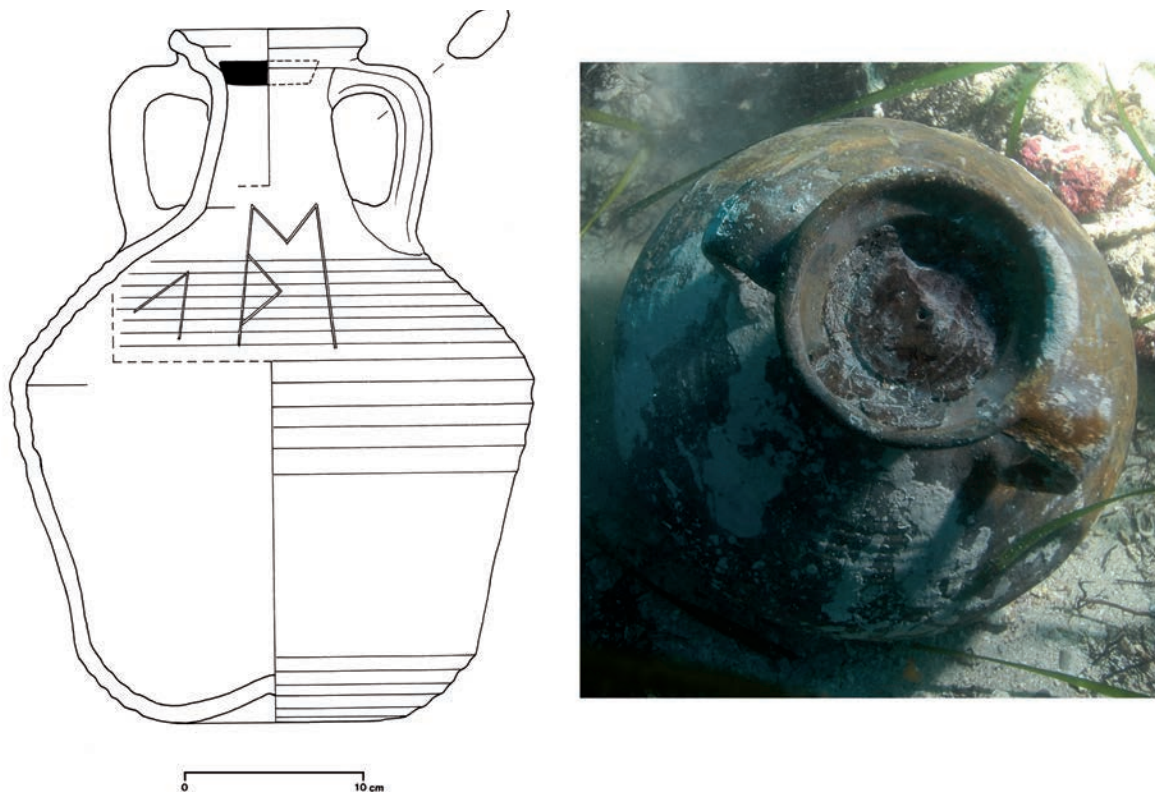


Figure 5. Cape Stoba: amphora sealed with a wooden stopper (photo: I. Miholjek; drawing: V. Zmaić Kralji).

Many of the amphorae from the shipwreck have graffiti inscribed on the upper part of the body. In addition to the graffiti, some amphorae also had a stamp imprinted on them before firing. A total of 47 graffiti and 14 stamps occur on 44 of the 99 amphorae. The graffiti may be divided into several distinct groups: single-mark and multiple-mark graffiti, in Greek/Cyrillic letters, Turkic/Oghuric runes, and graffiti that can be described as geometric, pictorial symbols or numerals (Collins, 2012: 95). The most common marks are X, M, and A. These symbols have been categorized as a Greek/Cyrillic letter, although they also have parallels in the runic alphabet and the mark X may possibly represent a number, such as the Roman numeral ten. The graffiti X appears in multiple character marks, including ligatures: XM, AX, MAX, XMA, XMD or NX, and the M appears in ligatures as well: XM, AM, MD, MP, MF, MFT, XMD. The marks have been identified as symbols from various runic alphabets that were used in the area around the Black Sea, particularly in Bulgaria and Crimea, in the medieval period (ibid. 118). There are also plenty of parallels with graffiti on amphorae found on inland sites around the Black Sea basin, including Chersonesos, Sarkel, Kiev, Aegyssus-Tulcea, Dinogetia, Pliska, Sinope, and the mouth of the Don as well as on amphorae from Byzantine shipwrecks (Garver, 1995: 68-74; Collins, 2012: 138). One of these shipwrecks was found on the south-west of Turkey at the Serçe Limanı site, with a cargo of glass objects and amphorae with various graffiti carved on them (Van Doorninck, 1989: 253, fig. 3.16). Three types of amphorae found on the wreck are analogous to those from the Cape Stoba wreck (Group I, IV, V) as well as some of the graffiti carved on them. Among other parallels, the most frequent marks on the Serçe Limanı shipwreck is the letter M, alone or with other joined marks, like the ones on amphorae from Cape Stoba. The meaning of the graffiti on amphorae from Cape Stoba wreck has not yet been established. During transportation and distribution, graffiti had various uses: to indicate goods stored in the amphorae or the capacity, either in volume or in weight. In trade, a wide variety of individuals handled the amphorae, from the stevedores, to the commercial officials who regulated trade (Collins, 2012: 107), therefore, these signs could also relate to those activities. On the other hand, Van Doorninck has hypothesized in his discussion of the Serçe Limanı amphorae that groups of graffiti inscribed on them appear to be marks of ownership, and belong to merchants involved in the ship's last voyage. Considering that very close parallels of those graffiti occur on medieval Bulgarian pottery, he suggests that some of them represented marks of merchants from the western Black Sea region or family marks of Bulgarian potters working along the coast of the Sea of Marmara (Van Doorninck, 1988: 23).

The glass cargo

The next connection between the two shipwrecks, the Cape Stoba and Serçe Limanı, is a cargo of glassware produced on the eastern Mediterranean. The glass fragments from Cape Stoba wreck mainly belong to bowls, beakers, goblets, bottles, cups, Byzantine lamps and plates in a variety of colors and patterns (Fig. 6). The most common combination of colors is transparent light green – yellow and cobalt blue, followed by green, yellowish, purple and gray glass. This luxury glass objects were decorated with the eye motif, imprinted on the hot glass surface and with undulating or horizontal applications of glass in a different color (Fig. 6). Among the large number of fragments, two almost completely preserved goblets were found made in a combination of transparent light green-yellow and cobalt blue glass decorated with the eye motif². While these shapes are common in the mediaeval glass industry on the eastern Mediterranean, decoration in two-color glass is fairly rare. It is known in Egypt in the 9th and 10th centuries and decoration with the «eye motif» is specific to the Islamic world, and also long the eastern borders of

² The first was found during the surveys in the 1970s and now is exposed in the Maritime Museum in Dubrovnik, and another was found during the excavations in 2012.

the Byzantine Empire in Syria, Egypt and Mesopotamia, whence Byzantine 9th and 10th century glass blowers took over this technique of making and decorating glass (Han/Brusić, 1978: 278-279). The trade and need for this luxury glassware in Byzantine urban centers on the eastern Adriatic coast and in the early Croatian period is attested by a find of a glass bottle and a cup in a grave (n.º 322) of a Croatian nobleman in the Ždrijac necropolis in Nin (Brusić, 2010: 251). The bottle from the grave is almost identical to the bottle that was found in the cargo of the Serçe Limanı shipwreck and to the neck of the bottle from Cape Stoba. This points to the fact that the same merchandise was sold along the trade routes in the entire Byzantine Empire, from the Levant and Bosphorus to the Byzantine colonies in Dalmatia, where the need for such luxurious items spread to the neighboring medieval Croatian kingdom.



Figure 6. Cape Stoba: glassware found during excavations 2009-2012 (photo: R. Mosković).

The connection with the cargo of Serçe Limanı³ is crucial for the dating of Cape Stoba shipwrecks. The ship sunk in the later part of the 3rd decade of the 11th century carrying a mixed cargo that included pottery, glassware and glass cullet, probably shipped from the Fatimid Syrian coast to some glass – making center in Byzantine waters (Van Doorninck, 1989: 250-257; Bass *et alii*, 2004). Among the finds on the wreck were the glass weights for pan balances used for weighing gold and silver Fatimid coins. The most recent weights are stamped with a date that corresponds to 1024-1025, or 1021-1022, thus they gave a chronological point of reference (Van Doorninck, 2002: 902), and the ship must have sunk not long after. In addition to the Serçe Limanı excavation, several examples that confirm the chronology come from excavations in the Athenian Agora (Günsenin, 1990: 287-318), where analogies for almost all types of amphorae from the Cape Stoba shipwreck can be found in sealed strata dated to the 10th and 11th centuries.

³ The shipwreck that lies in the waters off the coast of Serçe Limanı was excavated from 1977 to 1979 by the Institute for Nautical Archaeology under the direction of George Bass.

Conclusions

The island of Mljet is settled on a traditional trade route between the Eastern and the Western Mediterranean. The shipwreck at Cape Stoba was excavated in four short campaigns, from 2009 to 2012. During those campaigns, the archaeologists investigated remains of the ship's cargo, consisting of over a hundred amphorae and various glassware. Up till now nine types of amphorae were identified, most of which bear characteristics attributable to the area of the Black Sea and the Marmara, and one that can be linked to the production in southern Apulia. The shape, making and decoration technique used on the glassware point to an Eastern-Mediterranean descent. The glass of same descent and analogous types of amphorae were found in a sunken ship at Serçe Limanı, dated to the 1020s, so the shipwreck at Cape Stoba can be placed roughly in that period. Looking at the broad picture of the political and economical situation in the 10th and 11th centuries on the Eastern Adriatic, the six medieval shipwrecks with amphorae cargo and dozens of sporadic finds on land and in the sea clearly point to the fact that the use and trade of clay containers was still a common practice in this area in the Middle Ages, thanks to the trading connections within the Byzantine Empire. On the contrary, finds of Byzantine amphorae are rare and sporadic in the Western Mediterranean and in most of Italy from the 8th century onwards, except for the southernmost part of Apulia, which was under the Byzantine rule over a longer period of time. A similar situation is reflected in other areas that were under Byzantine rule, so such amphorae can be found in Albania, Greece, Bulgaria, Romania, the area around the Black Sea and Marmara, and the eastern Mediterranean with Constantinople at the center. The Cape Stoba ship was most probably wrecked transporting cargo from a trade port in the Eastern Mediterranean. Its cargo was intended for trade in the Byzantine towns on the eastern Adriatic coast. Considering that the excavations uncovered five amphorae filled with sand, it was most likely transshipment. It seems that the sand filled amphorae were used as ballast, and future analysis of sand samples will give us more specific answers. One Byzantine amphora of the Apulian type in the ship's cargo points to a possibility that the trade route included southern Apulian harbors.

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The Antique Port of Seville: Transformations from Roman Times to the Islamic Period

El antiguo puerto de Sevilla: transformaciones desde época romana al periodo islámico

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Abstract: The purpose of this paper is to briefly introduce and discuss some of the geomorphological transformations that the Guadalquivir River and the ancient port of Seville endured from the Roman period until the Middle Ages. To illustrate these transformations different archaeological finds from the *Plaza Nueva* site will be presented. In 1981, a cruciform iron anchor and the remains of a wooden boat were found in a salvage excavation conducted at *Plaza Nueva*. At present, this salvage excavation is the only archaeological intervention that has been conducted in an area where the ancient port of Seville once was located. The archaeological findings from *Plaza Nueva* are helping us to better understand the geomorphological transformations of the Guadalquivir River. Particularly, they are helping us to understand when the ancient riverbed of the Guadalquivir and the ancient port of Seville ceased to be navigable and, soon after, disappeared after being assimilated by the expansion of the city.

Key words: Paleo-geomorphology, *Lacus Ligustinus*, Guadalquivir River, ancient port of Seville, *Plaza Nueva* site.

Resumen: en este trabajo se presentan y discuten brevemente algunas de las transformaciones geomorfológicas que el río Guadalquivir y el antiguo puerto de Sevilla sufrieron desde época romana hasta la Edad Media. Para ilustrar estas transformaciones, se presentarán diferentes hallazgos arqueológicos del yacimiento de la Plaza Nueva. En 1981, un ancla de hierro cruciforme y los restos de una barca de madera fueron hallados en una excavación de urgencia llevada a cabo en la Plaza Nueva. Hasta el momento, esta excavación de urgencia es la única intervención arqueológica que se ha llevado a cabo en un área donde una vez se encontraba el antiguo puerto de Sevilla. Estos hallazgos arqueológicos nos están ayudando a comprender mejor las transformaciones geomorfológicas del río Guadalquivir. Particularmente, nos están ayudando a en-

tender cuándo el antiguo cauce del Guadalquivir y el antiguo puerto de Sevilla dejaron de ser navegables y cómo, poco después, desaparecieron siendo asimilados por la expansión de la ciudad.

Palabras clave: paleo-geomorfología, *Lacus Ligustinus*, río Guadalquivir, antiguo puerto de Sevilla, excavaciones de la Plaza Nueva.

Scholars place the origin of Seville in a settlement on a small hilly island surrounded by and connected to the salt-water lagoons and the *Baetis* (i.e. the name Romans used for the Guadalquivir River). Around the 9th century BC, the Phoenicians founded a colony and started to interact with already established nearby Turdetan settlements (Escacena/García, 2012: *passim*). This Phoenician colony was known by the Semitic name *Spal* or *Ispal* (Lipinski, 1984: 100). In the first century BC, following orders from Julius Caesar, a roman colony was established at the same location, and given the name *Hispalis* (Ordóñez, 1998: *passim*).

The roman colony of *Hispalis* was probably the most important *emporium* and port of the wealthy *Provincia Baetica*. It has been estimated that 53 million amphorae (mostly Dressel 20 type) comprise *Monte Testaccio* in Rome (Rodríguez, 1984). All these amphorae, among many other cargoes, largely departed from the port of *Hispalis*. However, despite the major role that this port played in antiquity, the exact location and characteristics of the ancient port of Seville are still little known by scholars.

The city of Seville was continuously called *Hispalis* thorough the convulsive historical periods that followed the fall of the Western Roman Empire (i.e. Germanic invasions, Visigoth period, and Byzantine occupation). In AD 712 *Hispalis* was occupied by the armies of the Umayyad's Empire and subsequently controlled by different Islamic governments until AD 1248, the year in which it was conquered by Christian armies under the command of Ferdinand III of Castile. During the Islamic period the city was renamed as *Isbbiliya*, the name from which its current name *Sevilla* (i.e. Seville in Spanish) comes from.

Paleo-geomorphology of the Guadalquivir River

Seville is located 85 km inland northwards from the Atlantic coast; it is separated from the ocean by an extended area of marshy lowlands near the banks of the Guadalquivir River. The Guadalquivir marshes have an approximate area of 2000 km², they are one of the largest agricultural production areas of rice in Spain, and are also the home of one of Spain's largest natural reserves: Doñana National Park, declared a Unesco World Heritage Site in 1994. However, during Roman times the area that occupies these marshes was very different than in the present day; it was a large body of water that can be described as an interior sea, a large inner lake, or a large estuary (Fig. 1). The lake slowly became filled in with deposited sediment, gradually transforming into the current marshes (Ruiz *et alii*, 2002).

We know that during Roman times this interior sea was navigable and deep enough to allow seagoing merchant vessels of considerable size to navigate through it (Strabo 3.2.3). However, we do not know under which name this area was known during Roman times since none of the main Roman Era geographers named this interior body of water. Neither Strabo, Pomponius Mela, Pliny the Elder nor Ptolemy assigned a specific name for this area.

Ptolemy, however, is the only geographer that, despite not using a specific name, described the area in detail; in his *Geography*, he gives a description of the *Baetis* River and the cities and towns around it. He refers to this area as the estuary (i.e. *ἀνάχνησις*) of Asta and Nabris-

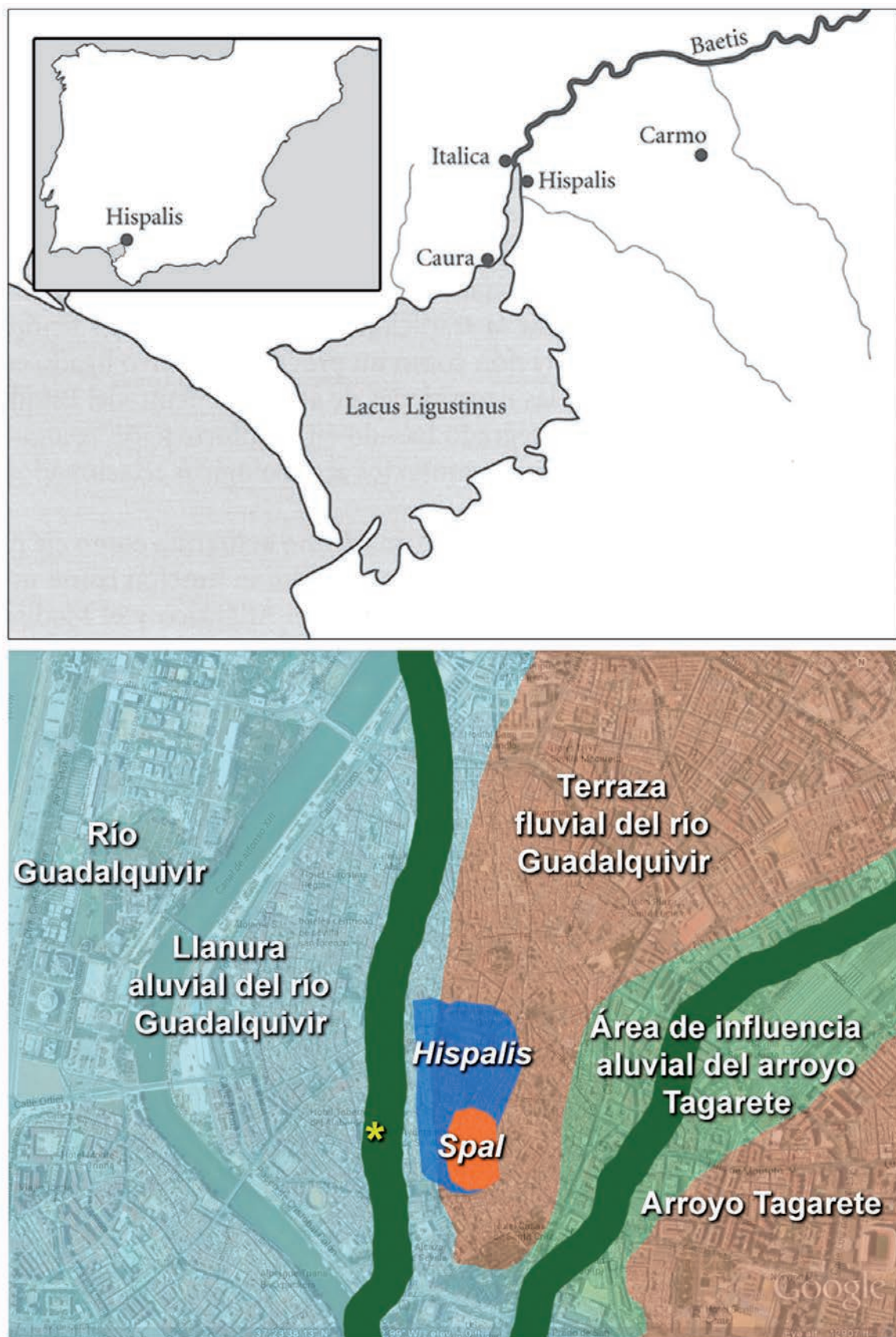


Figure 1. Reconstruction of *Lacus Ligustinus* and location of *Hispalis* (top); geomorphology of the Guadalquivir in Seville and the position of the ancient riverbed circa 1st c. AD, the asterisk marks the *Plaza Nueva* (bottom).

sa (Strabo 3.1.9). He defines *ἀνάχουσιν* as follows: «the name of estuaries is given to hollows covered by the sea at the high tide, and in the same way that rivers afford waterways to the interior and to the cities on their shore».

Ptolomy continues describing the area above the Atlantic coast situated between the «Sacred Promontory» (i.e. Cape St. Vincent) and the «Pillars» (i.e. Strait of Gibraltar) where, he described, there is a considerable plain that extends inland. This plain is composed by many inlets and hollows running from the sea towards the interior; these were large size riverbeds of the Baetis estuary that extend for many stadia (Strabo 3.2.4).

Despite the extended and detailed geographical description of the entire area that Ptolomy produced he described it as estuary or country but never gives a specific toponym. The first time that a specific name is used for the estuary of the Guadalquivir River occurred in the 4th century AD, when Avienus described the area as *lacus Ligustinus* in his *Ora maritima* (Avieno, *Ora Maritima*, vv. 283-303).

Ora maritima is a poem containing borrowings from the early 6th century BC *Massiliote Periplus*. The editor of one of the French translations of *Ora maritima*, A. Berthelot, remarked that Avienus composed his poem by searching archaic travel accounts and *periplus* and then summing the information gathered with his personal impressions and perceptions of the world in the 4th century AD (Avienus, 1934). The result is a rather confusing account of the coastal regions of the known world in the form of a poeticized *periplus*. The account is confusing because the geographic description of the areas is real yet the toponyms used to name certain places are often borrowed from other different and distant locations. Consequently, neither the indigenous peoples living in the *Baetica* region nor the Romans that colonized it called the estuaries of the *Baetis* with the name *lacus Ligustinus* (Ferrer, 2012: 65). Avienus borrowed this term from the *ligur* coast, a place located in the Mediterranean shores of southeast Gaul close to the Greek colonies of the area. Nevertheless, and despite never being used by the Romans, the hydronym *lacus Ligustinus* is widely accepted in the modern day historiography probably because we lack a different name for the *Baetis* estuary (Ferrer, 2013: 218).

Strabo described how the area of the *lacus Ligustinus* was navigable from the sea to the many cities located inland for both small and large vessels (Strabo 3.2.4). He also explains further and in more detail that the *Baetis* was navigable for seagoing vessels across 500 *stadia* (i.e. a distance of about 80 to 92 km) as far as *Hispalis*; up to *Ilipa* was navigable for smaller vessels; and up to *Corduba*, 1200 stadia from the sea (i.e. a distance of about 192 to 222 km), was only accessible by river-boats (Strabo 3.2.3). *Hispalis* was, therefore, located at the reach of tides from the Atlantic Ocean occupying a strategic point at which two different and complementary networks converged: the maritime Mediterranean network and the riverine and terrestrial network of the *Provincia Baetica* within the Guadalquivir Valley.

The strategic position of this area was unquestionably recognized by the Phoenicians, which founded a colony in this precise spot around the 9th century BC (Escacena/García, 2012). Scholars place the origin of *Spal* on a small hilly peninsula surrounded by and connected to the salt-water lagoons and the *Baetis* (Ordóñez, 2003: 59). This location at the tip of a peninsula close to the sea and also close to indigenous settlements, follows the traditional model that the Phoenicians used for establishing their colonies around the Mediterranean (Aubet, 1993: *passim*).

In antiquity, the area where *Spal* was founded was significantly different from today's geographical morphology. The settlement was in an area within the Atlantic Ocean's tidal range, surrounded by salt-water lagoons, and nearby several streams. This peninsula is a fluvial terrace of the Guadalquivir River with an average height of more than 10 meters above sea level, thus

protected from tides and river floods. The peninsula is flanked towards the west by a large alluvial plain of the Guadalquivir River, in which the ancient riverbank flowed through a corridor situated in a different location than the current riverbed. Towards the east the Tagarete stream, and its area of influence, flanked the other side peninsula (Fig. 1).

The position of the Guadalquivir riverbed has changed through time. The current position of the riverbed has been stable from the 12th century onwards but through Antiquity and the Early Middle Ages the position of the ancient riverbed changed. On the alluvial plain of the Guadalquivir River, it is possible that a few riverbeds existed alongside the elongated peninsula where *Spal* was established. The exact number of riverbeds in antiquity is uncertain, their exact position and evolution remains unclear and has been a point of debate for scholars who have thoroughly studied the formation process of the city of Seville (Ordóñez, 2003: 59; Ménanteau, 2007: 173-178). However, archaeological and geological evidence suggest that one main riverbed existed from the 1st century AD onwards. The ancient riverbed of the Guadalquivir flowed north to south through an area that today is occupied by central downtown Seville (Fig. 1). It was in this ancient riverbed where the ancient and little known port of the colony *Spal*, later on named as *Hispalis*, and finally *Ishbiliya* was located.

Geo-archaeology of Guadalquivir in the area of Seville

For the last two decades geologists have studied the morphological changes that the Guadalquivir River endured from Roman Times to the Medieval Period. Although precise details remain unclear, the general evolution and migration processes of the Guadalquivir ancient riverbed is now understood.

One of the works that provides the most complete information for understanding the paleo-geomorphology of Seville is a doctoral thesis later published as a book. The thesis focused on the palaeographic reconstruction of the city of Seville, its immediate surroundings, with an emphasis on the paleo-hydrology of the Guadalquivir River. The study encompasses the evolution of Seville and the river during the last Holocene period, known as the Sub-Atlantic climatic phase that goes from approximately 500 BC to present (Barral, 2009).

According to this work, the palaeographic reconstruction of the city of Seville during the last 2500 years could be accomplished by understanding the migration processes of the Guadalquivir riverbed(s) by comparing two opposed phenomena: first, the *alluvial phases* that were predominant during the aggradation processes that shaped the alluvial plain of the Guadalquivir River; and in contrast, the *stability phases* that allowed the urban expansion and development of the city in different historical periods (Barral, 2009: 534).

This study was conducted analysing three different, but complementary, sets of data: geomorphological information (provided by bore core samples), historical information, and archaeological information. Once the study was concluded a series of different alluvial phases were established by the author.

During one of the phases, the one described by Barral Muñoz as «alluvial phase from pre-Roman to early Imperial», a process of change in the fluvial river dynamics comes to an end; in this period (*circa* 500 BC to *circa* 50 BC) the Guadalquivir River leaves a braded system of multiple interlaced riverbeds, or river channels, evolving into a meandering system in where one single riverbed existed (Barral, 2009: 537-540). In this phase, first a large alluvial plain composed the paleo-environment of Seville where possible multiple riverbeds flowed interlaced (i.e. braded system) on the west side of the city; this environment was highly affected by both alluvial

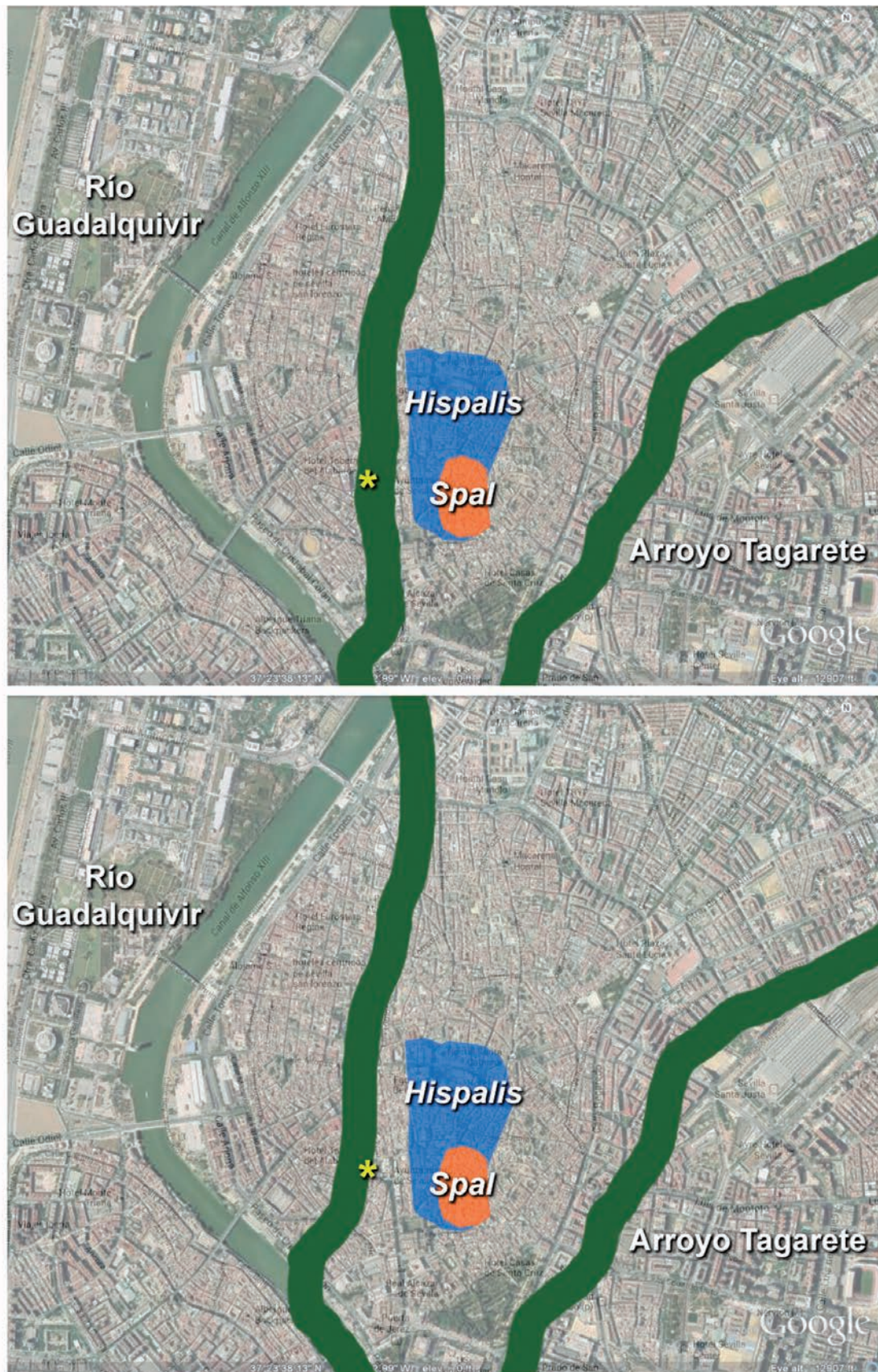


Figure 2. «Roman Imperial stable phase» of the ancient riverbed 1st-2nd centuries AD (top); position of the ancient riverbed circa 6th-9th centuries AD, note that it has migrated slightly westwards (bottom).

seasonal episodes and the regular Atlantic Ocean tides creating many marshy areas affected by floods. Later on, the Guadalquivir alluvial plain environment changed towards a state in which only one riverbed was more predominant. This single riverbed seems to have migrated eastwards during this phase, and towards the end of the Republican period became fairly stable closer to the east bank of the Guadalquivir and the city of *Hispalis*.

The following phase is a stable one and it occurred during the 1st and 2nd century AD, Barral Muñoz denominates it «Roman Imperial stable phase». At the beginning of this phase there is an inverted displacement of the riverbed that in two points of the city moved slightly towards the west and then they stabilized (Fig. 2) (Borja, 2014: 285, fig. 6). In general, this period is characterized by fluvial and riverbed stability; this immobility of the riverbed allowed the expansion of different urban areas of the city that were previously affected by floods (Barral, 2009: 540-542).

The Roman Imperial phase of stability coincides and it is related with the beginning of the new decrease of the sea level (Borja, 2014: 290). Relative sea level is the sea level related to the level of the continental crust. Relative sea level changes can be caused by absolute changes of the sea level and/or by absolute movements of the continental crust; also, climatic and morphological influences on coastlines could cause localised regional sea level changes. Therefore, sea level changes are relative movements that vary from place to place (Angremond/Pluim-Van der Velden, 2001: 18-19).

Multidisciplinary studies along different locations of the Western Mediterranean coast are improving our understanding of historical sea level change. Some of these studies have used a multidisciplinary approach including the study of roman fish tanks with the aim of documenting the relative sea level changes in the Mediterranean since Roman times. The studies concluded that the sea level during the 1st century AD was slightly lower than at present (Evelpidou *et alii*, 2012: 275). It seems that relative sea level changes since Roman times have been very minor of the order of a few decimetres. It has also been suggested that the role of the sea level in shaping coastal changes is relatively minor in comparison to other geological phenomena such as sediment inputs (Morhange *et alii*, 2013: 371). Aggradation is a term used in geology to refer to the increase in land elevation due to the deposition of sediment by a river, stream or current. Aggradation occurs in areas in which the supply of sediment is greater than the amount of material that the system is able to transport.

The lower sea level that occurred during Imperial times (Borja, 2014: 290) produced a change in the gradation and velocity of the Guadalquivir River. Fluctuations in sea level have a long-term impact on the riverine environment of rivers that flow into the sea. If the sea level rises, the gradient of the river in its lower course is reduced; consequently, the velocity of the water carried by the river declines, hence so does its ability to carry sediment. As a result, riverbeds increase horizontally expanding and occupying nearby areas that would be converted into flooding areas. This results in the sediment being mainly deposited near the river mouth (Campbell, 2012: 11).

On the other hand, if the sea level falls, the velocity of the water carried by the river should increase; its ability to carry sediment (i.e. downcutting) will increase accordingly. This results in riverbeds with deeper and very stable channels that have narrower breadth. This later scenario is what happened to the Guadalquivir River during the 1st and 2nd century AD, the phase that Barral Muñoz denominates «Roman Imperial stable phase». This stability of the riverbed is not completely incompatible with other aforementioned processes of migration of channels, seasonal fluvial floods, or with daily tides as indeed happened in *Hispalis* demonstrated by some of the boring cores obtained in the study (Barral, 2009: 541).

Brief description of the Roman port of Hispalis during the imperial period (1st-2nd centuries AD)

During this so-called «Roman imperial stable phase», the ancient port of *Hispalis* seems to have experienced its greatest commercial activity and urban development period. The humble port infrastructures from the Republic period, located around the area that today occupies the Cathedral of Seville, were expanded southwards towards the mouth of the Tagarete stream. During the Augustan and Julio-Claudian periods the port infrastructures of *Hispalis* were expanded and conditioned to manage a substantial increase in maritime commercial activities (García, 2013: 259). It is in that period when the estimated 53 million amphorae (mostly Dressel 20 type) from *Monte Testaccio* in Rome (Rodríguez, 1984) were shipped in *navis oneraria* departing from the port of *Hispalis*.

During the Flavian dynasty a new commercial district was erected adjacent to the large port that included storehouses, small shrines, and, probably, commercial corporations (García, 2013: 259). To the north of this port district, the eastern bank of the *Baetis* had anchorages, jetties, and other lesser port infrastructures used in connection to different storage and craft production areas located both inside and outside the city walls; these commercial areas, and their related port infrastructures, are documented from the Julio-Claudian period until the Flavian dynasty (García, 2013: 259-260).

It seems that this greatest commercial activity and urban development period lasted until the last years of the Flavian dynasty or the early Nerva-Antonine dynasty, when the south port district was transformed into a large necropolis. Also around the end of the 1st or the beginning of the 2nd century AD, the commercial areas in the north part of the *Baetis* seem to be replaced by residential areas (García, 2013: 260).

Plaza Nueva archaeological findings

As we have seen, very little is known about the exact position, morphology, or installations of the ancient and now lost port of Seville; but we know that the ancient riverbed passed through the area occupied today by the *Plaza Nueva* Square. In different public works carried out in the public square (because of different urban development projects) several archaeological findings, in direct relation with the ancient port and its use, were discovered. The study of these archaeological remains is of paramount importance because they could provide essential information for a better understanding of the ancient port of Seville that, despite its importance, is still largely unknown by scholars.

In 1258, after the Christian conquest of Seville (AD 1248), the convent of San Francisco was built on the site now occupied by the *Plaza Nueva*. This Franciscan monastery, one of the largest and most important in Spain until the 19th century, was destroyed by fire in 1810 (Castillo, 1988). Around the mid 19th century the ruins of the convent of San Francisco were demolished creating on its site a public square. This public square had several names throughout its first century of existence and in 1931 was renamed *Plaza Nueva* (AA.VV., 1993: 139-144).

In 1851, during the demolition of the ruins of the convent of San Francisco, a necropolis from the Islamic Period of Seville was found directly beneath the convent in *Plaza Nueva*; within the numerous graves an epitaph was recovered with an inscription dated to the year of the Hegira of 412/AD1022 (Lévi-Provençal, 1931: 43-46). This epigraphic discovery seems to prove the existence of a graveyard located at *Plaza Nueva*, in the first quarter of the 11th century; this

graveyard seems to extend to adjacent areas of Seville's city centre such as the *Avenida de la Constitución* (Jiménez/Pérez, 2012: 310). Ibn Abdun, author of a *Hisba* treatise for the city of Seville written at the beginning of the 12th century, described the presence of a potter's neighbourhood with a mosque, next to which a graveyard was constructed at some point during the 11th century (García/Lévi-Provençal, 1981: 95). It has been previously hypothesized that the Islamic necropolis found at *Plaza Nueva* is the graveyard described by Ibn Abdun (Valor, 1989: 331). The existence in the year 1022 of a necropolis in the *Plaza Nueva* area would provide a *terminus ante quem* (Renfrew, 2012: 132) for the existence and navigability of the ancient riverbed of the Guadalquivir.

However, the most noteworthy archaeological findings from the *Plaza Nueva* were a boat and an anchor discovered during the construction of Seville's underground in 1981. The fact that the ancient riverbed runs through the city centre of Seville is the reason why a boat and an anchor were found at *Plaza Nueva*, located far from the Atlantic Ocean in the busy city centre. In addition to the findings described in this article, on at least two occasions shipwrecks (or remains thereof) were found during the second half of the 20th century in areas where the ancient riverbed ran through. Some publications mention these findings without providing further information due to the unfortunate absence of archaeological control or intervention at the time of their discovery (Ordóñez, 2003: 67).

The Plaza Nueva salvage excavation of 1981

During the preliminary construction work of Seville's subway, in 1981, abundant archaeological remains were found in a public square called *Plaza Nueva*. The remains ranged from the Iberian to Islamic periods. Mr. Fernando Fernández Gómez was in charge of the archaeological retrieval (i.e. salvage) of material recovered at the subway tunnel works. According to him, different *strata* or archaeological levels were discovered during the subway public works at *Plaza Nueva*.

From all the archaeological materials found in the tunnel pit of the *Plaza Nueva* two finds were most significant: the remains of a small boat and an iron anchor. These two artefacts were found at different *strata* or archaeological levels. In early June 1981 the remains of a wooden boat were found 11 meters from the surface (Fig. 3), in a *stratum* where pottery sherds from the Islamic period were found in abundance (Guerrero, 1984: 95). The anchor was found 4 meters beneath the boat (i.e. at 15 meters from the surface) (Fernández, 2007: 168). The *stratum*, in which the anchor remains were found, also contained three marble column shafts. Finally, beneath the *stratum* where the anchor was found, Roman Era archaeological material appeared; these were described as pottery and *amphorae* sherds identified as: one handle of an Iberian *amphora* and multiple sherds of Dressel 8, 11, 17, 19, 20 *amphora* types among other ceramic materials (Guerrero, 1984: 95). Beyond that *stratum*, no archaeological materials were found¹.

The boat, the iron anchor, and other related finds (e.g. *amphorae* sherds) found at *Plaza Nueva* in 1981 seem to indicate that this location was a longstanding anchorage area in the ancient port of Seville. This discovery, therefore, could help to determine the position of the Guadalquivir River during different historical periods, and their detailed study could help establish the exact chronologies, as well as some morphological characteristics of the ancient port. The preliminary results of the study of the *Plaza Nueva* findings can be found elsewhere (Cabrera, 2013; 2014; in press).

¹ Fernando Fernández Gómez, personal comment.



Figure 3. Remains of the *Plaza Nueva* shipwreck at the time of recovery in 1981 (top); drawing of the boat's wooden remains that were able to be documented during recovery (bottom).

The Plaza Nueva shipwreck

The remains of the wooden boat were found in a *stratum* composed by fine slit (Fig. 3), which allowed the preservation of the wooden remains (Grattan, 1987: 55-67). At present the remains kept at the museum are broken into more than 400 fragments. It seems that less than circa 30% of the original boat's hull is preserved in the museum. The majority of the timber remains belonged to the external hull strakes and the internal frames of the original vessel. At this stage, it is difficult to evaluate how much of the external hull was recovered in 1981 and is now preserved in the museum.

The hull was carvel built. The planks are fastened to the internal frames with wrought iron nails driven from the exterior of the hull. Nails seem to be the only type of fastener used in the construction. It seems that the original boat had no sail, since no remains of mast step, mast, or any rigging elements were found or documented at the time of the retrieval. However, the

remains of what are probably the handles of two oars have been found. The discovery of two oars may support the hypothesis that this was the only propulsion system of the boat. Based on the preliminary study, the *Plaza Nueva* shipwreck was probably a lighter or tender boat used to carry goods from larger ships, anchored in the Guadalquivir River, to the port installations on the shore of Seville (Cabrera, 2013: 521; 2014: 243). Thanks to a 1:10 scale drawing made at the time of the retrieval (Fig. 3) and several original photographs taken on the same occasion, the boat's overall measurements can be reconstructed to circa 7 m in length by circa 2 m in beam.

Within the timber remains kept at the museum, fragments of cylindrical wooden pieces are present. These cylindrical fragments of wooden posts were probably found and recovered from the same pit at *Plaza Nueva*; they are poorly laboured and they are too thick and heavy to have been any structural part of the *Plaza Nueva* boat. The wooden posts are straight cylindrical pieces of wood; they are tree trunks from which branches have been cut and the bark has been removed. Some of the ends are sharpened and the opposite ends are cut flat. One post has residue of what seems to be remains of a white paint. The posts are probably part of the port installations of the ancient port of Seville; they seem to be piles from a pier or remains of mooring-posts, in which vessels, such as the *Plaza Nueva* boat, could have been moored.

The presence of the original oars within the boat remains suggests that it was not intentionally abandoned or scuttled. On the contrary, it seems that the boat suffered an unexpected wreckage. Therefore, the remains are not a derelict vessel but a shipwreck (Richards, 2008). This hypothesis could be supported by the presence of a mooring post nearby and the nature of the *stratum* in which the boat was found which was composed by fine silt. The wreckage probably resulted from an unforeseen incident of severe weather, such as a big storm/s and the subsequent flood of the Guadalquivir River.

With the objective of determining the historical period to which the boat belongs, radiocarbon dating analysis was conducted (Cabrera, 2013: 523; 2014: 243). One sample was extracted from the timbers from the boat's remains of *Plaza Nueva*, and taken for radiocarbon dating analysis. The result of the analysis gives dates of 12.6% probability of 898-920 cal AD and 82.8% probability of 947-1023 cal AD.

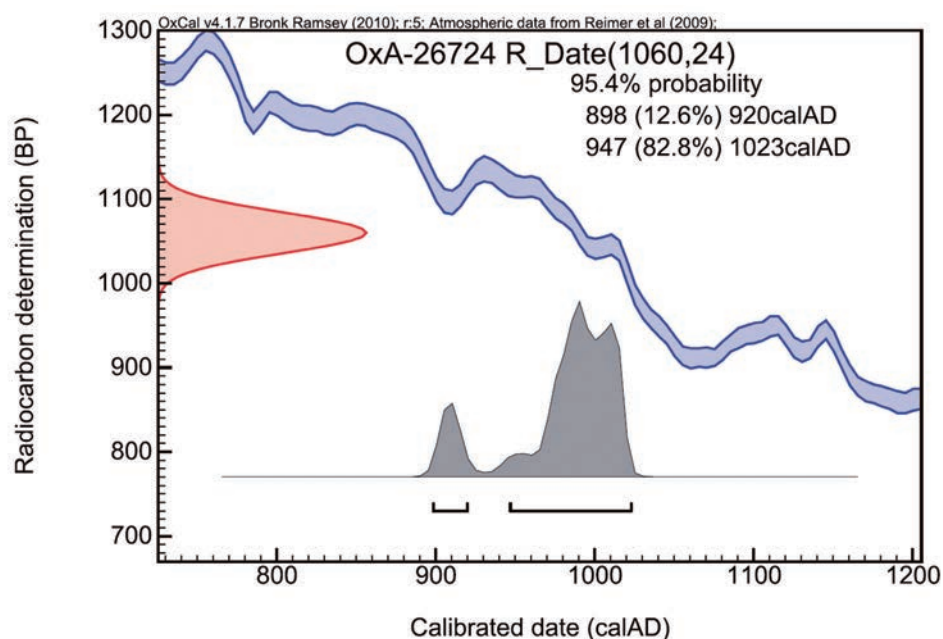


Figure 4. Results of the radiocarbon analysis of a wood sample from the *Plaza Nueva* boat.

probability of 947-1023 cal AD (Fig. 4). Taking into consideration the statistical distribution of the results, they seem to indicate that the boat was probably constructed and used during the second half of the 10th century or the first quarter of the 11th century. These results respect the *terminus ante quem* for the existence and navigability of the ancient riverbed of the Guadalquivir, established in the year 1022 by the presence of a necropolis in the *Plaza Nueva* (Lévi-Provençal, 1931: 43-46). Consequently, based on the preliminary results of radiocarbon dating analysis, it seems that the boat found at *Plaza Nueva* was lost during the last period in which the ancient riverbed of the Guadalquivir was navigable.

The Plaza Nueva anchor remains

Soon after it was recovered, the anchor from *Plaza Nueva* was studied. In 1984 Guerrero Misa, a Spanish archaeologist, wrote a brief article about the anchor found at *Plaza Nueva* (Guerrero, 1984: 95). On the basis of typological characteristics of the anchor, such as its cruciform shape, Guerrero Misa identified it as belonging to the Byzantine tradition (Fig. 5).

A series of historical events occurred in Seville during Late Antiquity, in which the city played a key role, which could support this hypothesis. In a series of subsequent military campaigns Justinian I (527-565) restored direct Roman rule over Vandal's North Africa, Ostrogothic Italy, and Visigothic Spain (Sarris, 2002: 46). In the early 550s the southern and eastern regions of the Iberian Peninsula, including Seville, were controlled by the Byzantine Empire and were known as *Provincia Spaniae* or *Spania* (Collins, 2000: 123). According to chronicles and historical accounts, it could be interpreted that Byzantine forces controlled Seville during three different periods: from 552 to 567, from 580 to 583, and in 610 (Vallejo, 1993: 123-124). However, the last occupation is unclear and debatable for some scholars (Vallejo, 1993: 241-243; Guerrero, 1984: 97).

Therefore, according to Guerrero Misa, on the basis of relating the anchor with the historical period in which Seville was under Byzantine rule, he suggested the following: that the anchor found at the *Plaza Nueva*, belonged to a vessel which anchored in the ancient harbour of *Hispalis* and that lost one of its anchors most likely during the second half of the sixth century AD (Guerrero, 1984: 98).

Taking into consideration its morphological characteristics (i.e. cruciform shape), the anchor, currently kept at the Seville Archaeological Museum, was probably made and used during Late Antiquity (Kapitän, 1984; Eliyahu *et alii*, 2011). However, its precise chronology, provenance and cultural origin are difficult to establish. The hypotheses by Guerrero Misa who suggests a chronology of the second half of the 6th century, a provenance from the Eastern Mediterranean, and a byzantine cultural affiliation are based partly on historical grounds. These hypotheses, although possible, seem not to be very firmly established. In opposition to this narrow proposed chronology, stands the fact that cruciform anchors were used since the second half of the 4th century until the 13th century (Kapitän, 1984: 42-43; Eliyahu *et alii*, 2011: 236-237). Consequently, and in the absence of a detailed study of the anchor, it can be suggested that the anchor from *Plaza Nueva* probably belongs to a chronology between the 6th and 9th centuries (Cabrera, 2013: 522; 2014: 244).

The characteristics and dimensions of the anchor could provide information about the size and nature of the vessel that carried this anchor and finally lost it in the ancient port of Seville. The anchor found at Seville is similar to the ones found among the remains of the 7th century *Yassi Ada* shipwreck that sunk off Turkish shores (Bass/Van Doorninck, 1982). Eleven anchors were found at this underwater site. The Seville anchor closely parallels anchors number

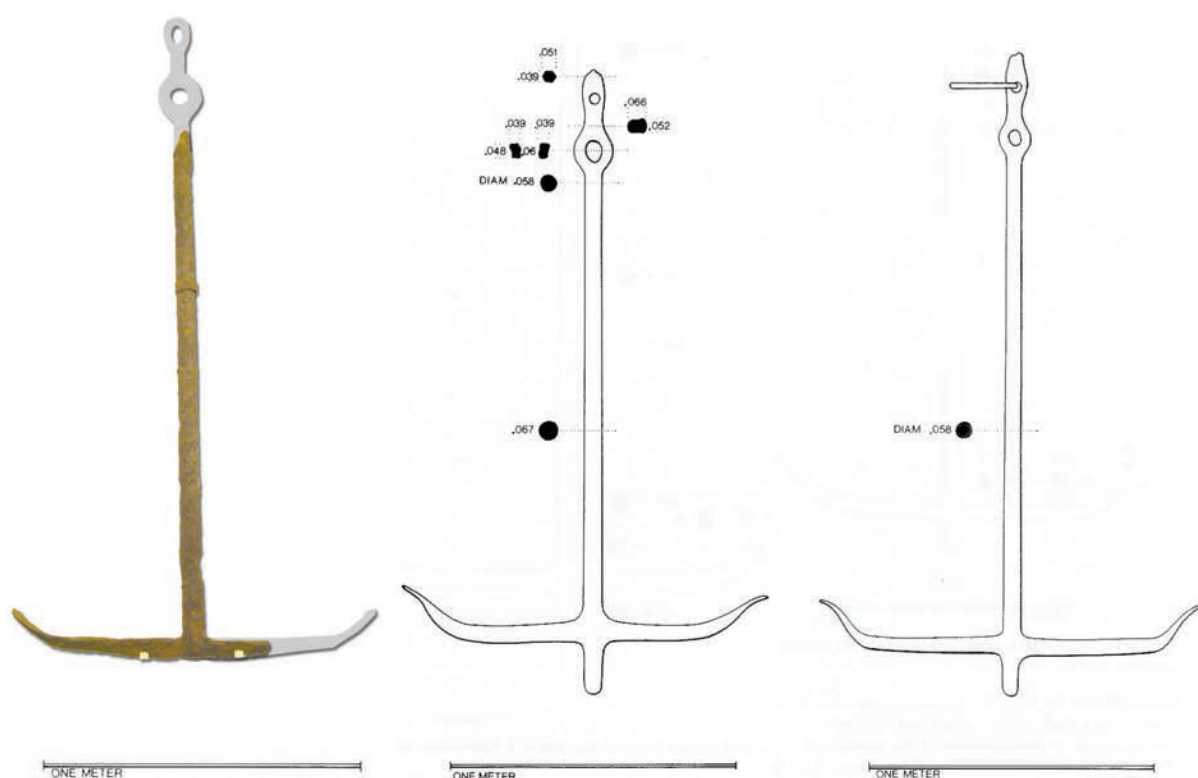


Figure 5. *Plaza Nueva* anchor (right), compared to anchors from the 7th c. *Yassi Ada* shipwreck # 3 (centre) and # 7 (left).

three and seven of the 7th century *Yassi Ada* shipwreck, since they all possess very similar overall dimensions and morphology (Fig. 5) (Bass/Van Doorninck, 1982: 126). Anchors number three and seven of the 7th century *Yassi Ada* shipwreck were used as bower anchors (Bass/Van Doorninck, 1982: 137). J. Richard Steffy's reconstruction of the *Yassi Ada* shipwreck suggests that the ship had an overall length of 20 meters and a capacity of about 60 tons (Steffy, 1994: 80). Steffy's reconstruction could provide an idea of the average size of the vessel that lost an anchor in the ancient harbour of *Hispalis*. Perhaps, having no further evidence to identify and describe the vessel that lost one of its anchors in *Hispalis*, it seems reasonable to think that the vessel was probably around the size of the *Yassi Ada* shipwreck, if not larger. Yet, taking into account the fact that there is no other evidence but the anchor remains, little more can be said about the vessel, which carried it.

Despite the limited information that the anchor provides, its size (i.e. *circa* 2 meters) suggests that it belonged to a fairly large ship. Therefore, the presence of the anchor at the *Plaza Nueva* provides an important piece of information: it suggests that during the historical period when the anchor was lost (i.e. estimated to be between the 6th and 9th centuries) the ancient riverbed of the Guadalquivir was navigable for seagoing ships of considerable size.

Deciphering the disappearance process of the ancient port of Seville

In this paper we have briefly presented the study of the remains of a small wooden boat and a cruciform anchor found at Seville's *Plaza Nueva* in 1981. The results of radiocarbon analysis conducted as part of this study indicate a 95.4% probability that the boat found at *Plaza Nueva* was built during the 10th or early 11th century (Cabrera, 2013: 523; 2014: 243), and probably be-

longs to the period of the Caliphate of Córdoba (929 to 1031). The fact that pottery sherds from the Islamic period appeared in the same *stratum* where the ship was found (Fernández, 2007: 168) would support this chronology. The results of the radiocarbon analysis rule out a previous hypothesis that described the «Ship of Seville» as Byzantine from the 6th century (AA.VV., 1988: 106).

The presence of the original oars within the boat remains suggests the boat was not scuttled but instead it suffered an unexpected wreckage, and it should be considered a shipwreck. The boat was found within sediment consisting of fine silt; this seems to suggest that an unforeseen incident of severe weather, such as big storm/s and the subsequent flood of the Guadalquivir River probably caused the wreckage. The lack of a sail propulsion system seems to indicate that the boat was not used for open sea or large-scale fishing. The presence of oars as the only method of propulsion seems to indicate that the boat was used to transport passengers or cargo from merchant ships to the harbour installations, or to cross the river from one bank to another (Cabrera, 2013: 521; 2014: 243). This type of multipurpose boat could be referred to as lighter or tender boat.

The ship remains were found in a *stratum* four meters above the anchor and closer to the surface (Fernández, 2007: 168), and hence, deposited later in time. This supports the hypothesis that the boat has to belong to an older historical period than the anchor.

The study reveals that the morphological characteristics of the *Plaza Nueva* anchor are similar to some of the anchors found in the *Yassi Ada* Shipwreck (7th century AD). Taking these similarities into account it has been previously proposed that the anchor found in Seville could be dated from the second half of the 6th century AD (Guerrero, 1984); this hypothesis also takes into consideration the historical period in which Seville could have been under the control of Byzantium. However, cruciform anchors were used since the second half of the 4th century until the 13th century (Kapitän, 1984: 42-43; Eliyahu *et alii*, 2011: 236-237). Therefore, and in the absence of a detailed study of the anchor, and taking into consideration the radiocarbon analysis of the boat, it can be suggested that the *Plaza Nueva* anchor probably belongs to a chronology between the 6th and 9th centuries (Cabrera, 2013: 522; 2014: 244). The presence of this cruciform anchor in the ancient port of Seville is of importance since it represents the archaeological example of a cruciform anchor found the farthest west within the Mediterranean (Votrubá, 2014: *passim*).

It does not seem logical that an anchor about 2 meters long belonged to a small boat of about 7 meters in length. Therefore, it can be suggested with some assurance that the remains of the anchor are unrelated to the boat (apart from the fact that they were found in the same excavation pit) and should not have been associated. Very likely the anchor and boat were lost during different incidents and probably belong to different historical periods (Cabrera, 2013: 522; 2014: 243).

Although the anchor and boat may belong to different historical periods (i.e. Late Antiquity and Caliphate of Córdoba period), they were lost in the same area and found *in situ*; this indicates that this area was an anchorage of the ancient port of Seville for many centuries. Furthermore, to date, they represent the only archaeologically documented nautical finds from the ancient port. Due to the similarities of the *Plaza Nueva* anchor with those recovered from the seventh century *Yassi Ada* shipwreck, it can be suggested that this anchor, of *circa* 2 meters, must belong to a vessel around 20 meters in length if not larger in size. This suggests that in the historical period that the anchor was lost (i.e. estimated to be between the 6th and 9th centuries) the ancient riverbed of the Guadalquivir was navigable for oceangoing ships of considerable size.

As we have seen, the existence in the year 1022 of a necropolis in the *Plaza Nueva* area (Lévi-Provençal, 1931: 43-46) provides a *terminus ante quem* for the navigability and existence of the ancient riverbed of the Guadalquivir. In light of archaeological evidence, it seems likely that at some point prior to the 11th century the ancient riverbed of the Guadalquivir, as well as the port on its east bank, would no longer have existed in that particular area of the city. It seems that the ancient riverbed changed its position or morphology prior to the 11th century.

This hypothesis seems to be supported by recent studies of urban geoarchaeology in Seville (Borja, 2014). These studies, based on dozens of bore core samples, suggest that during the 9th and 10th centuries there was a dramatic change in the fluvial dynamics of the Guadalquivir River. The final study suggests, that over a long period of time, which probably began in the 9th century and lasted until the 11th, the Guadalquivir River progressively divided into two different channels or riverbeds. This splitting process (called avulsion in the field of fluvial geomorphology) was produced by progressive silting of the main riverbed from the sediments transported by the river. This avulsion was caused by a complex combination of different phenomena such as climatic, geological (i.e. variation of sea level) and to a lesser extent anthropogenic. Upon reaching a critical point the main riverbed (which existed since ancient times) could not assimilate more sediment and the water of the river, its course being obstructed, created a new channel through which it could flow freely. This process was gradual and needed around 40 events of high energy or floods providing the necessary quantities of sediment necessary to block the ancient riverbed; these episodes of high energy or floods would have occurred over a period of 150 years. If we take into consideration that by the 11th century the ancient riverbed was no longer navigable and that the avulsion process took about 150 years the following could be proposed: during the 9th and 10th centuries, the ancient riverbed of the Guadalquivir began to split gradually becoming a secondary channel, and gradually reducing its navigability. For a lengthy but undetermined period of time, around the 9th and 10th centuries, two channels or riverbeds coexisted (Fig. 6) while gradually, the new western channel became the main one (Borja, 2014: *passim*). This new main riverbed is the current course of the Guadalquivir River that separates Seville's centre from «Barrio de Triana», although during the High Middle Ages this channel was located further east from its current position (Fig. 6).

Therefore, it seems that the ancient riverbed, that throughout Antiquity and the Early Middle Ages accommodated the ancient port, gradually silted up until it was no longer navigable; this happened no later than the early 11th century, due to the presence of a necropolis in the *Plaza Nueva* dated in the year 1022 (Lévi-Provençal, 1931: 43-46) which offers us a *terminus ante quem* for existence of the ancient riverbed of the Guadalquivir. We saw that the boat from *Plaza Nueva* was found with its oars *in situ* within sediment consisting of fine silt, suggesting that its loss was an accidental product of a violent flood. It is possible, therefore, to propose that the incident where the boat was lost was one of the episodes of high energy or floods that recent geoarchaeology studies have shown were part of the avulsion process of the Guadalquivir's ancient riverbed, which ultimately led to its gradual disappearance. The radio carbon dating of the boat, which may belong to the Caliphate of Córdoba period (*vide supra*), respects the *terminus ante quem* from the presence of a necropolis of the 11th century and coincides with the proposed dates for the occurrence of episodes of high energy or floods (i.e. 10th century).

These morphological changes of the Guadalquivir River caused the wide corridor (through which the old riverbed ran) and its extensive port, to be no longer navigable, becoming a large barren area. Floodplains, ponds and sloughs made up this area and it was affected by the rise and fall of the river's water level caused by the Atlantic Ocean tides. As a result, this area would have had a limited use yet potters certainly would have found it useful since it provided unlimited supplies of quality raw material for the development of their craft. As we have seen, Ibn

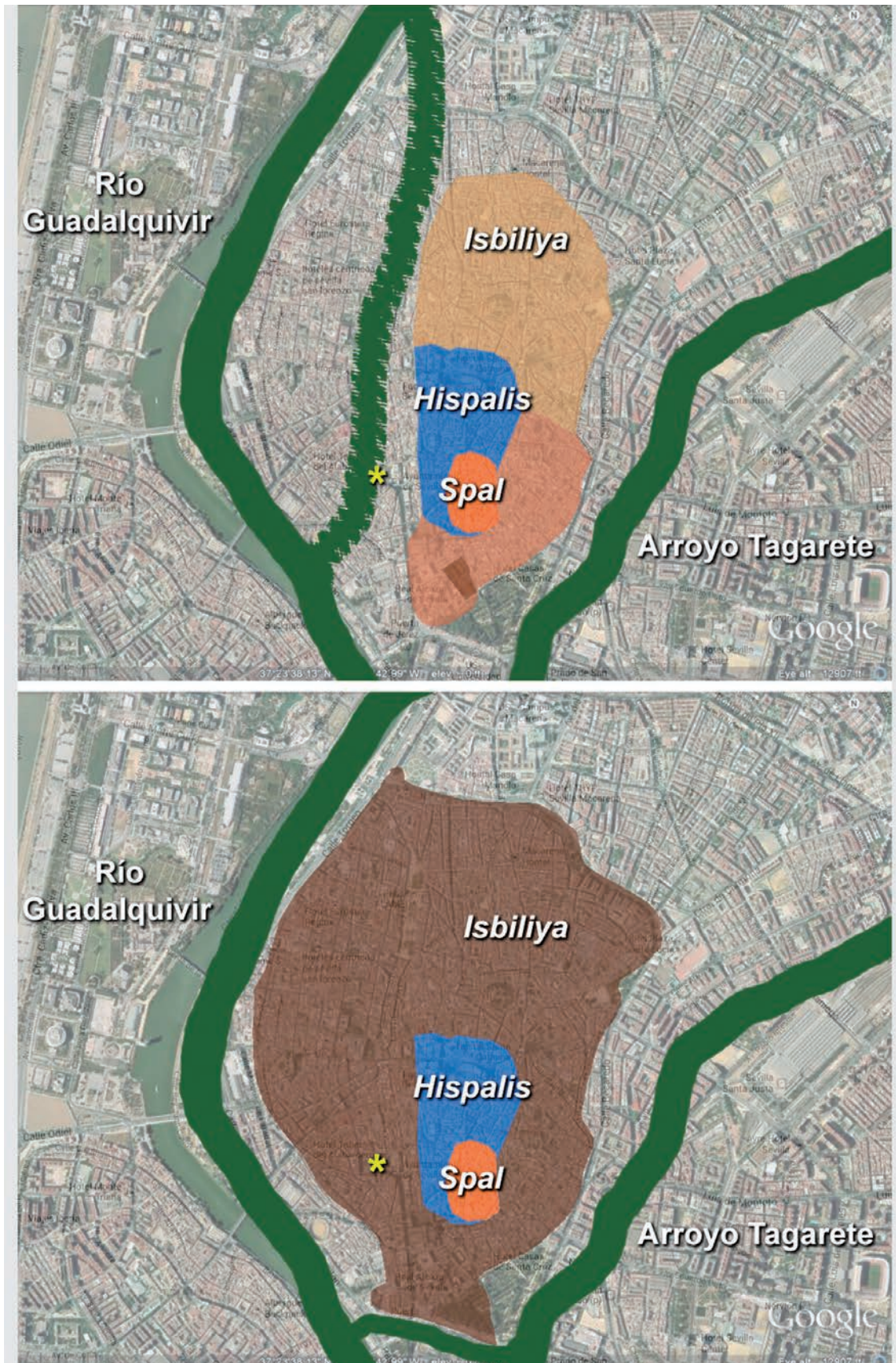


Figure 6. Splitting process of the Guadalquivir River *circa* 9th-10th centuries (top); position of the new riverbed in the 12th c. west to the walled Almoravid city (bottom).

Abdun described the presence of a potter's neighbourhood with a mosque, next to which a graveyard was constructed at some point during the 11th century (García/Lévi-Provençal, 1981: 95). It has been previously hypothesized that the Islamic necropolis found at *Plaza Nueva* is the graveyard which Ibn Abdun describes (Valor, 1989: 331).

Despite the usefulness that these floodplains provided to the potters, the rest of the inhabitants of the medina *Isbbiliya* probably thought that this area was dangerous and insalubrious. The emergence of this new large area in the western part of the city certainly caused urban and administrative challenges for the Islamic rulers of *Isbbiliya*. This area of floodplains separated the medina of the vital Guadalquivir River and its port, forcing people to constantly cross through it. The emergence of this new large area, in the western part of the city, certainly led to the major urban transformations that *Isbbiliya* underwent during the 12th and 13th centuries, initiated by the Almoravids (Almagro, 1987: 427-428) and whose greatest period of urban renewal occurred during the Almohad Caliphate (Valor, 2008: *passim*).

To conclude, the study of the archaeological materials found at *Plaza Nueva*, currently in process, seem to be providing important archaeological information that, undoubtedly, is increasing our knowledge about the ancient and little-known port of Seville as well as helping in understanding the complex fluvial transformations that the Guadalquivir River has suffered throughout its history.

Specifically, the epitaph dated in the year of the Hegira of 412/AD1022 found at *Plaza Nueva* offers a *terminus ante quem* for existence of the ancient riverbed of the Guadalquivir. The finding of a cruciform anchor has proved the navigability of the ancient riverbed during Late Antiquity or Early Medieval Period, and a detailed study of it could improve our understanding of cruciform anchors in the Western Mediterranean. The study of ceramic materials from *Plaza Nueva* (currently in process) could support some of the hypotheses presented in this paper and contribute with new information. Finally, despite the fact that the boat found at *Plaza Nueva* does not belong to the Byzantine culture, its remains are still important. To this point, the circumstances of its accidental loss, due to a violent flood, have strengthened the geo-archaeological hypothesis that argues the Guadalquivir River split into two channels through a process of avulsion by means of a series of high-energy events (i.e. floods), which occurred during the 9th and 10th centuries (*vide supra*). Furthermore, the study and future reconstruction of the boat would likely provide additional information on the boat's function and use in the context of the ancient port of *Isbbiliya* as well as information about the shipbuilding techniques used in its construction. In the Western Mediterranean, there is scant information on shipbuilding practices during the Early Middle Ages or related to the Islamic Culture. The *Plaza Nueva* boat constitutes one of the few examples of ancient ships dated to the 10th or early 11th century. Therefore, a complete study is potentially of great importance because it could expand our knowledge about early medieval shipbuilding, especially in the Guadalquivir Valley.

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«Opus portus Ydronti». Ancient submerged structures near the modern pier San Nicola at Otranto (Lecce, Italy)

«Opus Portus Ydronti». Estructuras antiguas sumergidas cerca del muelle moderno San Nicola en Otranto (Lecce, Italia)

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Abstract: The project is part of a research carried out by the Department of Cultural Heritage of the University of Salento - Underwater Archaeology, about underwater archaeological contexts as markers of the paleolandscapes. The research aims to highlight the interactions between people and environment and to reconstruct the ancient coastal landscapes by evaluating relative sea level changes (Barker/Bintcliff, 1999; Auriemma, 2004a; Auriemma/Solinas, 2009). The numerous survey activities carried out near the modern pier of «San Nicola» at Otranto (Apulia region, South Italy) allowed us to identify the remains of an ancient structure partially submerged, constructed of huge blocks of hydraulic concrete in wooden formworks. The structures date back to the Medieval age (due to the radiocarbon analysis) and can be related to the extensive program of redevelopment of the Otranto harbour which occurred in the Angevin period. We enriched our description of the building techniques with a critical review concerning the Otranto harbour's role in that period.

Key words: Otranto, Apulia region, Angevin age, medieval port, coastal landscapes archaeology.

Resumen: el proyecto forma parte de la investigación realizada por el Departamento de Patrimonio Cultural de la Universidad de Salento - Arqueología Subacuática, sobre los contextos ar-

queológicos subacuáticos como marcadores de los antiguos paisajes. Su objetivo es poner de relieve las interacciones entre los hombres y el medio ambiente y reconstruir los antiguos paisajes costeros mediante la evaluación de los cambios relativos del nivel del mar. Las numerosas encuestas efectuadas cerca del muelle moderno de «San Nicola» en Otranto (Apulia, sur de Italia) nos permitieron identificar los restos de una antigua estructura parcialmente sumergida, constituida por enormes bloques de mortero hidráulico en encofrados de madera. Las estructuras se remontan a la Edad Media (según análisis de radiocarbono) y podrían relacionarse con el amplio programa de obras de ampliación del puerto de Otranto realizado en el periodo Angevino. Enriquecemos nuestra descripción con una revisión crítica sobre el papel del puerto de Otranto en ese periodo.

Palabras clave: Otranto, región de Puglia, edad Angioina, puerto medieval, arqueología de los paisajes costeros.

Premise

This paper is part of the ongoing updating and reviewing of the research conducted by the Laboratory of Underwater Archaeology, Department of Cultural Heritage (University of Salento), concerning the *Forma Maris* of the Salento peninsula (Apulia region, South Italy), the Geographic Information System (GIS) of the submerged heritage, which has firstly published in 2004 (Auriemma, 2004b), and now has been upgraded and developed in a Web-GIS (Cossa/Auriemma, 2013: 3-4 http://www.arcgis.com/apps/OnePane/storytelling_basic/index.html?appid=edb2b5022b3a4d-4abb1b6f4abc95a2c7; Cossa *et alii*, 2010; Cossa *et alii*, 2012; Zaccarelli *et alii*, 2011).

Archaeological data

The preliminary survey in June 2009 and the recent topographical survey (2014) carried out by the group of Underwater Archaeology of Salento University near the modern pier of «S. Nicola» in Otranto investigated some marine installations in concrete, already surveyed and ascribed to Roman age (Crupi, 2008). The activities were carried out outside the arm of the S. Nicola pier up to a depth of 8 meters, and covered an exposed area of 30 000 square meters.



Figure 1. Otranto (Lecce, Italy). The modern molo S. Nicola and in the foreground the ancient submerged structure (Photo: De Santis 2006).

Remains of a monumental maritime structure from Punta S. Nicola (called also «La Punta») and extends toward the Secca delle Casse, where also the modern breakwater was built.

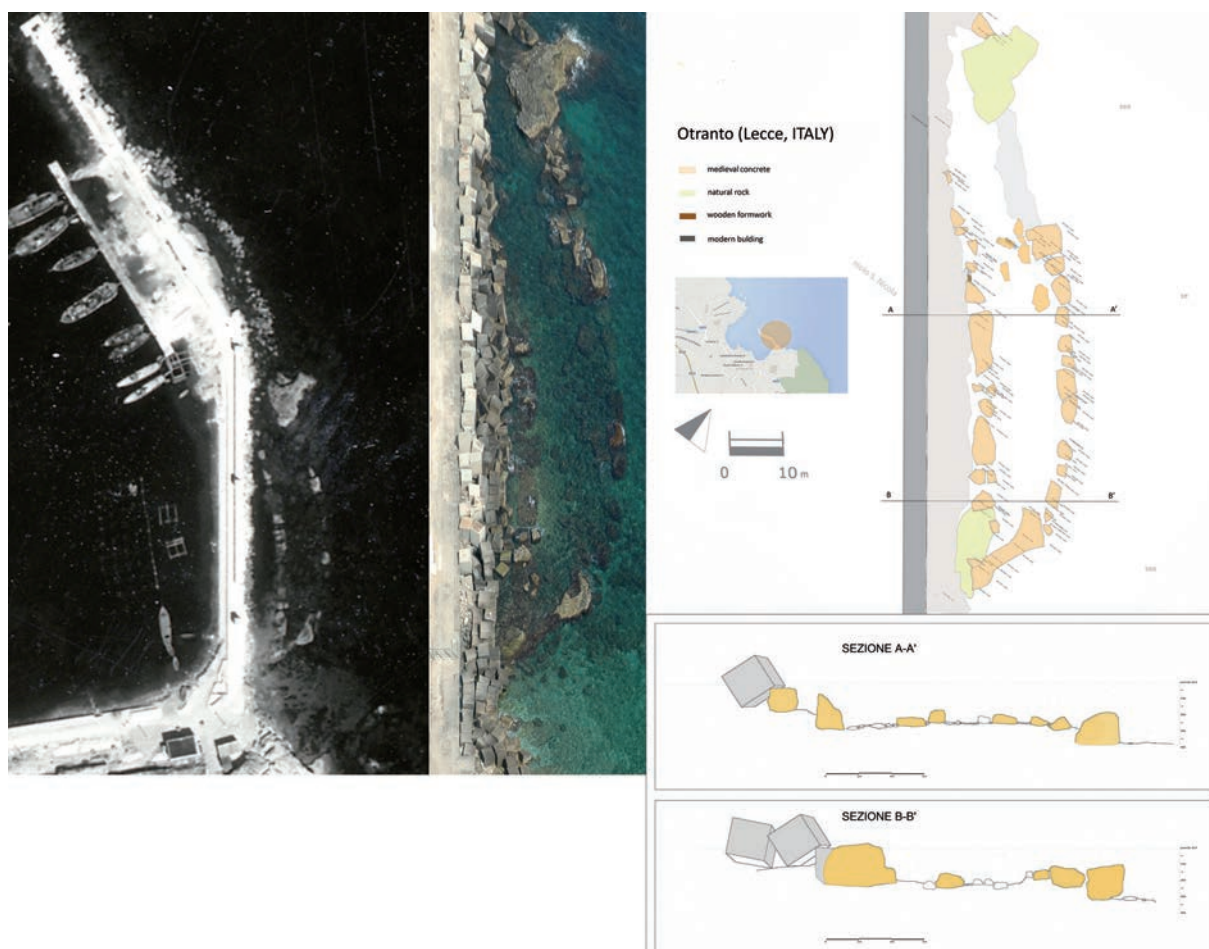


Figure 2. Otranto (Lecce, Italy). Ancient pier. Aerial photo (LABTAF 2009. Dipartimento Beni Culturali – Università del Salento) general plan and cross-section of the structure.

It is lined with marginal walling of concrete plinths in wooden formwork, alternate to some rocky irregular blocks; these two «curtain walls» run parallel each to the other at about 24 m of distance, following a curve profile along SE-NW direction. The outer line/alignment is preserved for around 137 m and composed by 15 aligned contiguous blocks (as *pilae*) of $2.1 \times 1.8 \times 3.3$ m (elevation from the seabed; average dimensions). Along its inner side other 5 elements (concrete masses) have been noticed: they could be wall reinforcements in the stretch most exposed to the waves, streams and winds energy.

The inner line/alignment is preserved for around 90 meters, with smaller concrete plinths (average dimensions $1.9 \times 1.6 \times 1.35$ of elevation...) and it is partially hidden by the cement blocks (*tetrapodi*), due to the recent enlargement works of the modern S. Nicola quay.

The breakwater was constructed in part on a natural reef, where we can recognize the *Secca delle Casse* (*Caisson Shallows*)¹; the outer/eastern alignment lies on the base of the natural

¹ The name alludes obviously to the traces of formworks: *Cassa* is chest, i.e. caisson.

drop, at -3.70 m of depth, rising up to m 3.3 as mean elevation; it works as retaining wall of the rubble levelling layer underlying the original structure, on which the inner alignment's plinths appear to have been built. Therefore the latter ones stay at less depth (-1.20) and are lower (mean elevation 1.35 m).

The two curtain walls originally contained in all likelihood a rubble filling, probably terrain and stones, in the most part washed off by environmental energy (wind and wave motion); it is partially preserved behind the eastern side. In the same inner strip some others concrete smaller blocks are visible, in some case strongly damaged by the environmental energy, could be possible internal reinforcing of the breakwater or disjointed, fragmented sections of the original marginal walling.



Figure 3. Otranto (Lecce, Italy). Ancient pier: the concrete masses. Survey steps.

In some points traces of the original formworks, where the concrete has been poured in, are visible; in the northern area there is one concrete block with a vertical hole (diameter 30 cm), impression of the original internal post/pile (*destina*); in the central part of the breakwater, under one plinth of the inner walling (more protected although hidden by the modern mole), above the rubble leveling/foundation layer, is still visible the timber board shuttering that appear to be the flat bottom of the formwork, simple panel or part of a prefabricated box («single mission barge»); one shuttering stretch (6 timbers boards), fully exposed due to the missing concrete, was sampled.



Figure 4. Otranto (Lecce, Italy). Ancient pier: the concrete outcropping plinths.



Figure 5. Otranto (Lecce, Italy). Ancient pier. Vertical hole (diameter 30 cm), impression in the concrete of the original internal post/pile (*destina*) and the timber board shuttering identified as the formwork bottom.

On the S-E side of the structure, at a distance of 50 m and to a depth of 1 m, the presence of some outcrops aligned with the external curtain of the ancient pier has been identified, natural outcrops bearing various quarry cuts. Near those outcrops, at a depth of 3 m and among collapsed limestone boulders, a lithic element was found, pointing possibly to a large mooring of mushroom shape.

The plinths are alternated with some outcrops of the bedrock (*secchette*), used as anchoring points for the structure.

At the depth of 5 m along the natural escarpment pottery fragments related to the Late Antique and Medieval periods were found in secondary position.

The radiocarbon dating by mass-spectrometry accelerator carried out by the Laboratory of LTL (Lecce Tandetron Laboratory) and the Laboratory CLAMS (Chemical Laboratories for Accelerator Mass Spectrometry) of the CEDAD. The estimated dates from the wooden elements have provided a chronological frame from 1150 to 1280 AD.

Building technique and comparisons

In the Roman Imperial age (since first century BC) harbor structures constructed of hydraulic concrete with pozzolana, poured in wooden formworks/cassons, are well known throughout the Mediterranean (Portus, Ostia, Anzio, Cosa, Santa Liberata, Campi Flegrei area, Egnazia, Caesarea, etc. I remember the excellent last book of C. Brandon, Hohlfelder, Jackson and Oleson 2014, *Building for eternity*). It consisted of a mortar made from lime, *pozzolana* (a sand-like volcanic ash, naturally rich in alumino-silicates, capable to prevent the release of lime hydrates by salts, and the mortar decomposition: Mannoni *et alii*, 2004; Hesnard, 2004: 201), and water, to which various types of rubble aggregate were added. The resultant mixture was a hard and durable concrete that could solidify underwater. While still in a liquid or plastic state, it was placed in wooden formwork of various shapes and sizes to form monolithic masses, including structures known to the Romans as *pilae*, separated and jointed by arches or juxtaposed to form a continuous structure extended section by section (Auriemma, 2003; 2004; Brandon, 1996; 1997; Brandon/Kemp/Grove, 1999; 2004, 2006, 2007; Felici, 1998; Brandon *et alii*, 2014). Various formwork solutions –diversified if compared to the Vitruvius passage (*De Arch.* 5.12.1-6)– have been surveyed in the Mediterranean: 1. inundated form constructed *in situ*, in wood, or, less often, masonry (stone blocks); 2. watertight/double walled formwork constructed *in situ*, designed for dewatering prior to placement of concrete; 3. prefabricated (with shipbuilding techniques) formworks floated into position and made sunken adding concrete (flat-bottomed, box-shaped single mission barges; also unused, redundant, abandoned ship hulls filled, and prefabricated sections after assembled on site fall in this category). These building techniques have been kept, thanks to the experience of workers, still after the end of Roman age, during medieval and post-medieval period. A variant of the last technique (large floating box forms) was used in Late Roman, Byzantine and Medieval periods: described as cribs or chest works, these were timber frames without planking, floated to position then filled with stone rubble rather than concrete Procopius of Caesarea (*De Aedificiis* 1.11.18-20) describes the use of a number of large box-shaped forms of this type, termed coffer (kibotoi), in the construction of the Justinian harbour at Constantinople sometime between 527 and 553-555. A passage in the Arab geographer Al-Mukaddasi (c. 945-946, 991), describing the construction of the harbour fortifications in Acre/Akko, testifies the survival of this technique of floating box forms still in the medieval age (Brandon *et alii*, 2014: 35, 215; Hohlfelder, 1988).

As far as this topic is concerned, the archival and iconographical sources can be very helpful: for instance we can mention the Codice 490 - Biblioteca Capitolare of Lucca, dated between late eighth and early ninth century AD, that teaches about building structures in the sea by wooden watertight formworks, prefabricated, floated out and sunk into position; also the books of accounts and contracts of employment of judges of the port of Genoa and notarial deeds, which in the fifteenth century record contracts with the master carpenter and the workers for the construction of the «fence» around the area and for its draining (*ad agotandum*: Boato, 1996: 74). The architecture treatises of the Renaissance are particularly interesting, such as the manuscript of Teofilo Gallaccini, *Sopra i porti di mare* (1597-1602)², or the works of Buonaiuto Lorini (*Delle fortificazioni libri cinque*, Venezia 1597), Francesco di Giorgio Martini, etc. (Simoncini, 1993a).

But we can recall also some archaeological evidences.

The case of the so-called Crusader Harbour lying beneath the Crusader fortress in Apollonia (Palestine) is still debatable: the presumed trapezoidal basin is enclosed by two projecting

² The Gallaccini manuscript, rich in drawings, describes the formworks constructed *in situ* or prefabricated and the infrastructure building in the inner stretch, emptied of the water. It illustrates also the solution with the rubble stone jetty as base-ment, that will be adopted in the 17th century in Genua by Arnaldo de Mari (see below).

piers ending with two towers and one breakwater parallel to the shoreline that links the two pier ends, with a gap 10 m wide for the entrance. The still-preserved northern pier reveals the use of adjacent wooden formworks with piles framed with horizontal beams, where was poured in the concrete containing volcanic ashes probably imported from Italy. After the removal of the timber boards, the concrete adjacent blocks look separated by gaps/slots, intentionally not filled to allow the water to flow into the basin. According to Raban, on the basis of his studies about the sea-level changes, the «Crusader Harbour» isn't a maritime installation but a lower terrace of the fortress, but the underwater surveys carried by Eva Grossman suggest that it was a real harbour, built in the Byzantine era, on the basis of pottery sherds and mortar samples, even if other mortar samples indicate a renovation of the piers, when the Crusader fortress was built in the early thirteenth century (Raban, 1993: 964; Grossmann, 2001: 65-74).

In the Leptis Magna harbor, the two structures composed by reused architectural elements lying off the two imperial piers, probably built between the 4th and 6th centuries AD. To prevent the build-up of sand in the harbour entrance, include also some concrete masses (*pilae*), whose primary or secondary position is still under discussion (Beltrame, 2012: 323-325).

An impressive example is offered by medieval and modern Genova harbour (Melli, 1996; Melli/Penco, 2004; Mannoni, 1996): the pier of the twelfth century under the San Marco Church, the wharfs and docks of the fourteenth and the fifteenth century (Ponte del Pedaggio, Ponte Calvi), have been built following the roman technique; sometimes they preserve remains of the foot of the formwork, sunk into the original sea bottom or its impression in the concrete, or it's possible to notice some wooden plank still *in situ*³.

The building technique was the same until to the sixteenth century: the stretch of water was firstly delimited by piles driven into the seabed and horizontal planks shuttering, then dried; the seabed was enforced with piles of wood increasing its/their resistance in the water (as elm or alder) and filling the spaces with stone blocks⁴; on this basement the Lombard masters built walls wide about 2 m, with the outer curtain with big squared blocks and the inner one less regular and accurate; the space between them was filled with mortar concrete and big stone sherds. Completed 3 walls, the inner area (pier, embankment, dock) was filled with terrain and waste dump (Mannoni, 1996: 26-29). At Otranto we find one similar but not identical solution, because have been employed flat-bottomed barges, prefabricated, floated and sunken adding concrete, that in Genua will be used only in the seventeenth century, in the extension of the Molo Nuovo, in a stretch of sea deep up to 15 meters; the engineer Arnaldo de Mari decided to raise a rampart high 10 meters, on which building with the concrete-filled barges high 5 meters, containing *pozzolana* from Rome, in the same way as 1600 years before, Roman workers made in the huge port of Herod the Great, the *Sebastos* in *Caesarea Maritima*, Palestine. In the Genua piers, above the concrete formwork foundation, i.e. above the sea level at the building period, the outcropping structure showed a wall surface with squared blocks and millimetric joints, mostly on the sea side, as we can notice in the Otranto ruins (Melli/Penco, 2004).

In Varigotti, always along the Ligurian coast, we can find traces –above or under the current sea level– of the mediaeval port, destroyed by the Genoese people in 1341; remains of the concrete core of the outer pier are still visible (Lamboglia, 1976; Mannoni, 1996: 87).

³ The Genua port structures –partially excavated for the celebrations for 500th anniversary of the discovery of America– have mortars containing dolomitic lime, kaolin and fossilized marine sand; the cooked kaolin compounded with lime is particularly resistant to the water. The usage of the kaolin doesn't belong to the genoese building tradition before the 15th century, but it was well-known in the eastern Mediterranean, from where the Genoese merchants imported it since the 13th century.

⁴ This wooden piles foundation as seabed strengthening frequently occurs in the Genua port infrastructures; other mediaeval examples are attested in Ragusa/Dubrovnik and Trogir, in Croatia: (Radić Rossi, 2004: 181).

Also in the Lisboa harbor, the archaeological excavations have revealed wharf and docks –even if datable to later periods (16th-17th centuries)– built in wooden formworks or by fence, sometimes reusing naval carpentry elements (Blot/Gachet Alves, 2004: 203-207).

Wooden formworks are documented in one building phase of the late medieval bridge (xv c.) of Cahors, in France (Depeyrot, 1974).

The Otranto pier could be an example, like other medieval harbours of the Mediterranean, of this persistence of competences and technological knowledge during the so-called «dark ages».

Chronology of the structure

The Otranto harbor had played a very significant role in ancient times. At the moment of the Norman conquest (1068) and in the second half of eleventh century Otranto was one of the Apulia main port cities, both on the military-strategic and religious side (archbishop's seat and important interregional routes hub).

During the centuries between the Norman coming and the end of the Swabian age, Otranto reached an evident urban development, thanks to the economical expansion and the agricultural production increase.

Between the sources that allowed us to envisage the city features in the twelfth century, we remember the *Tabula Rogeriana* (*The Book of King Roger*), drawn and written by al-Idrisi for Roger II of Sicily in 1154, where it is indicated the distance from Lecce to Otranto (20 miles, in direct line) and Otranto is described as: «...città di antiche vestigia, molto popolosa; ha mercati frequentati e vivo commercio. Il mare ne lambisce le mura da tre lati, essendo essa unita al continente da tramontana...» and, in another codex (B), «Otranto città grande, primitiva, popolata e civile; abbonda d'ogni ben di Dio e ha colti non interrotti. Circondata dal mare da ponente e da mezzogiorno, e recinta di mura ben costruite, essa siede all'imboccatura per cui s'entra nel golfo dei Veneziani» (Amari/Schiaparelli, 1883: 76-77, 102, note 2; Rizzitano, 2008: 71-73).

Otranto is quoted also in the first portolano in vernacular language, the *Compasso da navigare*, dating back about to half of twelfth century, that indicates the same distance -20 miles- (Motzo, 1947: 27).

During the Swabian age, the Otranto harbor keeps a relevant role: it is the final step of the Venetian trade in the Adriatic and obliged staging post of pilgrimage to the Holy Land (Masaro, 2007: 204-205).

But Frederick II privileges Brindisi and enhances its port from the strategic-military point of view; consequently Otranto loses its ability to compete on the market.

Charles I of Anjou, becomes *rex utriusque Siciliae* in 1266, starts an ambitious strengthening programme of the Apulian Castle system and defensive coastal installations such as of the maritime network, to develop an efficient harbour network in support of his economical and military policy (Poso, 2007: 159-163; Gianfreda, 1997: 218-219). He takes measures for restructuring the Otranto port: after he had verified – during his passage in the city, that the building works – although so long since commissioned, aren't finished, in the mandate of November the 9th 1280 (R.A. 24: p. 118, n. 47), he orders to the *maestri portulani* of Puglia and Abruzzo, Mauro Pironti and Nicola Castaldo, to complete these financed works (*opus portus Ydronti*), designed by the

royal architect Pierre d'Angicourt (*protomagister nostrorum operum*), relative of the king. In another mandate of November the 19th 1280 (R.A. 25: p. 7 n. 18) we come to know that the *expensores opus portus Ydrounti*, who farmed out the works execution, were Nicola di Mastrogiovanni and Giacomo di Mileto, to which Charles orders to complete the reconstruction of the coastal tower termed Aco. Nevertheless, the works proceeded very slowly and haven't been finished in 1281, as another mandate, addressed to d'Angicourt, attests (R.A. 25: p. 49 n. 219; June the 3rd 1281). Only since 1282 one *portulano* (port captain, in charge for administrative and fiscal controls: Simbula, 2009: 191) starts to be noticed, therefore at that date the engineering works had to be concluded (R.A. 26: p. 181, n. 539; January-July 1283⁵).

This chronological range perfectly coincides with the calibrated radiocarbon dating considering also the time lapse between the wood cutting and its installation.

The ambitious purpose of Charles I answers to the new trade needs: the goods flow increase and the ship typology evolution shows the trend to build big vessels. These factors lead to continual works on the harbour: piers extension, basin enlargement, warehouses extension (Simbula, 2009: 25-27).

This powerful harbor installation probably didn't have long duration: it already looks like ruins or dangerous reefs (*secche*) in the sixteenth century, as the archivistic documentation attests (historical maps from sixteenth to sixteenth century and harbour projects of the nineteenth century).

The structures were already known in the past centuries and they are visible on some historical cartographic documents as well as in recent plans of the Otranto Municipality for the development of the port (Fig. 6). The most ancient document, dating back to the sixteenth and seventeenth centuries, indicate some (dangerous) shallows/reefs in the central part of the bay (Fig. 6e), visible also in the depiction of Otranto in T. Salmon work, 1763 (*Lo stato presente di tutti i Paesi e Popoli del mondo naturale, politico e morale*, vol. XXIII, Napoli 1763: fig. 6a). In the *Atlante Geografico del Regno di Napoli*, foglio 22 by Giovanni Antonio Rizzi Zannoni (1812) this structure is clearly indicated (Fig. 6b). The blocks' alignments can be recognized in a relief of Cap. W. H. Smyth (London, The British Library, 1843; Cazzato 1989: fig. 71) or even in the *Pianta dell'antica ed odierna città di Otranto*, where they follow the course of the medieval fortress and the port structure (Maggiulli, 1893). The reefs are still represented in a paper published by the Italian Navy Hydrographic Institute, Genova, in 1926.

Also the other sources give us similar indications: one report on the state of Kingdom of Naples, written by Camillo Porzio, Neapolitan advocate of the fifteenth century, addressed to the Viceroy Lopez de Mendoza (1575-1579), indicated only two ports in Terra d'Otranto, Taranto e Brindisi, «nobilissimi», meanwhile Otranto is defined as a fortress; in some *portolani* of the same century, included the Piri Reis one, it appears as a shelter for little and small ships, that with little expense could be very improved «para ynfinitas galeras»; the same imagine results from travel accounts of pilgrims headed to Holy Land⁶, nevertheless Otranto was a obliged staging post for travelers coming from the Eastern Mediterranean (Houben, 2007: 336; Poso, 2007: 155). Still in the seventeenth-eighteenth century, under the Spanish crown, the Otranto port was neglected (*intrattabile da bastimenti grossi*), notwithstanding continual requests of improvement; the traffic decrease and the port decline was caused by the heavy custom duties and the following contraband. Strikes to smuggling resulted in the interdiction of some ports, like Otranto and its

⁵ This document concerns Humbert di Chesnay, in charge in 1282.

⁶ The travel accounts of the humanist Heinrich Wölfl (1521) and the Benedictine monk Nicolas Loupvent (1543) indicate the scarce depth of the port that makes the ships to anchor at a distance.

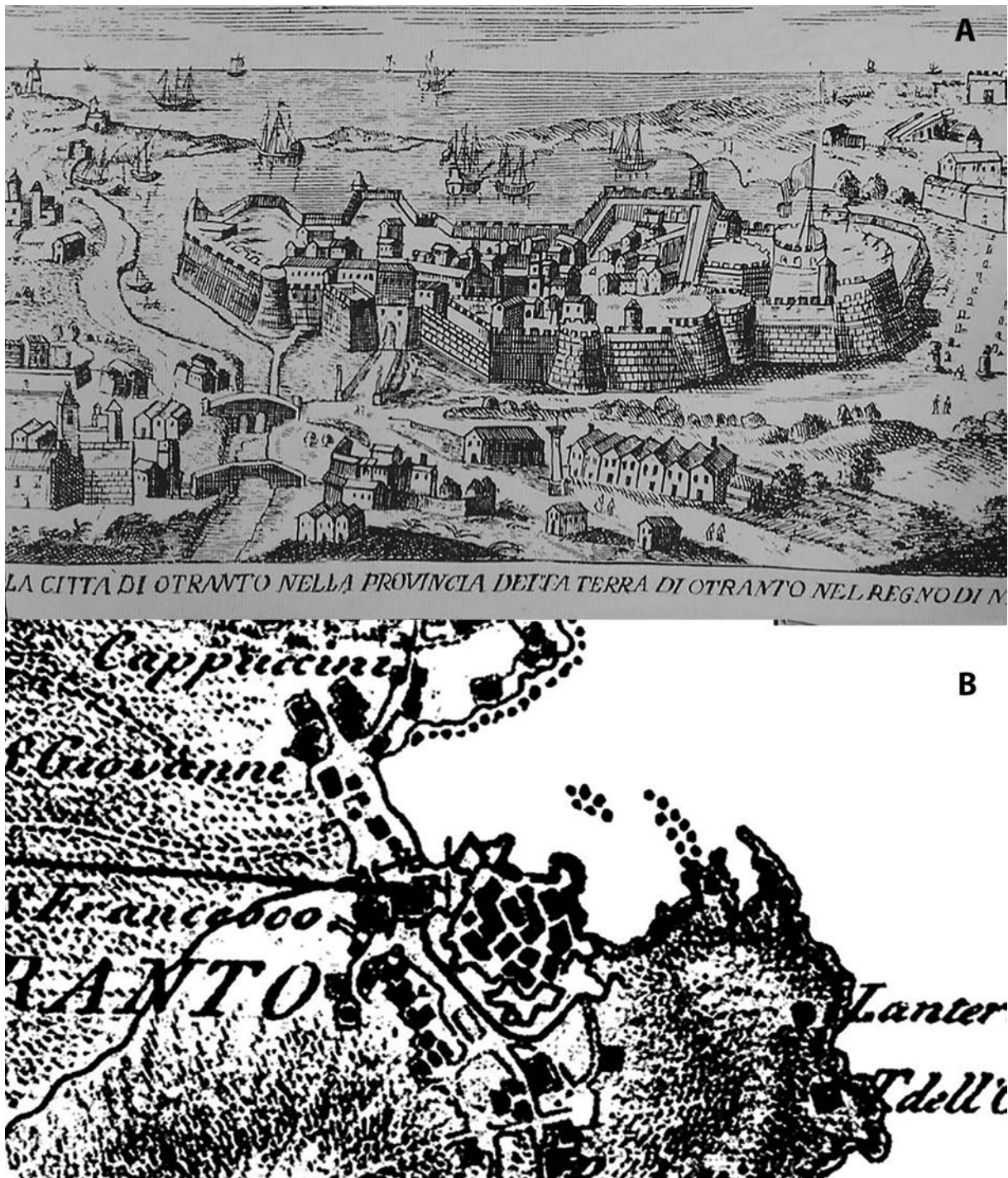


Figure 6. Otranto (Lecce, Italy). Otranto historical cartographic documents and plans.

alternative, the nearby Porto Badisco (Simoncini, 1993b: ix, 13-14; see, for the sources, Giustiniani 1803-1805; Sirago, 1993: 372-373; Appendice, 415-416). Between 18th and 19th centuries, Otranto carries out limited port activities, especially related to the oil trade, and probably didn't have piers more (Fiadino, 1993: 204). One *portolano* of 1770 indicates, at the left of the port, «alcuni scoglietti e secagni che lo compongono», probably the ruins of the Angevin big pier (Sirago, 1993: Appendice, 415).

As previously mentioned, the structures are also quoted or represented in reports attached to projects for the development of the port in modern times: one project of 1859 proposed to unify the *Secca di S. Nicola* with *Secca delle Casse*, to protect the basin from the norther winds; the topographical map *Rada di Otranto. Provincia di Terra d'Otranto – Circondario di Lecce – Comune di Otranto* (1866 Archivio Storico Lecce, Genio Civile, b. 235, fasc. 1181) shows small spots at the port entrance, that represent «residui di una muratura denominata Casse....avanzi di un molo artificiale, costruito dai Veneziani durante il loro periodo di denominazione in Terra d'Otranto» (attached report; Crupi, 2008, 105-106); the reefs (*Secche*) of «S. Nicola» and the ones of «Casse» appear also in the project plan *Porto di Otranto* of 1897 by the engineer Tramontani (Archivio Storico Lecce, Genio Civile, b. 235, fasc. 1180); the work would have provided the connection between the two ones (Crupi, 2008: 110 -111). The ruins are signaled as port preexistences in other engineering working reports of the beginning of the twentieth century (Crupi, 2008: 107-108; authors Francesco Nicola De Pace, 1905 and Coen-Cagli, 1910).

The ancient breakwater protected the south-eastern part of the harbour basin, whose entrance was at NW; this position probably was the best option, since the modern mole S. Nicola, built starting from the first year of the twentieth century, followed it.

In any case, the port exposure to the northern winds has compromised its functioning and security during the centuries, relegating Otranto to a secondary role between the Apulian ports of mediaeval and modern age, nevertheless its strongly strategic position.

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The impact of Arab invasion on the ship construction process in the Eastern Mediterranean in light of new evidences

El impacto de la invasión árabe en el proceso de construcción naval en el Mediterráneo oriental a la luz de nuevas evidencias

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Abstract: Maritime activities and the maritime cultural landscape in the Eastern Mediterranean went through dramatic changes during the Early Middle Ages, while also being influenced by politics. In mid-7th century, the Arabian conquest cut off Byzantine control and influence over the coast of the Levant and Egypt, thus the sea became politically and religiously divided. As it appears though, this division did not hinder the ongoing development processes in shipbuilding. The Arab invasion and stabilization of power on the Mediterranean just facilitated the spread of the already existing traditions along the conquered shores and introduced some new technologies, which were modified and utilized according to the needs of Mediterranean seafaring.

Key words: Shipbuilding traditions, transition, lateen sail, single rudder.

Resumen: las actividades marítimas y el paisaje cultural marítimo en el Mediterráneo oriental sufrieron cambios dramáticos durante el periodo de la temprana Edad Media. A mediados del siglo vii, la conquista árabe cortó el control bizantino de Egipto y el Levante, quedando, así, el mar dividido política y religiosamente. Sin embargo, aparentemente esta división no dificultó los continuos procesos de desarrollo de construcción naval. La invasión y la estabilización árabe en el Mediterráneo solo facilitaron la difusión de tradiciones ya existentes a lo largo de las costas conquistadas y la introducción de nuevas tecnologías que fueron modificadas y usadas de acuerdo a las necesidades de la actividad marítima mediterránea.

Palabras clave: tradiciones de construcción naval, transición, vela latina, timón único.

Historical background

In the mid-7th century, Arabian expansion changed the political map of the Eastern Mediterranean. It cut off Byzantine control and influence over the coast of the Levant and Egypt. In 634, Arabs defeated the Byzantine Emperor, Heraclius, on the banks of the Yarmuk River, expanding the control towards the main Middle Eastern towns. Damascus was captured in 637, Jerusalem in 639 and five years later, Arabs controlled Syria, Palestine and Egypt. It took them some time to conquer the coastal cities and approach the island of Arwad, because Constantinople had been supplying them by the sea. Thus, the development of an organized navy and fleet became a necessity for Muawiyah, Arab governor of Syria. To develop a fleet of similar strength to that of the Byzantium, they were relying on local facilities, naval bases, including docks, shipbuilding yards, building materials, as well as human resources. Experienced Christian shipbuilders and seamen of Egypt, Syria and Palestine, who felt no loyalty towards Constantinople, helped Arabs with their knowledge and skills. As a result of their successful cooperation with native Mediterranean people, they built ships similar to the Byzantine ones. They launched raids on Cyprus, Crete, Rhodes and Sicily. They were victorious in the sea battle of Rhodes in 654. Moreover, off the coast of Lycia in the following year, the Arab navy won the battle with the main Byzantine fleet under the command of Emperor Constans II. Several shifts in the Mediterranean balance of naval power could be noted here. The ports of Acre and Tyr were the bases from where part of the Arab fleet embarked for its battles and raids. Muawiyah's rule reestablished shipbuilding, which was previously in decline, by resettling Persian workmen from Antioch, Balbek and Hims to the ports of the Levantine coast. Alexandria had a big naval base with all the necessary facilities to support the construction of the fleet and establish Arabs as a concurrent sea power. It had docks, building materials imported from Syria, skilled shipbuilders, trained sailors, mariners and officers. After an unsuccessful attack on Nubia, the expansion turned westwards to Cyrenaica, towards the territories of the Berber tribes. In the following decades, Arabs ruled the North African coast and their fleet dominated the Western Mediterranean. Thus, the sea became politically and religiously divided (Abulafia, 2012: 241-246; Norwich, 2007: 72-76; Hourani, 1995: 53-60; Pryor, 1988: 28). The aim of this paper is to investigate how these political and cultural changes affected ship construction in the Eastern Mediterranean.

Transitional processes in shipbuilding during the Arab invasion

Following historical processes, the 1st millennium AD was a millennium of evolution in ship construction in the Mediterranean. The transitional process from shell first to skeleton first, was developed nonlinearly in different areas of the Mediterranean. Among other factors, geography, economy and the condition of the society had a significant influence in the transition during different time periods and in different areas. This could be reflected on the Eastern Mediterranean which was suffering under economic instability before and after the Islamic expansion (Kahanov, 2010: 78-79). By combining old and new archaeological evidence and by analysing them, we can partly reveal how the Arab invasion and the polarization of power, in particular, influenced transitional processes of shipbuilding in the Eastern Mediterranean and beyond.

The term «transitional process» refers to the changes in hull construction, where hull integrity is defined by the type of planking, the mortice-and-tenon edge-joining, or regarding frames, shell-first or skeleton first approach with possible mixed techniques. In the previously accepted linear theory of transition from shell first to skeleton first building technique, the Yassi Ada 1 wreck from the 7th century was a middle point built in a mixed hull design (Steffy, 1994: 80-85; Pomey, 2004: 32-33; Van Doorninck, 1982: 32-64). According to that theory, the process

was completed with Serçe Limani's wreck during the 11th century (Pomey, 2004: 33-34; Harpster, 2010: 44-55).

The wrecks which have been discovered in the last 20 years in the region of the Eastern Mediterranean changed the preexisting theories which talked about the evolution of the hull construction and the transitional process. Discoveries in the Dor / Tantura lagoon in Israel moved the completion of the transitional process to the mid-1st millennium AD, closer to the time of the Arab invasion (Wachsmann, 1995: 3-8; Kahanov, 2011a: 47-48). The Yenikapi group of 36 shipwrecks, dated from the 5th to the 11th century, unearthed in Teodosian harbor in Istanbul, provided evidence of the stages of transitional process in the northern coast of the Eastern Mediterranean (Kocabas/Ozsait-Kocabas, 2010: 109-127). The analysis of this evidence showed that transition was not a linear process and it took place in different stages in different parts of the Mediterranean. In order to assess the role of Arab invasion, all previously stated evidence should be taken in account, as well as evidence from other parts of the Mediterranean, like evidence found in the Bozburun wreck dated from the 9th century. This was found in the southwestern coast of Turkey; and the wrecks Bataiguer and Agay 2, that were found just off the Mediterranean coast both dated from the 10th century (Harpster, 2002: 409-418; Joncheray/Jézégou, 1994; Joncheray, 1994; Pomey *et alii*, 2012: 235-314).

Tantura Lagoon in Israel, located between the modern city of Haifa and ancient Caesarea, had been a natural anchorage of the frequent navigational route throughout the ages. The bay is located south of the ancient Dor tell, engulfed by several islands (Wachsmann/Raveh, 1984: 223-224; Wachsmann, 1995: 3).

During excavations in 1999, scattered fragmentary remains of local vessels were recorded and labeled as Dor D (Kahanov/Royal, 2001: 257). The remains consist of 14 hull timbers dated from the mid-5th to the mid-6th century (Royal/Kahanov, 2005: 310-311). It is an earlier evidence of a mixed-shell skeleton construction method than the 7th century Yassy Ada 1 (Pomey, 2004: 32-33). Unpegged mortise and tenon joints were used on every plank between strake edges. A pegged mortise and tenon joint was found joining two planks in a strake scarf both with nails and tree nails used as frame plank attachments (Pomey *et alii*, 2012: 263).

The remains of a smaller coaster, 12 meters long and 4 meters wide, discovered in the same lagoon, have been dated from the end of the 5th to the beginning of the 6th century and labeled as «Tantura A wreck». It is the earliest evidence which proves the end of transitional process, since the remains revealed no presence of mortises and tenons joints. The planks to the frames and the frames to the keel are connected by nails; a cross section of the hull consists of flat frames with a round turn of the bilge (Kahanov/Breitstein, 1995: 10-12; Pomey *et alii*, 2012: 259-260).

One of the most significant finds, which provided crucial evidence that changed preexisting theories of transition, was a Byzantine coaster, «Dor 2001/1», dating from the first third of the 6th century. It is the earliest archaeological evidence for frame-based hull, both in concept and in the process of construction (Kahanov/Mor, 2014: 61-62). Frames were nailed to the keel, planks were nailed to the frames, usually by two small iron nails and caulked, and no evidence of any kind of planking edge joints was found (Mor, 2010: 89). Cross section of the hull shows flat frames about amidships, a hard chine and straight edges that might suggest Nilotic origins of this tradition and can render the Dor 2001/1 wreck as its archetype (Fig. 1). It's assumed that this tradition originated in Alexandrian shipbuilding yards and later expanded throughout the Mediterranean (Pomey *et alii*, 2012: 262; Kahanov/Mor, 2014: 64; Kahanov, 2011a: 48-49).

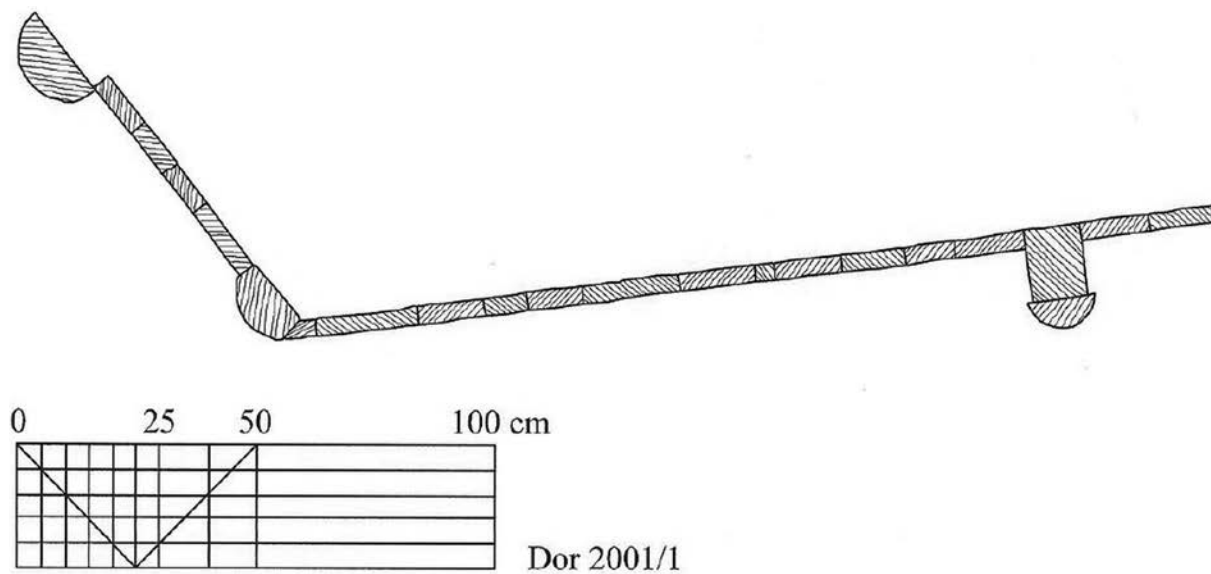


Figure 1. Dor 2001/1, planking cross section amidships (Kahanov/Mor, 2014: Fig. 13).

More archaeological discoveries from the Dor/Tantura lagoon dated to the later periods shed more light and support the theory of early completion of transitional process and its Egyptian origins. Tantura F was a local coaster or fishing vessel dated to the beginning of the 8th century or the early Islamic period. It was around 15 meters long and 5 meters wide. The general sequence of hull construction was clearly based on keel and frames. Planks were nailed to the frames and caulked. (Barkai/Kahanov, 2007: 21-31; Barkai, 2009: 25-33; Barkai, 2010: 97-105; Kahanov, 2011b: 143-144). Tantura E wreck, approximately 12.5 meters long and 4 meters wide, was a small coaster dated between the 7th and the 9th century and was found in a poor state of preservation. It was built using Eastern Mediterranean tree species in a frame-first technique with a dense framing pattern and exceptionally short planks. There is no evidence to suggest planking edge joints and the seams were caulked. Its construction method might have Nilotic origins (Kahanov, 2011b: 145-146; Israeli/Kahanov, 2014: 369-388). Another hull with Egyptian, Nilotic origins is the Tantura B wreck dating from the beginning of the 9th century. The remains are revealing flat floor timbers and half frames, but the shape of the turn of the bilge is not clear, nor is the shape of the sides. No planking edge joints was discovered and the hull was built in frame-first method following the Nilotic tradition (Kahanov, 2011b: 146-150; Pomey *et alii*, 2012: 271-273).

Yassi Ada 1 is a Byzantine wreck discovered in southern Turkey and it dates from the 7th century. The cross section of the hull has a wine glass shape with a round turn of the bilge. Unpegged mortise and tenon joints existed between the first 16 strakes that were reinforced by frames. From the 17th strake upwards, no mortise and tenon joints were evident and framing timbers supported higher side planking (Van Doorninck, 1982: 32-64). Before the discoveries in Dor/Tantura lagoon took place, this evidence was used to determine mixed hull construction, where neither framing, nor planking played a predominant role in hull integrity (Steffy, 1994: 80-83; Pomey, 2004: 32).

The Bozburun wreck was found in southern Turkey near Selimiye/Bozburun. It dates back to the 9th century. The hull had a shallow wine glass cross section, from the third strake, the bottom was flat and the turn of the bilge was round. There were no mortise and tenon joints found, but edges of planks were connected to each other with polygonal tree nails that were

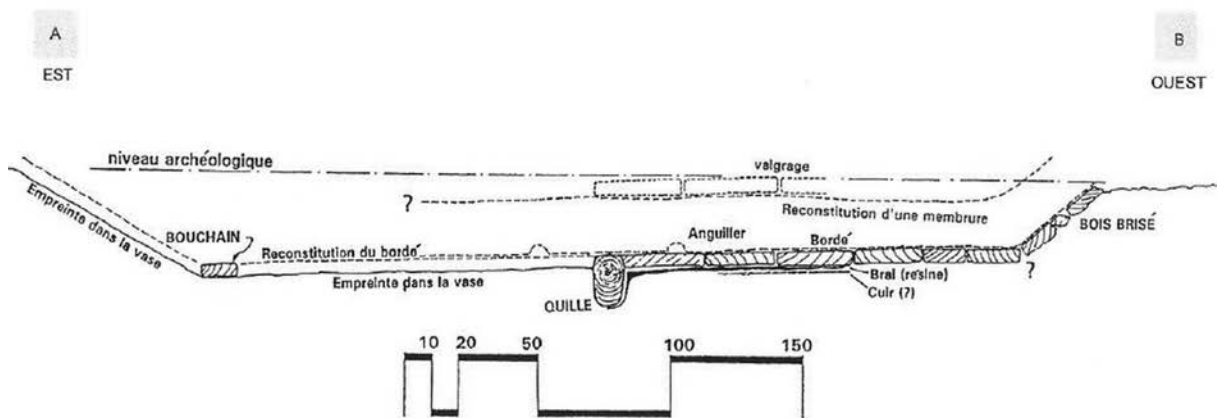


Figure 2. Bataiguiet shipwreck, cross section amidships (Pomey *et alii*, 2012: Fig. 62).

penetrating 50 mm deep into the planks. Between some planks caulking was traced. Assembly of the ship was most likely following this order; frames were forming shape of the hull and planks were joined to each other with tree nails, after nailed to the frames. Thus, the hull integrity was partially based on frames, so the construction sequence of the Bozburun wreck was a mixed construction process (Harpster, 2009: 297-313; Harpster, 2005: 88-94; Harpster, 2002: 409-418).

Two wrecks found in southern France, which have similar characteristics and origins, can help us understand the spread of ship construction traditions. Both date back to the 10th century. Bateguier was discovered near the shore of Canes. It was a merchant ship approximately 20 meters long. Its cargo has Andalusian, North African and Sicilian origins. The hull cross section has a flat bottom and sharp turn of the bilge (Fig. 2). The construction method of the hull was based on frames. Agay A wreck has the same origin of cargo and it was found near cap Dramont, Var, France. It was 20-25 meters long and its cross section shows flat floor timbers, rounded bilge and straight sides. No planking edge joints were noticed, so the hull was built according to frame-first principle. With regards to the shape of the hull, those wrecks appear to have certain similarities with the wrecks discovered in Dor/Tantura lagoon as well as with the Serçe Limanı wreck (Joncheray/Jézégou, 1994; Joncheray, 1994; Pomey *et alii*, 2012: 274-277).

The Serçe Limanı wreck was discovered in Serçe Limanı Bay in southwestern Turkey. Dating back to the 10th century, due to its construction features and absence of mortise and tenon or any other kind of planking edge joinery, it was representing a completion of transitional process until recent discoveries were made in Dor/Tantura lagoon (Bass/Van Doorninck, 1978: 119-132; Steffy, 1994: 85-91; Pomey, 2004: 33-34). The cross section of the wreck has a flat bottom, sharp turn of bilge and straight sides and it can be associated with the tradition which is apparent in the building of the Dor 2001/1, the Bateguier and most likely the Tantura E (Fig. 3) The Serçe Limanı was built using frame-first technique by using two mould frames (Van Doorninck, 1982: 7-11; Steffy, 1982: 13-34; Pomey *et alii*, 2012: 277-278; Harpster, 2010: 44-55).

The discovery of thirty six shipwrecks which vary in types and size in the Theodosian harbor of the Yenikapi district of Istanbul, provided crucial evidence on the transitional process in ship construction in the region of the Byzantine Empire during the period of 5th to 11th century. The wrecks of cargo ships, fishing vessels and five galleys were mostly built using the mixed technique. The dowels (coaks) were used as planking edge joinery of all the shipwrecks except one. The planks of one wreck were connected by unpegged mortise and tenon joints.

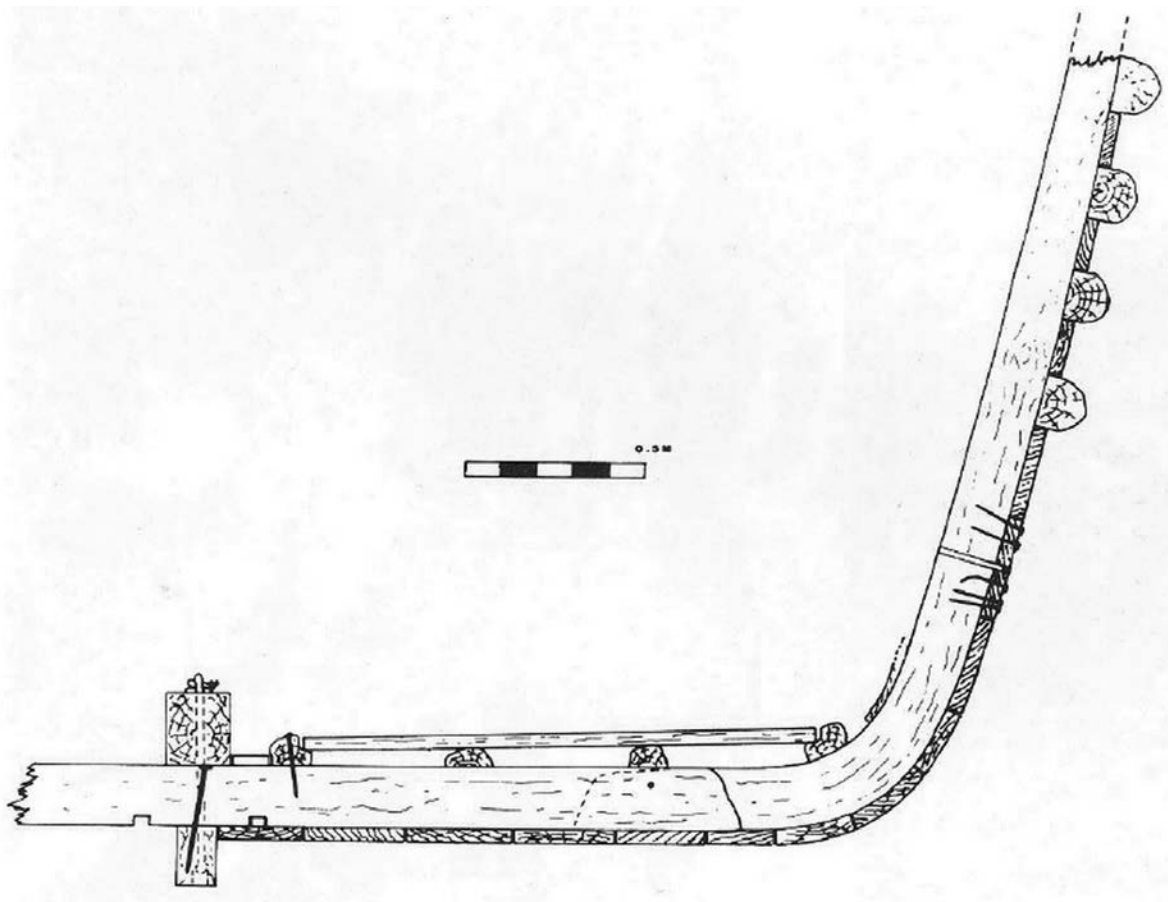


Figure 3. Serçe Limanı shipwreck, cross section (Steffy, 1982: Fig. 9).

The wrecks from the lower layers date back to the 5th and 9th century and were built mostly by using the skeleton first technique, while those which date back to the 9th to 11th century, were built with dowels. With regards to the cross section of the hull, the group of the wrecks which dates back to the 9th and 11th century was built with flat floor timbers and sharp turn of the bilge and another group with wine glass cross section and a round turn of the bilge (Kocabas/Ozsait-Kocabas, 2010: 109-127; Ingram/Jones, 2010: 8-17; Kocabas, 2012; Pomey *et alii*, 2012: 279-290).

The archaeological evidence of the wrecks Tantura A and Dor 2001/1 is revealing the completion of the transitional process of hull construction as early as the end of the 5th and beginning of 6th century. It actually predates the Arab invasion for approximately more than a hundred years. The rest of the wrecks from the Dor/Tantura lagoon, Tantura F, E and B, are providing evidence in favor of the continuity of this tradition in the region. Dor 2001/1 is an archetype of riverine, Nilotic construction tradition with sharp turn of the bilge, flat bottom cross section and rectangular sides. With regards to the hull construction design, the origins of the cargo and all the finds suggest that all the wrecks from Dor/Tantura lagoon have riverine, Nilotic origins, and it can be inferred that they might have been built in Alexandrian shipyards where this tradition might have evolved even earlier (Kahanov, 2011b: 150-151). Following the Arab expansion along the coast of Northern Africa, the riverine tradition moved westward. Its influence can be noted on the construction method of Bataiguiet and Agay A wrecks from the 10th century. Having crossed the borders of the Byzantine Em-

pire, its appearance is obvious on the Serçe Limanı wreck from the 11th century (Pomey *et alii*, 2012: 308).

While the Arabs were invading and stabilizing their power, in the Mediterranean on the southeast, and on the Byzantine coast in the north, the ships were being built in a mixed constructional technique until the 11th century as well as the Yassi Ada 1, Bozburun and most of the ships of the Yenikapi group (Pomey *et alii*, 2012: 307-308). The ships of the Yenikapi group fit well in the linear theory of transition between Yassi Ada 1 and Serçe Limanı, which proves that in the north, the process of transition was slower and came later than that of the Levant (Kahanov, 2010: 82). Future research and evidence will provide more clues as to whether this difference in construction method between north and south was affected by political polarization, namely by the formation of a new culture in the southeastern Mediterranean, which confronted Byzantium, causing the separation of the sea between two powers, or not.

Thus, it can be concluded that, Arab invasion did not directly affect the transitional process of hull construction, but it most surely facilitated its spread westwards, along the North African coast. There is also a possibility that their expansion and separation of the sea, delayed the wide acceptance of this technique in the northern Byzantine coast.

Introduction of lateen / settee sail

Studies of lateen sail in the Mediterranean during the last century were mostly based on the iconographic evidence from the late 9th century which postdated the Arab invasion. Widespread use of the triangular sail in the Indian Ocean lead to the conclusion that Arabs facilitated its introduction across the Mediterranean after the expansion (Hourani, 1995: 100-105; Casson, 1995: 243-245). Although there is still no clear evidence that can show us transition from square to lateen/settee sail, it is probable that square sail did not disappear as abruptly as we might think. Probably it coexisted with lateen throughout the Middle Ages, despite a gap in iconographic evidence from the 6th until the 9th or the 13th century, when square sail was again being depicted. The reasons which brought about the change from square to lateen/settee sail rig could be the same as those which caused the change in ship construction; namely economic, social or geographical (Castro *et alii*, 2008: 347-348). The discoveries of a mosaic from the Kelenderis port in southern Turkey and a graffito in the monastic site of Kellia in Egypt, both date back to the time before the Arab invasion, modified the previous theories about the introduction of lateen/settee sail (Frost, 1995: 154; Pomey, 2006: 326-329). The Kelenderis ship with quadrilateral sail with a short luff is depicted on a mosaic dates back to the end of the 5th beginning of the 6th century (Friedman/Zaoroglu, 2006: 108). The Kellia ship (Fig. 4), dating back to the early 7th century is undoubtedly a depiction of triangular lateen sail with halyard system and hook shaped masthead (Whitewright, 2009: 98). Even though it was a subject of debate, whether the Kelenderis ship displays square or lateen settee sail (Pomey, 2006; Friedman/Zaoroglu, 2006; Friedman, 2007), a halyard system and hook shaped mast is identical with that on the Kellia ship. The similarities of the rigs between the Kellia and the Kelenderis ships can lead to the conclusion that, the sail of the Kelenderis mosaic is a settee sail, more particularly, a quadrilateral type of lateen sail (Whitewright, 2009: 98-99).

Therefore, we can conclude that the settee sail was in use in the Mediterranean as early as the end of the 5th to the beginning of 6th century, while the triangular lateen sail was rigging the ships from the late 6th to the early 7th century. As both pieces of evidence predate the Arab invasion, this historical process did not directly affect the introduction or evolution of lateen sail in the Mediterranean, hence the answer should be sought in the complexity of social, economic and technological factors of that period.

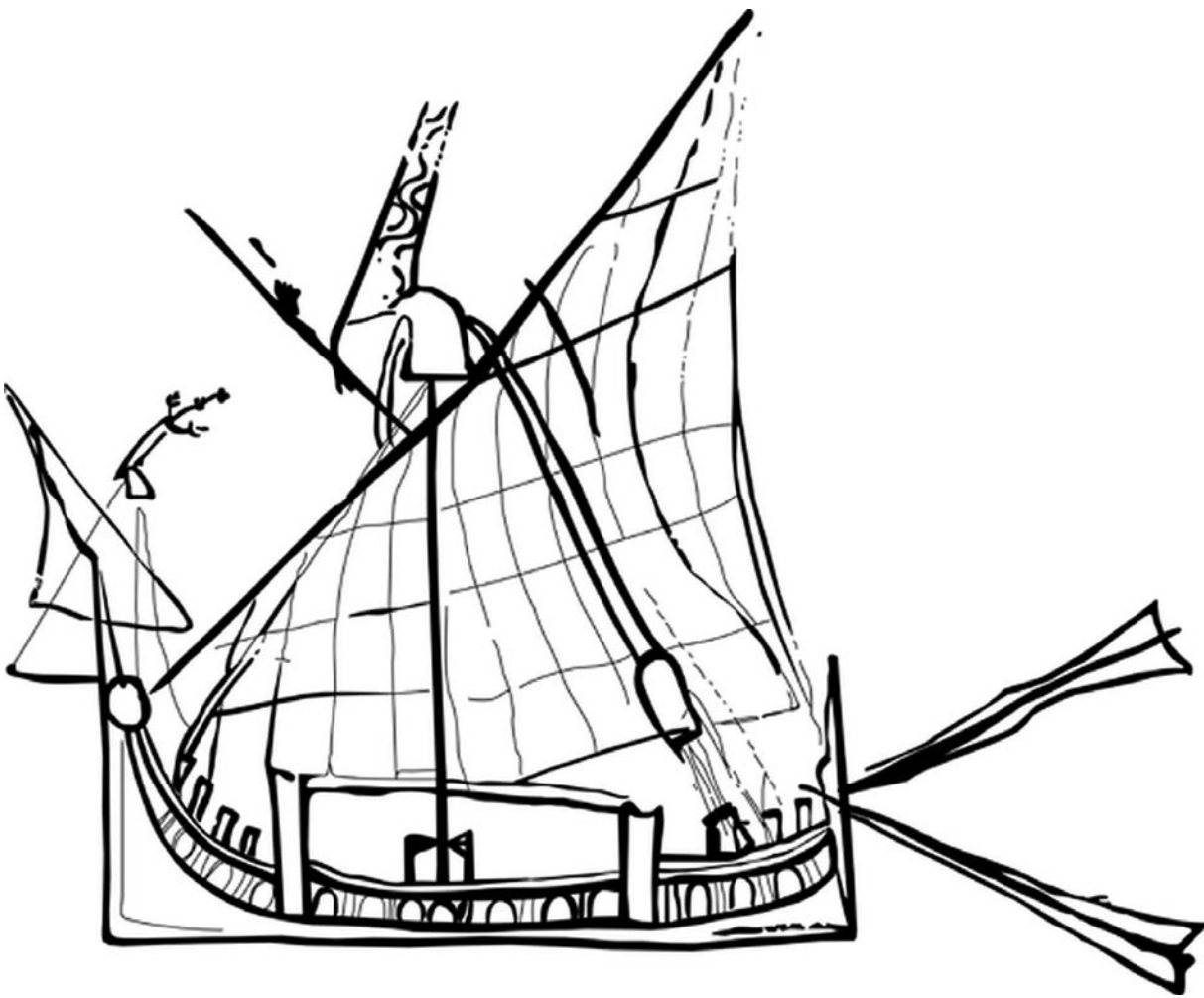


Figure 4. Depiction of Kellia ship (Whitewright, 2009: Fig. 2).

Introduction of a single rudder

It was assumed by several scholars that the single rudder and its development was a Chinese invention, which had been adopted by Arab sailors of the Indian Ocean and then spread to the Mediterranean through the Red Sea (Needham, 1971: 651-652, Christides, 1999: 96). There was difference among the Chinese and the Arab ships in the way that the rudder was secured to the sternpost; this led to the conclusion that the only idea which could be transmitted from the Chinese to the Arabs was that of a stern post mounted rudder. Chinese ships did not have a sternpost and their rudder was suspended and held in place by a system of tackle, while the Arabs secured the rudder permanently to the sternpost and controlled it by lines. This kind of attachment might well be the independent invention of the Arabs. In the 10th century, Al Muqaddasi wrote about steering the ship with two ropes; while later during the 13th century, John Montecorvino and Marco Polo provided descriptions of Arab stern post mounted rudders. The earliest iconographic evidence (Fig. 5), where the stern post mounted rudder is depicted with quarter rudders stems from the 12th century and Suwar al Kawakib (The book of fixed stars – written by El Sufi) (Mott, 1997: 120-121). According to the iconographic and textual evidence, the stern mounted steering oar was used by the Byzantine navy from the 11th and 12th century, but there are no iconographic depictions of stern post mounted rudders on Byzantine, Latin ships before

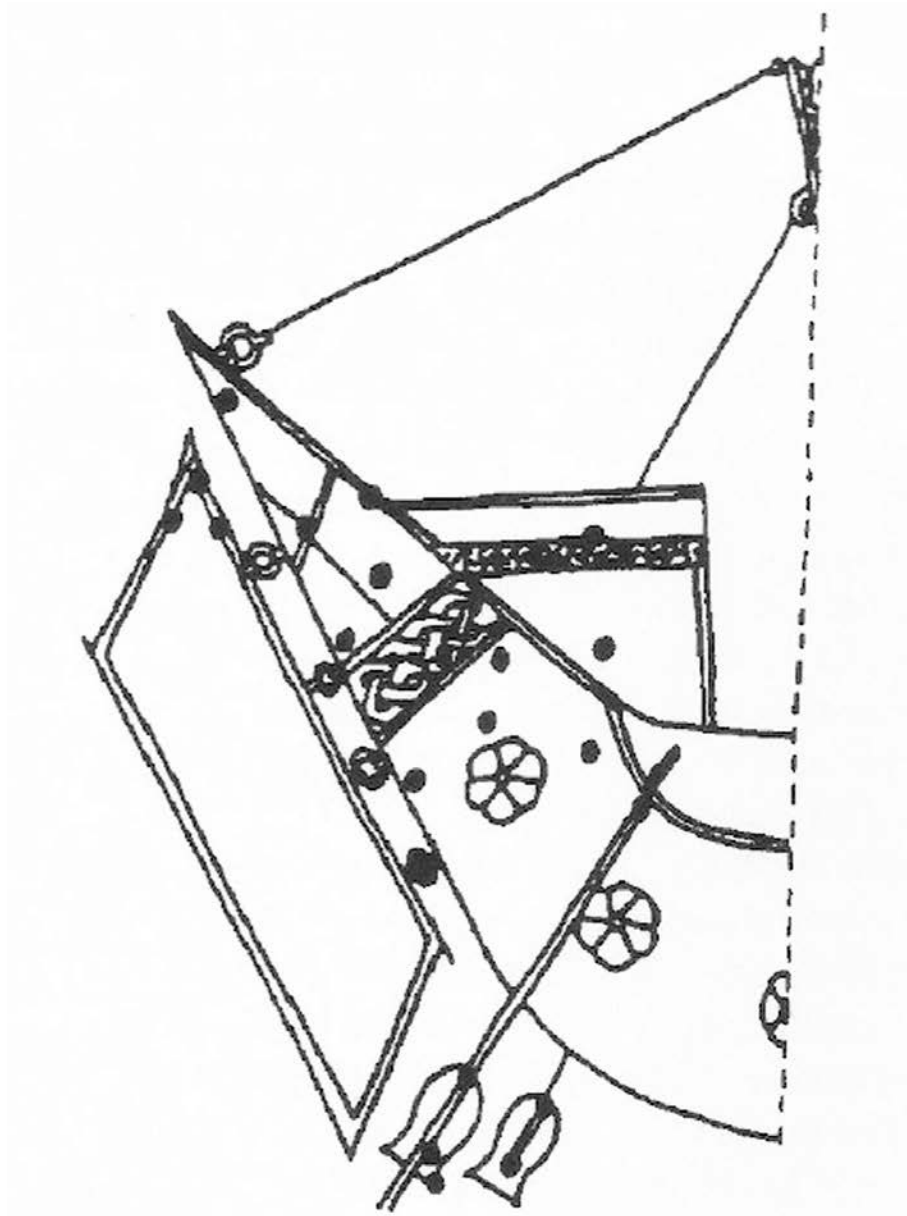


Figure 5. Mid 12th century, Arab vessel with both stern post rudder and quarter rudders (Mott, 1997: Fig. 71.).

the second half of the 13th century and from the 14th century, when the sternpost mounted rudder was introduced to the Mediterranean with the cog (Mott, 1997: 123; Pryor, 1988: 60-61).

Arab seafarers were using single rudder in their ships in the Indian Ocean from the 10th century. Although the tradition of stern mounted single oar was used in the Mediterranean since the times of ancient Egypt and through the Roman times, the single rudder was introduced by Muslim shipwrights, but it was not widely accepted or used, due to its method of mounting. The rudder needed to be fastened to the stern post by lashing and needed constant maintenance due to corrosion; plus, the Arab steering system with two lines was not suitable for large ships. Therefore, Mediterranean shipbuilding kept its continuity of using stern mounted steering oar that was still employed on light war galleys through the 12th and 13th century, until the introduction of pintle and gudgeon type of rudder in mid-13th century (Mott, 1997: 124-125).

Conclusion

Despite political and cultural changes on its shores, the Mediterranean did preserve its continuity regarding the ship construction traditions and rigging of vessels, without significant influence from the Arab invasion. The Arab invasion and stabilization on the Mediterranean just spread already existing traditions along the shores they conquered and introduced some new technologies which were modified and used according to existing shipbuilding tradition.

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La construcción naval medieval en Cataluña (siglos XIII-XV): un mismo principio, diversos procesos

The medieval naval construction in Catalonia (13th-15th centuries): the same principle, different techniques

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Resumen: la construcción naval en la Cataluña bajomedieval siguió la tendencia general mediterránea en el uso del principio de construcción de esqueleto y la colocación de la tablazón del forro a tope. En cambio, el proceso de construcción realizado por el carpintero de ribera pudo variar por diferentes razones. La determinación de formas de las cuadernas a partir de uno o más gálibos modificó el proceso constructivo, tal como se aprecia entre Serçe Liman (siglo XI), donde se utilizaron diversos gálibos, y Culip VI (siglo XIII), donde se utilizó el método del gálibo maestro, con la ayuda de la tabla de astilla y una regla. Entre los siglos XIII y XV en todos los pecios conocidos se utilizó el método del gálibo maestro, pero otras causas podían alterar el proceso de construcción –no el principio– tal como muestra el pecio *Les Sorres X* (siglo XIV) con una quilla formada por dos piezas superpuestas.

Palabras clave: construcción naval, proceso constructivo, Edad Media, Mediterráneo, Cataluña.

Abstract: Late medieval shipbuilding in Catalonia followed the general Mediterranean tendency of using the skeleton-first shipbuilding principle and placing the planks of the hull edge-to-edge. But the construction process varied depending on the ship carpenter. The design of the frame shapes from one to more moulds could modify the construction process, as we can see in Serçe Liman (11th c.) which used several moulds, and in Culip VI (13th c.) which used the master mould, the rise square and the ruler. Between the 13th and 15th centuries all the shipwrecks

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known used the master mould (or whole-moulding) method, although other factors could also change the construction process, not the principle. One example is Les Sorres X (14th c.) with its keel built with two overlaid pieces.

Key words: Shipbuilding, construction process, Middle Ages, Mediterranean, Catalonia.

Introducción

Barcelona, capital de Cataluña y centro político y económico de la Corona de Aragón, impulsó la expansión territorial y marítima que le permitió a finales del siglo XIII convertirse en la tercera potencia naval del Mediterráneo, detrás de Génova y Venecia. La conquista y creación de los reinos de Valencia y Mallorca en ese siglo, del reino de Sicilia a finales del mismo, de la isla de Cerdeña a mediados del siglo XIV y finalmente del reino de Nápoles en el siglo XV, no solo contribuyeron a ampliar el marco territorial de la Corona, sino a reforzar su papel de potencia naval consolidando su presencia en el Mediterráneo occidental y central.

La expansión comercial y militar de carácter marítimo se refleja en la documentación medieval, sobre todo la de época bajomedieval, y en concreto en el tema que nos interesa: el principio constructivo y el proceso de construcción de las embarcaciones realizadas en los astilleros y arsenales de la costa catalana, y por extensión en todos los que existían en las costas de la Corona.

Las fuentes de información a partir de las cuales podemos conocer cómo se construyeron las embarcaciones medievales en las costas de la Corona de Aragón son básicamente tres: evidentemente en primer lugar tenemos la principal fuente de información de todo medievalista, la documentación de archivo; en segundo lugar las imágenes que se crearon como elementos simbólicos, narrativos y decorativos en retablos y relieves, situados originalmente en iglesias, catedrales y monasterios; y en tercer lugar los yacimientos arqueológicos correspondientes a embarcaciones hundidas, los llamados pecios.

Es importante para el periodo cronológico de estudio abordar las tres fuentes de información, debido a que todas ellas se complementan. Esto se demuestra claramente entre la iconografía y la arqueología, en donde la parte del casco que nos muestran las imágenes suele corresponder a la obra muerta y el aparejo, mientras los restos arqueológicos suelen pertenecer al fondo del casco u obra viva. Si en la iconografía tenemos las imágenes y en la arqueología los restos materiales, en la documentación de archivo tenemos las «palabras», los nombres de las partes del barco, de las piezas de su estructura y otros elementos estructurales y del aparejo que nos muestra la iconografía, y que también nos aparecen en los pecios. Además podemos contrastar si realmente las medidas, el tipo y el origen de la madera utilizada que nos ofrece la documentación de archivo es la que se presenta en el yacimiento.

La documentación de archivo

De toda la documentación existente relacionada con la temática naval (inventarios, compra-venta, fletes, etc.) hay dos tipologías documentales que nos permiten conocer el principio y el proceso de construcción naval, y estas son los contratos de construcción y los libros de cuentas de construcción.

Los contratos de construcción naval se encuentran en los protocolos notariales, los fondos de los cuales se encuentran depositados en Cataluña en los siguientes archivos: los distritos

notariales de la provincia de Barcelona en el Archivo de la Corona de Aragón - ACA; los de la ciudad de Barcelona en el Arxiu Històric de Protocols de Barcelona - AHPB; los de la provincia de Girona en el Arxiu Històric de Girona - AHG, y los de Tarragona en el Arxiu Històric de Tarragona - AHT; mientras que los libros de contabilidad de construcción de naos y galeras, grandes embarcaciones de guerra y/o comercio, construidas para el rey, la Generalitat o bien para la ciudad de Barcelona, se conservan en este caso en el ACA, en la sección Maestre Racional para la documentación real, y en la sección Generalitat para la institución homónima, mientras que en el Arxiu Històric de la Ciutat de Barcelona - AHCB encontramos la documentación de la ciudad de Barcelona.

En la primera tipología documental, los contratos de construcción, aparecen el contratisa, o sea el armador o *senyor de la nau* (en catalán «señor de la nave»), que si forma parte de una sociedad, suele ser el que tiene más parte y a la vez puede ejercer de patrón del barco, y el contratado, el carpintero de ribera o *mestre d'aixa* (en cat. «maestro de azuela»). El acuerdo entre las dos partes nos ofrece el tipo de embarcación, sus dimensiones generales y el precio total. Muchas veces el coste de construcción debe pagarse en diversos plazos, según avanzaba la construcción, coincidiendo así con las diferentes etapas del proceso constructivo (armazón, forro, calafateado y botadura).

En los libros de cuentas –la segunda tipología documental– aparecen las cantidades destinadas a todo tipo de gastos, como los salarios de los operarios (carpinteros de ribera, calafates, serradores, etc.), la compra de material de construcción y calafateado (madera, clavos, pernos, brea, estopa, etc.), pero también la compra diaria o con algunos días de antelación de comida y bebida. Este tipo de gasto nos permite conocer la celebración del inicio o final de una fase importante del proceso constructivo. Por ejemplo, la compra extraordinaria de vino blanco y carne de ternera y buey para celebrar que se ha forrado todo el casco, dado que habitualmente se consume carne de cordero y cerdo para comer y vino tinto para beber. La *festa del romball* es la fiesta en que se celebraba que el casco se había forrado completamente, dado que el *romball* es un elemento del forro, no se trata de una tabla sino de la última pieza de madera que remata el acabado del forro. Otro tipo de gasto era la compra de copas doradas por parte del armador. En este caso las copas se asociaban a un acto festivo relacionado con el acabado, bautismo y botadura del barco. Las copas las entregaba el armador, o su representante, al carpintero mayor de ribera y al calafate mayor, y estos dos entregaban a cambio las herramientas que los identificaban, la azuela del carpintero de ribera y el martillo del calafate. Además se tenía que pagar la licencia episcopal para bendecir el barco y todos los gastos de carácter litúrgico y festivo de este día (músicos, sacerdotes, vajilla, comida y bebida).

Así pues, la documentación de archivo nos indica una serie de fases, que empiezan con: 1. *seure* (plantar la quilla en la grada). 2. *enramar* (colocar las cuadernas). 3. *cenyir* (poner todos los elementos longitudinales interiores y exteriores: sobrequilla, palmejares, carenotes, cintas, durmientes y trancaniles). 4. *cloure* o *fer blanc* (forrar el casco). 5. *calafatar* o *fer negre* (calafatear). 6. *Beneïr i varar* (bendecir y botar). 7. *arborar* (aparejar) (Pujol, 2012). Estas fases nos indican claramente que el principio de construcción es el de esqueleto, en el que la forma del casco viene dada por la sección longitudinal que da la roda, quilla y codaste, y la sección transversal dada por la cuaderna maestra, que se completa con el resto de cuadernas y los elementos longitudinales de refuerzo de la estructura, revistiéndose posteriormente toda la carcasa con las tablas del forro.

Básicamente la armazón viene definida y construida en las fases de *seure*, *enramar* y *cenyir*, mientras que se pone el revestimiento al *cloure*. Una de las características más importantes de este principio constructivo es el calafateado del forro del casco, para impermeabilizarlo, lo cual nos indica además que el forro era colocado a tope.

La documentación iconográfica

Las obras iconográficas más realistas y ricas en detalles son los retablos. Estos, pintados o esculpidos, son obras de gran calidad, por lo que debemos resaltar además su cantidad, se conservan más de 70 obras realizadas en Cataluña de los siglos XIII al XV.

Si observamos atentamente la representación de los grandes barcos de comercio (naos y cocas) podemos apreciar, en las obras del siglo XIII e inicios del XIV, cómo estas disponen de dos mástiles a vela latina y timones laterales de espadilla. Durante el siglo XIV la llegada de tecnología naval atlántica provocó cambios en el sistema de propulsión y de dirección de estas, pasando de dos mástiles a uno solo, y del uso de la vela latina se pasó a la vela cuadra, mientras que los timones laterales fueron sustituidos por el timón de codaste. A partir del siglo XV, vemos aparecer la nao de aparejo mixto, con dos palos, uno a vela cuadra, el palo mayor a proa, y el segundo palo a popa a vela latina, y a medida que avanza el siglo empiezan a aparecer las naos ya con tres palos, trinquete y mayor a vela cuadra y el de mesana a vela latina.

Esta evolución tan clara la reservamos en principio para los grandes barcos mercantes. Estos aparecen en numerosos retablos dedicados a vidas y milagros de santos, en los que en algún momento de su vida tuvieron algún pasaje o hubiesen realizado un milagro en relación con el mar, como san Nicolás, santa Úrsula, santa Magdalena, san Martín de Tours o Jonás, entre otros. Evidentemente la burguesía, los gremios y las instituciones financiaron la producción de retablos, deseando que apareciese el objeto que produjo su riqueza, a partir de la actividad comercial y marítima, representada por la nao. Pero si los retablos nos sirven para observar la evolución tecnológica del sistema de propulsión y de dirección, no se aprecia de manera clara el principio constructivo, si bien podemos entrever que la tablazón del forro fue colocada a tope.

Es probable que existieran diferentes líneas evolutivas a lo largo de los siglos XIV y XV. La iconografía conservada nos presenta en su mayor parte los grandes barcos mercantes de la época (naos y cocas), en segundo lugar, y en un porcentaje menor, nos aparecen barcas de pesca, en este caso en relación con pasajes de Jesús y los apóstoles-pescadores Pedro y Andrés en el lago Tiberiades, mientras que otros tipos de embarcaciones como las galeras o el gran repertorio de embarcaciones de porte medio y bajo dedicados al comercio están infrarrepresentados, de hecho están prácticamente ausentes del todo en la iconografía. Su evolución debe seguirse en la documentación escrita, en donde observamos por un lado la introducción del timón de codaste en las galeras, pero cohabitando con el uso del doble timón lateral, y en relación al aparejo, se mantiene la vela latina, aunque en las grandes galeras de comercio, especialmente las que iban a Flandes, se utilizaron como segundo juego de velas, los *treus* o velas cuadras. En cuanto a las embarcaciones de porte medio, la documentación de archivo nos aporta una gran diversidad de tipos y procesos evolutivos, si bien hay tipos propiamente mediterráneos, la introducción del timón de codaste se impone durante la segunda mitad del siglo XIV, aunque coexiste con el uso de los dos timones, como en la galera –utilizando uno u otro según el estado de la mar o el tipo de maniobra–, y aún algunas embarcaciones con el doble timón lateral. En cuanto al aparejo, la vela cuadra parece que no tiene tanta presencia, en los tipos mediterráneos se sigue utilizando la vela latina, mientras que en los tipos navales que llegan del Atlántico y se utilizan en el Mediterráneo, estos van aparejados a vela cuadra.

Aparte de las imágenes que nos muestran naos y cocas, hay otras obras que nos permiten observar el interior del casco. En este caso se trata de obras relacionadas con embarcaciones menores sin puente, como pueden ser las embarcaciones auxiliares de naos y galeras o bien barcas de pesca. Tal como se representaron estas barcas podemos llegar a ver su interior, con unas cuadernas divididas en varengas y genoles, empalmadas lateralmente, dispuestas a intervalos regulares, con el forro clavado a las cuadernas y colocado este a tope.

Probablemente el mejor objeto que nos permite conocer cómo era una nao o una coca de principios del siglo XV, y en concreto su principio constructivo, es el modelo de Mataró, conservado en el Maritiem Museum de Rotterdam. Un modelo en miniatura de un barco mercante construido seguramente por un carpintero de ribera, tal como si construyese un barco de verdad. En este podemos apreciar claramente, y en el exterior del casco, cómo las tracas del forro están dispuestas a tope, cómo están clavadas por clavos de hierro, que siguen la verticalidad de los brazos de las cuadernas, y el intervalo regular en el que están colocadas las cuadernas. Por las escotillas se puede observar cómo el interior está formado por la sobrequilla y otras piezas longitudinales y todo el conjunto de cuadernas, pero la gran cantidad de brea existente imposibilita el estudio detallado de esta parte del casco (Winter, 1956; Meer, 2004: 573-579).

La documentación arqueológica

La arqueología sigue siendo la disciplina que mejor permite conocer el principio constructivo utilizado y sobre todo el proceso de construcción. A partir del siglo XI, con el pecio de *Serçe Liman* (Turquía), se asegura que el único principio constructivo existente en el Mediterráneo es el de esqueleto y con las tracas del forro colocadas a tope (Pomey/Kahanov/Rieth, 2012: 235-314). Estas dos características son las que marcan la labor y la importancia del carpintero de ribera y del calafate. El primero determina la forma de las principales piezas de la armazón (roda, codaste y cuadernas) o esqueleto del casco, y el segundo es el especialista imprescindible en la impermeabilización del forro al ser colocadas sus tablas a tope.

La determinación de la forma de las principales piezas de la estructura del casco ha sido estudiada a partir de diferentes manuales o recetarios de construcción venecianos de los siglos XV y XVI, destacando a Mauro Bondioli (1996: 139-156; 2003: 10-13; 2007b: 92-98) como el principal investigador, y en cuanto a los pecios, estos se limitan a *Culip VI*, en Cataluña, de finales del siglo XIII, estudiado por Eric Rieth (1998: 137-190; 2005: 9-16) y la revisión y estudio de los pecios situados en un contexto veneciano, como el *Contarina I* (Bonino, 1978: 9-28), la galera de *San Marco in Boccalama*, y la fusta de Lazise de los siglos XIV al XVI, por parte del ya mencionado Bondioli (2007a: 82-84; Beltrame/Bondioli, 2006: 89-94). Sabemos bastante bien cómo el carpintero de ribera creaba y usaba el gálipo maestro para dar forma a la varenga maestra y cómo utilizaba diagramas de reducción para determinar cómo aplicar a las cuadernas las grandes diferencias que se observan entre la cuaderna maestra y las cuadras, como son el acortamiento del plan y la pérdida de horizontalidad (llamada también puja o astilla). El resultado de los diagramas utilizados –como la media luna o el triángulo– se pasaba al gálipo maestro (el acortamiento del plan) y a una tablilla de madera (la pérdida de horizontalidad). El carpintero de ribera decidía cómo aplicar estas dos reducciones a las cuadernas comprendidas entre la maestra y las cuadras de proa y de popa, jugando con el gálipo maestro, la tablilla de la puja y una regla, trazando la forma de la cuaderna con un tinte rojo llamado almagre.

Pero la determinación de la forma de las cuadernas nos indica el principio constructivo utilizado y parte del proceso de construcción, no todo el proceso. Tampoco se puede saber si una vez hechas las cuadernas en el astillero, se colocaron todas a la vez sobre la quilla, o si fueron puestas por grupos o alternadas, si bien la lógica supone que la maestra y las cuadras serían las primeras en ser montadas sobre la quilla.

El estudio de los detalles nos permite conocer mejor cómo fue el proceso de construcción, cómo eran las diferentes piezas de la estructura, la relación entre ellas, las juntas o empalmes y los elementos de fijación, y con suerte llegar a encontrar las huellas de la utilización de elementos propios del proceso de construcción pero que no se hallan en el casco construido. Recordemos que existían toda una serie de piezas de madera que no aparecen en el casco del

barco que navega, pero que fueron utilizadas durante su construcción, como los tacos del picadero, los puntales de sostenimiento del casco, los andamios y escaleras, las cabrias para manejar grandes piezas pesadas, los vasos y los maderos de la grada para facilitar la botadura, y sobre todo las vágaras o varillas de madera que se clavaban longitudinalmente en el exterior del casco para comprobar que el conjunto de las cuadernas tenía la forma adecuada (para ser desclavadas posteriormente y proceder al forrado del casco). Las vágaras son unas piezas que solo se utilizan durante el proceso de construcción pero que pueden dejar su presencia en el casco de un barco en forma de agujero por los clavos que se utilizaron para fijarlas a las cuadernas.

Culip VI (Cadaqués, Cataluña)

Es el pecio de una embarcación que realizaba un trayecto desde la costa del norte de África o la costa andalusí, hacia el Rosellón o el Languedoc, pasando por Mallorca. Iba cargado de cerámica andalusí (vajilla de mesa y contenedores de tipo medio y grande) y frutos secos, y un conjunto de vajilla perteneciente a la tripulación, la cual había sido producida en Cataluña y el Languedoc, y daba una datación de finales del siglo XIII. Según los restos conservados del casco, el barco era de porte medio, de unos 18-20 m de eslora, la presencia de puntales en la sobrequilla indicaba que tuvo puente, y las dos carlingas que aparejó dos mástiles a vela latina. Un barco que debía corresponder a lo que se llamaba un *lley gros cobert* (Nieto/ Raurich, 1998).



Figura 1. Mapa de situación de los pecios *Culip VI* y *Les Sorres X* (Cataluña) y la Corona de Aragón, siglos XIV-XV (Marcel Pujol i Hamelink / www.d-maps.com: Mediterráneo Occidental).

Este pecio se ha convertido en un hito histórico de la construcción naval, en el que si *Serçe Liman* (Turquía), del siglo XI, es el primer pecio y paradigma del momento a partir del cual se impuso el principio constructivo de esqueleto, *Culip VI*, de finales del siglo XIII, ha sido el primero en el que el proceso de determinar la forma de las cuadernas a partir de la utilización del gálibo maestro es un hecho.

Entre los siglos XI y XIII, se produjo una simplificación del mecanismo que regulaba el proceso de construcción. Los carpinteros de ribera concentraron toda la información requerida para determinar las formas de las cuadernas en un solo gálibo. De esta manera eliminaron el uso de diferentes gálibos y disminuyeron el protagonismo dado a las cintas y a las vâgaras en la determinación de las formas de las cuadernas. El gálibo maestro se trata de la plantilla que da forma a la cuaderna maestra, o mejor dicho a media varenga maestra, la cual y por simetría da la forma a toda la varenga, y en muchos casos sirve también para los dos genoles maestros. Además, las diversas reducciones que reciben las cuadernas a medida que se alejan de la cuaderna maestra y se aproximan a los extremos de proa y de popa (como la disminución del plan y de la manga, y la astilla o puja) se transportan al gálibo maestro. La obtención de estas reducciones se consiguió a través de diferentes diagramas, como el triángulo y la media-luna, tal como quedan reflejados en diferentes documentos venecianos del siglo XV, pero que debían ser de uso corriente ya en los siglos XII y XIII. Las reducciones del plan se trasladaban al gálibo maestro y las de la astilla (o puja) a una tablilla. El uso del gálibo maestro, la tablilla de astilla y una regla permitía a los carpinteros de ribera dar forma a prácticamente todas las cuadernas del casco. Estas, compuestas de varengas y genoles, se hacían en el suelo, aplicando los tres instrumentos sobre la pieza de madera, marcando la forma con almagre y trazando tres líneas que correspondían, la primera al eje de simetría (o parte de la varenga que se sentaría sobre la quilla) y las otras dos a cada extremo del plan de la varenga (marcando el punto de «escoa» o inicio del pantoque). La forma de la pieza podía ser pintada con el almagre, mientras que las tres líneas podían ser grabadas con un punzón. La gran cantidad de cuadernas que se iban produciendo obligaba además a tener controlado el orden y posición que tendrían al montarlas encima de la quilla, esto hizo necesario, tal y como se ha demostrado en el pecio *Culip VI*, marcarlas con números, empezando lógicamente por la cuaderna maestra con el I, y así sucesivamente hacia proa y popa (II, III, IIII, V, VI...). Las marcas numerales también fueron hechas con un punzón, dado que una vez hechas las varengas, la construcción de la cuaderna entera no era inmediata, y aún se podía tardar más días en colocar las cuadernas enteras sobre la quilla. Este es el motivo por el cual se marcaba con un punzón para señalar la posición de la cuaderna sobre la quilla, el final del plan y el número de la posición asignada a cada cuaderna.

Las varengas y genoles se empalmaron lateralmente con una junta a rayo de Júpiter y fueron clavadas con dos largos clavos de varenga a genol y de genol a varenga, creando la cuaderna. Una vez producidas todas las cuadernas, se procedió a montarlas sobre la quilla, roda y codaste. A partir de esta fase aparecen toda una serie de piezas que van ganando cada vez más importancia, dan más cohesión a la estructura, y a la vez permiten reducir el grosor de las cuadernas y obtener un casco más ligero. Se trata de todas las piezas longitudinales, tanto interiores como exteriores. En primer lugar la sobrequilla que se encajará sobre las varengas y se fija mediante pernos de hierro o madera a la quilla, por norma a través de las claras para no perjudicar las varengas, por no tener estas suficiente grueso. A ambos lados se colocaron las tablas de «escoa», las cuales podían tener el mismo grosor que las tablas del forro, pero estaban endentadas y encajadas a las cuadernas, y además podían estar hechas de otro tipo de madera. Su principal función no era el revestimiento del casco, sino mantener las cuadernas en su posición, que tuviesen la separación o clara requerida y en cierto modo también actuaban de vâgaras. Además, se colocaba uno o dos palmejares por el interior, también endentados y encajados a las cuadernas, siguiendo el final del plan de todas las cuadernas, y fijándose uno de los dos palmejares mediante pernos de hierro o madera a las tablas de «escoa», a través de las claras. El importante

rol dado anteriormente a la cinta en la cohesión de la estructura se va trasladando a los diferentes elementos longitudinales, como la tabla de «escoa», pero también a los interiores, como al palmejar, durmiente y trancanil. Este hecho se constata claramente en el pecio *Culip VI*, pero también en el ámbito veneciano, en los pecios de la nave de *Contarina I* y la galera de *San Marco in Boccalama*, ambos del siglo xiv, y en los recetarios navales del Arsenal de Venecia del siglo xv (Beltrame/Bondioli, 2006: 89-94). Toda pieza longitudinal exterior tiene su correspondiente interior a la cual se une mediante pernos (quilla-sobrequilla, «escoa»-palmejar, cinta-durmiente). Este conjunto de piezas permiten dar una mayor cohesión al conjunto de la estructura y reducir el grosor de todas las piezas de madera del casco, obteniéndose así un barco más fuerte y ligero.

Les Sorres X (Castelldefels, Cataluña): mismo principio, variante en el proceso de construcción

El pecio de *Les Sorres X* es una barca de comercio de cabotaje, de unos 9-10 m de eslora, que se hundió en una marisma del delta del río Llobregat, al sur de Barcelona. Iba cargada con jarras cerámicas que contenían pescado en conserva, las cuales dataron el pecio a finales del siglo xiv.

El casco presentaba una carlinga monóxila colocada encima de la sobrequilla, a cierta distancia por delante de la varenga maestra, la cual, y además por su cronología, nos indica que aparejaría un solo mástil a vela latina. Además, apareció otro elemento sumamente interesante, la presencia en popa de elementos pertenecientes al timón de codaste. Se trata de un codaste



Figura 2. Vista del casco sin cuadernas, con la popa al fondo. Se puede apreciar la «tabla de quilla» en el centro y los carenotes endentados a ambos lados (Albert Martín i Menéndez).

curvado, típico de las embarcaciones mediterráneas, en el que el timón se fija al codaste mediante dos agujas, una corta situada en la parte alta del timón y otra larga situada en la parte baja del codaste. La aguja larga con los elementos metálicos de fijación al codaste son los que aparecieron en el yacimiento, en su posición original, aún clavada al codaste.

La cronología dada por el cargamento cerámico al yacimiento sitúa el pecio como el más antiguo del Mediterráneo en disponer de roda de codaste. Se trata de una excepción arqueológica, más bien por ausencia de pecios de dicha época, pero documentalmente no, dado que la documentación de archivo nos indica que el timón de codaste ya era de uso habitual en las embarcaciones menores a partir de la segunda mitad del siglo XIV (Pujol, 1992: 29-48).

El conjunto del casco estaba bastante bien conservado, apareciendo un total de cuarenta cuadernas, de las que se conservaban totalmente las de la mitad de popa. Identificamos la cuaderna maestra doble (Q31 y Q32) por el cambio de sentido de empalme de los genoles a la varenga; a partir de esta hasta el codaste había 23 cuadernas, mientras que en la mitad de proa, eran 15 cuadernas que llegaban hasta la base de la roda (Q47), perdiéndose el resto porque la proa de la embarcación había desaparecido. En las varengas aparecieron marcas trazadas por el carpintero de ribera que indicaban el uso del método del gálbo maestro para determinar la forma de las cuadernas, siendo estas marcas de dos tipos, la central y las laterales o de «escoa», igual que las que presentaba el pecio *Culip VI*, pero en *Les Sorres X* ninguna varenga presentaba marca numeral.

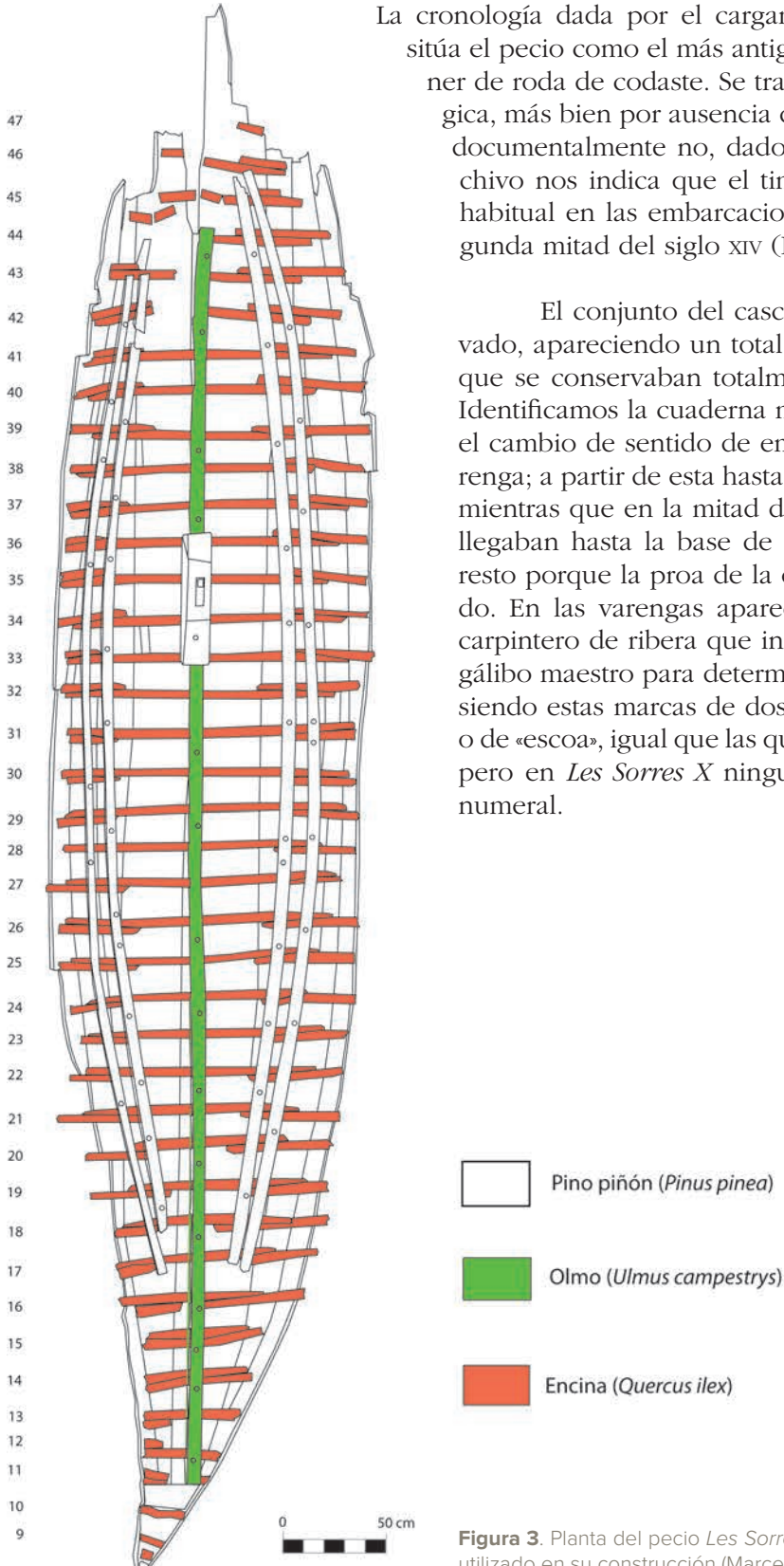


Figura 3. Planta del pecio *Les Sorres X*, con indicación del tipo de madera utilizada en su construcción (Marcel Pujol i Hamelink).

Si todos estos detalles forman parte del sistema de propulsión (la carlinga), de dirección (el timón de codaste) y de la concepción y determinación de las formas de las cuadernas (las marcas), encontramos una serie de detalles que podemos considerar como atípicos. La quilla –o mejor dicho el conjunto de piezas que forman la quilla– se trata de un caso singular desde el punto de vista constructivo.

En prácticamente todos los barcos, la espina dorsal o columna vertebral del casco es la quilla. De hecho cumple una serie de funciones, la primera y más importante, ser la pieza base de la construcción, la segunda recibir la traca de aparadura, la tercera ser pieza de ligazón esencial de la estructura, la cuarta sirve para resistir o recibir los golpes que da el casco contra el fondo, y por último, evita la deriva lateral producida por la corriente y la fuerza del viento.

La quilla del pecio es una pieza extraordinaria y totalmente atípica. El motivo es que estaba compuesta de dos piezas, una primera que llamamos «tabla de quilla» y la segunda «quilla», pero las dos formaban en su conjunto la quilla.

La «tabla de quilla» tiene el mismo grueso que las tracas del forro (2 cm), es la base de la construcción, sobre ella se sientan las cuadernas y a ella se fijan mediante clavos de hierro, y recibe además a las tracas de aparadura.

Mientras que la pieza inferior o «quilla» sobresale del casco y cumple con todas las otras funciones que se asignan a una quilla: ser pieza de ligazón esencial por unir todo el conjunto, «quilla», «tabla de quilla» y sobrequilla, mediante cavillas de madera; recibe los golpes del casco contra el fondo o el rozamiento al botar y varar; y evita la deriva lateral.

La «tabla de quilla» es realmente como una tabla del forro, sobre la cual se colocaron y fijaron las cuadernas. Posteriormente se puso por debajo la «quilla» y por encima la sobrequilla, uniéndose todo el conjunto con las cavillas. La «tabla de quilla» (6,50 m) tiene 15 cm de más en los extremos de proa y de popa que la «quilla» (6,20 m), permitiendo que se siente la «tabla de quilla» encima de la roda en el extremo de proa y sobre el codaste en el extremo de popa. La unión entre «quilla» y roda, y también con el codaste es una junta simple, pero el conjunto de «quilla» y «tabla de quilla» con la roda y el codaste lo convierte en una junta de media madera.

En este pecio las tablas de «escoa» son verdaderas quillas laterales o carenotes. Lo curioso es que si el carpintero de ribera utilizó este sistema de dos piezas para la quilla, no lo aplicó en los carenotes. Estos estaban situados a ambos lados de la quilla, y tenían como función evitar la deriva lateral cuando escora sobre un lado, además de amortiguar o reducir el balanceo y mantener el barco derecho cuando es varado en la playa. Los carenotes se fabricaron de una sola pieza y fueron colocados directamente contra las varengas, sin ninguna pieza intermedia como podría ser una tabla del forro, y por último fueron fijados con cavillas de madera a los palmejares.

Si la «tabla de quilla» es la base de la construcción, las cuadernas se montaron sobre esta. Las primeras que se colocaron fueron la cuaderna maestra, doble, formada por la Q31 y Q32, que se fijaron mediante un clavo de hierro, de la varenga a la «tabla de quilla», y una tercera cuaderna, la Q30, también de la misma forma. En cambio para todas las cuadernas de una mitad y otra, de la Q33 a Q43 (mitad de proa) y Q29 a Q13 (mitad de popa) se fijaron todas mediante un clavo de hierro, pero en este caso desde la «tabla de quilla» a las varengas. Las dos cuadernas restantes (la Q44 y la Q12), en los extremos de proa y de popa de la «tabla de quilla» respectivamente, no llevaban ningún sistema de fijación a la «tabla de quilla», no había ningún clavo de hierro que las fijara a esta. Estas dos cuadernas debían ser las cuadras, a no ser que fueran las inmediatamente anteriores Q43 y Q13. Las horcazas, o cuadernas situadas sobre el codaste se

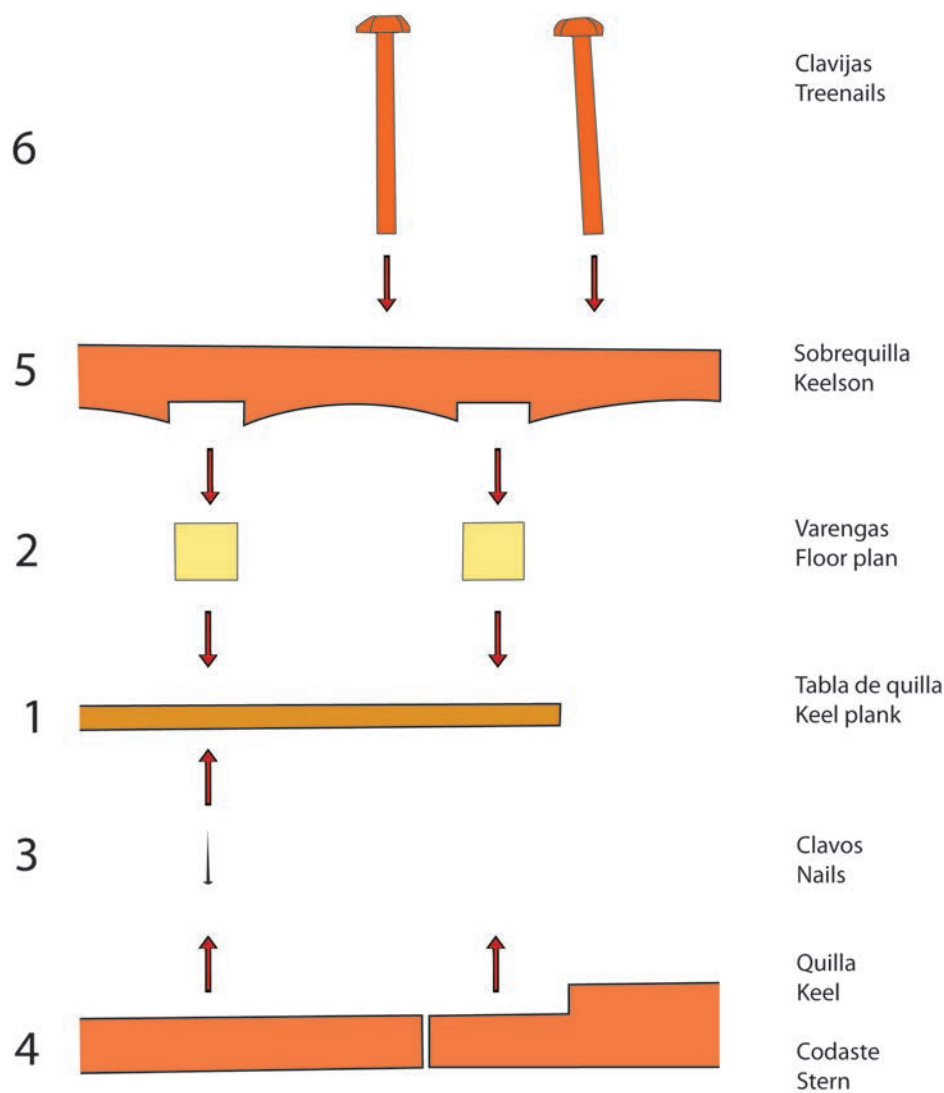


Figura 4. Sección longitudinal de la sobrequilla, cuadernas, «tabla de quilla», «quilla» y codaste (Marcel Pujol i Hamelink).

fijaron mediante uno o dos clavos de hierro, con una dirección en diagonal desde el interior del barco hacia el codaste.

Hipótesis sobre el proceso de construcción

Una primera hipótesis que planteamos sobre el proceso constructivo es que la «tabla de quilla» o base de la construcción estuvo siempre en contacto con el picadero hasta que se puso la «quilla», la roda y el codaste.

La primera pieza de la estructura fue la «tabla de quilla» que se puso directamente sobre el picadero. Seguidamente, sobre la «tabla de quilla» se montaron las cuadernas Q32, Q31 y Q30, fijándose mediante un clavo de hierro. Por norma se ponen las cuadras a la vez que la cuaderna maestra, por norma al extremo de la quilla, que en este caso tendría que corresponder a las que se encuentran en los extremos de la «tabla de quilla», las cuadernas Q44 y Q12. Dado que estas dos no fueron fijadas mediante clavo alguno, las cuadras tendrían que ser las inmediatamente

anteriores (Q43 y Q13). Una vez colocadas las maestras y las cuadras se procedió a montar todo el conjunto de cuadernas situadas entre la Q43-Q32 y Q30-Q13. Como prácticamente todas las cuadernas estaban clavadas a la «tabla de quilla» desde ella, esto obligaría a mover el conjunto, para poder clavarlas, debido a la presencia de los tacos del picadero. Una vez montadas todas las cuadernas encima de la «tabla de quilla», el carpintero de ribera tuvo que levantar el conjunto, para permitir poner debajo la «quilla» y en los extremos la roda y el codaste. Esta es la razón por la cual las cuadernas Q44 y Q12 no estaban clavadas, se tenía que dejarlas sin fijar en principio para poder empalmar y clavar la «tabla de quilla» a la roda y al codaste. Después se pusieron las dos cuadernas en su sitio, aunque incomprensiblemente no se clavaron, si bien quedarían sujetas por la sobrequilla.

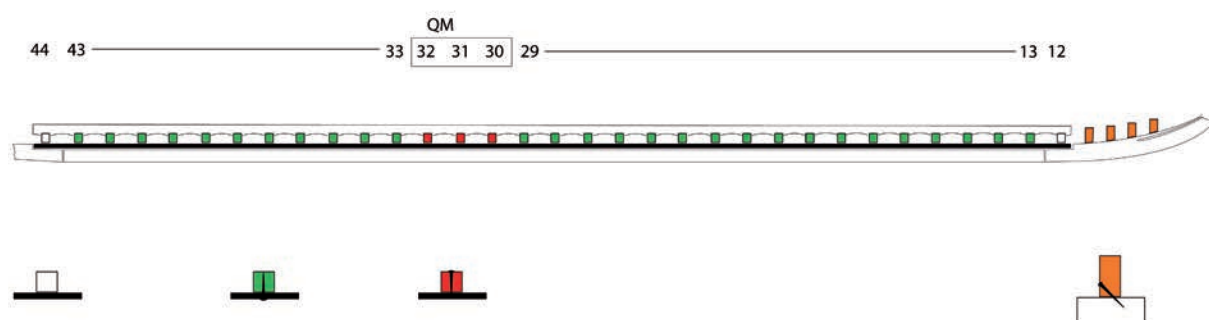


Figura 5. Sección longitudinal con los diferentes tipos de fijación de las cuadernas a la «tabla de quilla», roda y codaste (Marcel Pujol i Hamelink).

En el momento que se colocaron la roda y el codaste se procedió a montar los piques (u horcazas) clavados al codaste mediante dos clavos de hierro en diagonal y de la cuaderna hacia el codaste. Seguramente también se aseguró la posición de las horcazas colocando formas a ambos lados y a diferentes niveles. Parece que la primera horcaza colocada fue la de más a popa, las otras fueron colocadas sucesivamente hasta llegar al pie del codaste. Esta podría ser la razón por la que las cuadernas Q44 y Q12 fueron las últimas en sentarse y no fueron clavadas a la «tabla de quilla».

Todas las cuadernas quedaron fijadas por la sobrequilla, que endentada, las sujetaba y fijaba mediante un clavo a las cuadernas, además para reforzar el conjunto se pasó una cavilla de madera desde la sobrequilla, pasando por la clara, y atravesando la «tabla de quilla» y la «quilla».

Una suposición que tenemos es que se colocó el palmejar exterior de cada lado y se fijó a una forma externa mediante cavillas de madera. Una solución provisional, dado que acto seguido se pusieron los dos palmejares interiores (ligeramente más gruesos y sólidos que los exteriores) y los carenotes, fijándose entre ellos mediante cavillas de madera que pasaban por las claras. Es de suponer, aunque no tengamos pruebas arqueológicas que así lo demuestren, que también se pusieron las cintas y los durmientes y probablemente unidas con el mismo tipo de fijación.

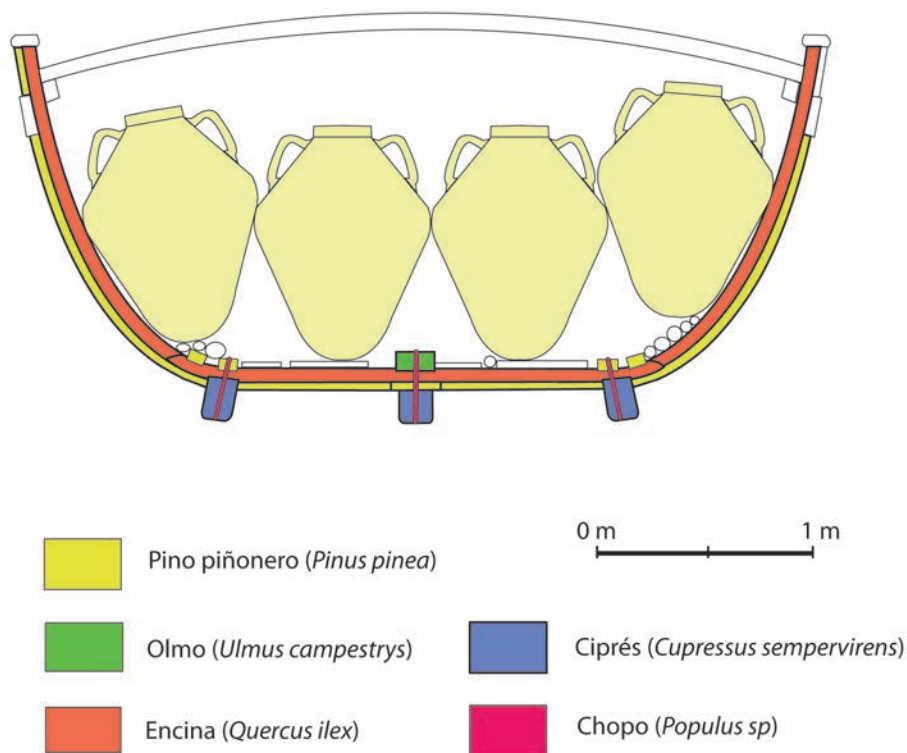


Figura 6. Sección transversal, con indicación del tipo de madera utilizado en su construcción (Marcel Pujol i Hamelink).

Al iniciar el forrado del casco, se cortaron las cavillas de los palmejares exteriores, se quitaron las formas y se fueron colocando todas la tracas del forro, entre la «tabla de quilla» y los carenotes, y de los carenotes a las cintas. De hecho el aspecto del proceso constructivo que nos plantea más dudas es la presencia de cavillas de madera cortadas en los dos palmejares exteriores. Estos elementos de fijación tuvieron la función de unir, aunque fuera provisionalmente a una tabla «de escoa» o a una vágara, o bien anteriormente habían sujetado los carenotes. Aunque el uso de cavillas de madera es razonable, debido a la distancia existente y al hecho de pasar a través de las claras.

Una segunda hipótesis sobre el proceso de construcción llevado a cabo por el carpintero de ribera que construyó el pecio *Les Sorres X* es la siguiente: la «tabla de quilla» se puso encima del picadero, se colocaron las cuadernas Q32, Q31 y Q30, y se fijaron mediante un clavo de hierro. Aquí empieza la diferencia respecto a la primera hipótesis planteada. El carpintero de ribera podría haber invertido el conjunto, poniéndolo cabeza abajo, soportando los extremos de la «tabla de quilla» con las cuadernas móviles Q44 y Q12. Posteriormente se fueron colocando debajo de la «tabla de quilla» el resto de cuadernas y se clavarón desde la «tabla de quilla» a las varengas. Se colocaron formas para fijar el intervalo o espacio dado a las claras y para comprobar que realmente la forma que cogía el conjunto de cuadernas era la correcta.

Seguidamente se volvió a invertir el conjunto, procediéndose a colocar la «quilla» y la sobrequilla, uniéndolas con clavijas de madera de sobrequilla a quilla, que pasaban por las claras y con clavos de hierro de la sobrequilla a las varengas. Al mismo tiempo o poco después se procedió a poner la roda, ajustándola a la «tabla de quilla» y lo mismo se hizo al codaste. Se colocaron las cuadernas de los extremos, las llamadas piques u horcazas. El resto del proceso fue tal como hemos expuesto para la primera, el montaje del resto de elementos longitudinales y la tablazón del forro.

Estas son nuestras dos hipótesis sobre el proceso de construcción de la barca de cabotaje de *Les Sorres X*, la cual por sus dimensiones y singularidad, aunque claramente pertenece a un barco construido según el principio de esqueleto y tiene el forro a tope, puede ser objeto de diferentes interpretaciones y sugerencias sobre variantes en su proceso de construcción. Si el principio de construcción de esqueleto es el utilizado por los carpinteros de ribera del Mediterráneo medieval, el proceso constructivo puede mostrar variantes, que pueden existir debido a diferentes razones, como la costumbre local, el tamaño y porte de la embarcación, el peso del armazón, la disponibilidad de materia prima, entre otras causas.

En conclusión

El uso del principio de construcción de esqueleto y el forro a tope en la construcción naval catalana del periodo bajomedieval queda confirmado por la aportación de diferentes fuentes de información. La documentación de archivo nos informa de las fases del proceso de construcción, implícitas al principio constructivo (*seure, enramar, cinglar y cloure*), y el forro a tope por el importante papel dado al calafateado, y en el que el maestro mayor calafate cobra igual que el carpintero de ribera mayor, aunque este sea el verdadero director de la obra. Además la presencia de la fiesta del *romball* viene dada por la colocación de la última pieza que rellena un hueco del forro, de hecho inexistente en la construcción de casco previo en el que las tracas se ponen por hiladas, sujetas entre ellas sin la posibilidad de dejar huecos en el forro. La iconografía nos muestra el esqueleto de cuadernas formadas por varenga y genoles, ensamblados y clavados lateralmente, en las obras que nos permiten observar el interior, como las barcas de pesca o el modelo de Mataró, o bien, desde el exterior se pueden apreciar las líneas de clavos que clavan las tablas del forro, formando una serie de líneas verticales que resiguen a cada cuaderna.

La documentación arqueológica permite entender mejor el principio utilizado y cómo los carpinteros de ribera en el siglo XIII ya utilizaban diagramas de reducción y utilizaban el método del gálibo maestro para determinar la forma de las cuadernas. Aunque el principio de construcción queda confirmado por todas las fuentes de información como de uso corriente y exclusivo por parte de los astilleros y atarazanas catalanas, no parece que el proceso de construcción fuera el mismo. El pecio *Culip VI* sigue la norma estándar, el proceso constructivo no difiere del que conocemos en otras partes del Mediterráneo, como nos muestran los pecios del área veneciana. Pero sin embargo, el pecio *Les Sorres X*, de finales del siglo XIV, tiene una quilla atípica, formada por dos piezas que condicionan el proceso constructivo, alterando en cierta manera lo que tendría que ser habitual. Por otro lado, este pecio reafirma el uso del gálibo maestro para determinar la forma de las cuadernas, subraya el importante papel dado a los elementos longitudinales que permiten conseguir un casco ligero y sólido a la vez, presenta la convivencia de dos tipos de elementos de fijación (cavillas de madera y clavos de hierro), y destaca además por la excepcionalidad de disponer de carenotes y timón de codaste.

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The Doel Ships: Research aims, approaches in methodology

Los barcos de Doel: objetivos de investigación, enfoques en metodología

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Abstract: Two shipwrecks found during harbour works in Doel near Antwerp, were for centuries captured below the water table under a thick layer of sediment. Both ships, Doel 1, a nearly complete hull of a cog discovered in 2000 and Doel 2, a partially preserved wreck of the same ship type, discovered in 2002, were excavated, dismantled and stored awaiting further investigation. At that stage, the project was interrupted and the wooden remains stayed for almost a decade untouched in containers filled with water. At the end of 2009, a research and conservation project was launched. To disclose the scientific potential of these particular ships, thorough research with a multidisciplinary approach was necessary to obtain as much information as possible. As no cargo was found in and around the ships, research was focussed on the ship's archaeological study combined with multiples analysis of the shipbuilding materials.

Key words: Ship archaeology, 14th century AD, cog, methodology.

Resumen: durante las obras portuarias en Doel, cerca de Amberes, se encontraron dos pecios que estuvieron siglos debajo del nivel freático bajo una gruesa capa de sedimento. En el 2000 fue descubierto Doel 1, un casco casi completo de una coca y en 2002 Doel 2, una embarcación similar parcialmente conservada. Ambas naves fueron excavadas, desmontadas y almacenadas a la espera de una futura investigación. En esa etapa, el proyecto fue interrumpido y los restos de madera se mantuvieron sin tocar en recipientes llenos de agua casi una década. A finales de 2009, se puso en marcha un proyecto de investigación y conservación. Para divulgar el potencial científico de estas embarcaciones y obtener la mayor información posible, fue necesaria una rigurosa investigación multidisciplinar. Como no se encontró ningún cargamento en los barcos ni alrededor, la investigación se centró en el estudio arqueológico del barco combinado con múltiples análisis de los materiales de construcción naval.

Palabras clave: arqueología naval, siglo XIV, coca, metodología.

Introduction

In Belgium, the harbour of Antwerp and the adjacent region is a most interesting area, where ships have been sailing since time immemorial. The commercial activity in the ports of Bruges, Ghent and Antwerp in the late middle ages, was more than considerable. This region was geographically very well situated for maritime transport and its success was internationally renowned. It was the reason why several economic stakeholders in late medieval society were represented in these cities. Official cantors of the German Hanseatic League opened first in Bruges and later after the decline of its harbour, also in Antwerp.

Today, the port of Antwerp is still the second biggest of Europe and one of the most dynamic ports in the world. As maritime trade grows bigger and bigger new infrastructural works are made on land, at the waterfront, and on sea. This activity increases the potential of new and major archaeological finds reflecting this long and rich history.

Two shipwrecks discovered during harbour works in Doel near Antwerp, were for centuries captured below the water table, upside down and under a thick layer of sediment and for that reason well preserved, apart from the damage caused by the bucket of an excavator (Van Hove, 2005: 50-69).

The discovery of a medieval ship is rare. Wood was for millennia the most suitable material for ship building – but as it is very vulnerable to all kinds of threats, archaeological wooden ships seldom emerge from the soil so well preserved.

Because of the rareness of this kind of finds, society is obliged to deal most carefully with this highly valued maritime heritage and the archaeological information that belongs to it.



Both ships, Doel 1 (Fig. 1), a nearly complete hull of a cog discovered in 2000 and Doel 2 (Fig. 2), a partially preserved wreck of the same ship type, discovered in 2002, were excavated, dismantled and stored awaiting further investigation. At that stage, despite of the considerable effort of the regional archaeological Service Waasland (ADW) to do the excavation and disassembling (Van Roeyen, 2004), despite several ideas and proposals on the continuation of this unique project had been formulated, the project was interrupted and the wooden remains stayed for almost a decade untouched in containers filled with water (Van Hove, 2005: 50-69; Maarleveld/Guérrin/Egger, 2013: 161) (Fig. 3).

Figure 1. Doel 1, an upside down cog like vessel dated to AD 1325-1326 was found in 2000. © Gemeentelijk Havenbedrijf Antwerpen.



Figure 2. Doel 2: the bottom part of a cog like vessel, dated to AD 1328 found in 2002 © Archeologische Dienst Waasland.



Figure 3. The ship remains stored in containers filled with water on a desolate spot in the harbour. ©Kris Vandevorst On-roerend Erfgoed.

Finally, at the end of 2009, Flanders Heritage agency was asked to take over the remains and to develop a research and conservation project. Being conscious of the urgency –because of the worsening condition of the wood– and the scientific potential of these particular ships, It was necessary to respond quickly to this opportunity.

Organising a complex large-scale multi-year investigation is not easy. In this article a short overview of the research aims, the approach and the methodology is given.

Research aims

As infrastructural works have more impact on the environment and will probably lead to more exceptional finds, like the Doel ships, it is essential to maximize the research on this rescued heritage (Hocker, 2004: 1-11).

Translated into this project, the main concern was of course the collection of evidence, which means the analysis of every bit of material, placed within the broader context of the maritime landscape in which both ships have sailed.

Observations

The ship type that we call «cogs» is commonly known.

Among 30 ships of this type –or more precisely– mostly fragments of this ship type have been found and studied so far (Vermeersch/Haneca, 2015: 127). The general features of cogs are already known, nonetheless it is still necessary to confirm previous observations and to look for regional or time-bound differences between ships to see if certain evolutions, tendencies or influences can be detected (Grille, 2002).

We did not expect that this project would add much information to the list of general features of cogs. Was further research necessary or even appropriate, given the considerable cost?

Would it be possible to know more about specific characteristics. Is it perhaps possible to recognize the individual choices of the people who built these ships or those who commissioned them? Is it possible to know more about the life of these ships, about the people who sailed them? Is it possible to get a glimpse of the world where it was, sailing through the remains that were left? (Flatman, 2009).

Medieval shipbuilders purchased their ship building material from local producers or through international trade. After a ship is built, it sails from harbour to harbour and needs constant maintenance and restoration. Research of shipbuilding material like wood, pollen and macro remains allows us to determine age and/or provenance. Revealing places of origin from different materials, used for building and repairing ships would give a better insight in the late medieval world of shipbuilders and their suppliers as well in the ancient shipping routes.

To have a better understanding of these ships and the maritime landscape connected with these ships the appropriate data are required.

When it is known what data to collect, what should be the frequency and accuracy of data collecting necessary when performing a thorough research? Is it necessary to study every

millimetre of the ship, to take samples of every bit of material, to collect dendrochronological evidence for each piece of wood?

Is it possible working with a *pars pro toto*- approach? Are a small number of samples even effective to obtain good results as a fully documented research with a large selection of samples?

Is it possible to have a conclusive proof by analysing a random chosen sample or is it more appropriate to make a choice inspired by an interdisciplinary approach?

Can a separate part of a research programme stand on its own or are crossovers between different sections necessary to obtain results.

The research team knew that there must be correlations and focussed on them.

Project management

For managing such a project, it is indispensable to have a strong project plan: The Doel Ships Project integrated guidelines and practices (Jones, 2010) from different projects and research units as well as the recommendations of Peter Fix of Texas A&M.

These recommendations were made in a preliminary report that we commissioned as a possible basis for the possible project, made in 2007-2008. The draft of this methodology, made in the winter of 2009-2010 was helpful to determine a well-defined series of methods and techniques that were useful to reach the research goals. Other research programs that inspired the Doel Ships Project: La Belle, Austin, Texas, USA; The Newport Ship, Newport, Wales; The Viking Ship Museum, Roskilde, Denmark; Barcode Ships Project, Oslo; Deutsches Schiffahrtsmuseum, Bremerhaven, Germany; l'épave de la Canche, Beutin, France; Rijksdienst voor het Cultureel Erfgoed, Lelystad, Netherlands; INA Bodrum, Turkey). Each step of what can be considered as wood processing was part of an algorithm and was analysed carefully to ensure compatibility between each step and the project goals (Fix/Hamilton, 2008: 36-37).

The process scheme gives an indication of the complex sequence of actions that needs to be strictly followed to collect equivalent and accurate data. This includes basic logistical solutions as well as the most appropriate science such as for instance 3D measurements, all adapted to the project's needs.

The Doel Ships Project had a considerable advantage: As no cargo was found in and around the ships, research was focussed on the ship's construction combined with multiple analysis of the shipbuilding materials. Objects additionally found in context are sometimes drawing the attention away from the primary evidence which is the construction material.

For studying ship archaeology one of the basic instruments in this methodology was the use of what project members called the «FRAUG method» (Fig. 4).

FRAUG is an abbreviation of Faro Rhinoceros Archaeological Users Group and unites a group of people using digital recording of archaeological timbers. It is based on the use of a measuring device and Rhinoceros software. The technique was first introduced and elaborated by F. Hocker for the study of the Kolding Kogge (2000). Since then it was used in several maritime archaeological research projects and additional applications were developed. The Doel Ships Project used two FARO Fusion arms of 3.7 m and 2.4 m.



Figure 4. The Doel Ships research laboratory. With FRAUG techniques and Faro measuring equipment, more than 900 pieces of timber were analysed. ©Kris Vandevorst Onroerend Erfgoed.

Not by scanning, but by measuring each part of the ship in three dimensions, the investigator is forced to look very attentively, millimetre by millimetre, at each of the features that can be discovered. Each feature becomes a layer on the 3D drawing. The layer structure of the software programme is used as a checklist which improves the quality and accuracy of the data. While measuring the investigator is able to interpret the traces.

The result of Faro measuring is a 3D drawing on which points and lines can be noticed in different colours, each colour representing a layer.

Starting from the drawing, a perfectly shaped model of each timber can be made, which can be printed. For Doel 1 prints were made by laser sintering on scale 1 to 10. The knowledge of the Belgian partner, one of the world leaders in 3D printing technology was helpful to optimize the printing process. By inking and painting the polyamide models they get a more adapted behaviour (better texture and stiffness) to be placed in the scale model.

Finally, the result of this process is not only a ship model, it is exactly the same ship (on a scale of 1 to 10), as the one that was sailing almost 700 years ago. All timbers fastened to each other, joining corresponding treenail holes and nail holes, as well as joining smoothly all frames and planks and all joggles are well fitted on the strakes (Fig. 5).



Figure 5. The construction of the scale model of Doel 1 is not yet finished. All pieces of timbers could be joined in the same way as it was in the 14th century. ©Kris Vandevorst Onroerend Erfgoed.

After scanning the whole model, it will be possible to create a virtual replica that can be used for shipbuilding analysis, for calculating for instance the load and sail capacity, possible speed and drift of this medieval vessel without building an oak wood 1 to 1 replica.

This way of working also leads to very detailed information that can be combined with other studies on samples and dendrochronology.

If a repair plank is inserted in the hull structure, the study will focus on the construction, the caulking and dendrochronology in that specific area and make the comparison with other elements.

Another basic instrument is the high frequency of analysis, taken for scientific research (Fig. 6). After interdisciplinary consultation a large quantity of samples was selected for further analysis of tree ring series, of mosses and other macro remains, and also pollen (Haneca/Daly, 2014: 87-102; Deforce *et alii*, 2014: 299-314).

Additionally, samples of tar were examined at the British Museum by Pauline Burger (Burger, 2012).

Also, in addition to this research and at the same time a thorough condition assessment of the wood was made to develop and execute a conservation programme.



Figure 6. The large scale and accuracy of material assessment was one of the strengths of the project. Collecting a large amount of data in a multidisciplinary way and trying to put it in a broader context was rewarding. ©Kris Vandevorst Onroerend Erfgoed.

Results

It was possible to retrieve more information about the ships and the broader context of our ships. The Doel Ships' Project did get a glimpse of the late medieval world.

Collecting a large amount of data in a multidisciplinary way and trying to put it in a broader context was indeed rewarding. It is possible to trace at a certain level the ancient ship routes and to know more about the organisation of the late medieval world of ships, shipbuilders and their suppliers. The FRAUG method was useful in revealing the medieval ship building and made it possible to rebuild the original ship with modern techniques. It was even possible to experience at a certain level the actions of the medieval shipbuilders.

More detailed information about the results of the researches is available in several publications (Haneca/Daly, 2014; Vermeersch/Haneca, 2015; Deforce *et alii*, 2014).

Publications about the ongoing conservation of the Doel ships will be provided in a later stage.

From forgotten medieval shipwreck to trending tweep

Apart from the scientific research, the Doel Ships Project was also a laboratory for communicational and educational activities. The Doel ships became living objects using social media (Jacobs, 2014: 6).

Conclusions

The most important input of the Doel Ships Project in best practices for this kind of research was the interdisciplinary character of the study, the large scale and accuracy of material assessment and the simultaneous approach of all actions.

The methodology and project management made it possible to obtain the required results within a limited time-frame.

The project plan and methodology helped us to ensure that each step of the process was carefully thought-out. The quality of the research group has led to excellent results. The collected data were equivalent, accurate and useful for their purpose. The samples and data are available for re-examining and for additional research.

This history of this project is not a showcase of how society should deal with heritage, despite the efforts made by each of the archaeologists initially involved and the research performed by the Doel Ships Project.

If important and necessary infrastructural works intervene, there should be an executable plan and sufficient funding. This would prevent the loss of unique sources of information.

Was the delay of 10 years between dismantling and research detrimental for the study? On the one hand, due to the delay, information was lost because of the worsening condition of the wood. However, on the other hand the project could benefit from the creation of new technology and the evolution of the sciences that were used. This proves that conservation *in situ* –if it is possible– is better in the longer term.

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Nuevas embarcaciones a tingladillo en la ría de Gernika (Bizkaia)

New Clinker boats in the estuary of Gernika (Biscay)

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Resumen: a lo largo de los dos últimos años, en la desembocadura de la ría de Gernika han ido apareciendo diversos restos de madera en posición secundaria e inconexas, en los periodos de bajamar. Estos restos, que se identifican con fragmentos de tablas y cuadernas, corresponden inequívocamente a una o varias embarcaciones construidas a tingladillo, sistema de construcción típico medieval de esta zona geográfica.

Palabras clave: *Laida*, medieval, pecio, tingladillo, Txatxarramendi.

Abstract: Over the past two years, at the mouth of the estuary of Gernika various remains of wood have appeared in secondary position and disjointed, during periods of low tide. These remains, identified as fragments of tables and frames, correspond unambiguously to one or more clinker-built vessels, of typical medieval construction system in this geographical area.

Key words: *Laida*, mediaeval, shipwreck, clinker-built, Txatxarramendi.

Introducción

Durante los dos últimos años ha tenido lugar el hallazgo de diversos restos de madera en el tramo final de la ría de Gernika, concretamente en el entorno de la isla de Txatxarramendi. Estos fragmentos han ido apareciendo de forma aislada, concentrados en un área bastante limitada, y corresponden a tablas y cuadernas que, por sus características, hemos identificado como pertenecientes a embarcaciones construidas a casco previo y a tingladillo.

En las siguientes páginas presentaremos las descripciones y características de los restos, para seguidamente realizar una valoración histórica de los mismos, todo ello de forma muy concisa debido a las limitaciones de espacio que imponen estas páginas.

Hallazgo y ubicación de los restos

En el verano de 2012, mientras realizábamos inspecciones de control de los pecios *Laida I* y *Laida II* en los periodos de bajamar a instancias del Departamento de Cultura de la Diputación Foral de Bizkaia, comenzamos a detectar que en los alrededores marinos de la cercana isla de Txatxarramendi aparecían maderas sueltas, algunas de las cuales presentaban claramente características propias de las embarcaciones hechas a tingladillo. Dado que, en la mayoría de los casos, los restos se encontraban sueltos, y ante la evidencia de que en esas condiciones quedarían a la deriva con el cambio de marea y se perderían definitivamente, tomamos la determinación de recuperarlos, una vez posicionados y documentados. Posteriormente, una vez en Gernika, las maderas eran introducidas en un tanque de agua para evitar su desecación, a la vez que se iniciaba un proceso de documentación de cada uno de los fragmentos.

Además de las maderas extraídas, se localizaron algunas otras que, por sus dimensiones y estado semienterrado en la arena, fueron dejadas *in situ*, una vez documentadas convenientemente.

Desde que localizáramos la primera de estas maderas, en julio de 2012, se han seguido sucediendo los hallazgos hasta el momento presente, lo que arroja un total de 27 fragmentos localizados, de los cuales 23 han sido extraídos. En la actualidad continuamos haciendo controles periódicos en la zona, no solo para documentar la aparición de nuevos restos, sino fundamentalmente para controlar el movimiento de arenas que se produce constantemente por la dinámica propia de la ría y por los temporales, por si ello diera lugar a la aparición del núcleo o núcleos del cual proceden las maderas.

Además de esto, tenemos en proyecto la realización de una serie de análisis en algunas de las maderas, enfocados a conocer tanto la datación de estas, como la especie arbórea a la que pertenecen, y con ello determinar, por un lado, si forman parte de una sola embarcación o si, por el contrario, estamos ante los restos de más de un barco; por otra parte, nos permitirá conocer si comparten las características propiamente cantábricas en el uso de los diferentes tipos de madera para la construcción de las piezas de la embarcación.

El no disponer aún de estos análisis, debido a un retraso en la fecha de elaboración de los mismos, nos ha obligado a replantear el presente artículo y hacerlo más descriptivo que interpretativo. No obstante, confiamos en que en fechas próximas se lleven a cabo los citados análisis, y sus resultados nos permitan abordar el estudio de los restos con más certezas de las que tenemos en el momento actual. Por otra parte, el hecho de que sigan apareciendo restos de madera hace que los estudios estén inacabados y no se puedan ofrecer conclusiones definitivas.

Descripción de los restos

Dedicaremos este apartado a la descripción de 20 de las 27 piezas localizadas en el entorno de la isla de Txatxarramendi. El hecho de omitir algunas de ellas se debe a razones de espacio, ya que intentar incluirlas todas en estas páginas hubiera supuesto una merma en la información que ofrecemos de las restantes; así pues, hemos dejado para otra ocasión la descripción de aquellas que, por su menor tamaño, no ofrecerían datos tan relevantes y contundentes como las que a continuación se describen.

Sin embargo, antes de pasar a exponer sus rasgos individuales, ofreceremos una serie de características que son comunes a todas ellas.

En primer lugar hemos de señalar que el aspecto general de todas las maderas es similar en cuanto a color, textura, compacidad, etc., debido, probablemente, a que todas proceden del mismo estrato sedimentario. Además, una primera inspección macroscópica permite aventurar que se trata de madera de roble, si bien serán los futuros análisis los que confirmen o desmientan esta hipótesis.

La mayoría de las piezas localizadas son tablas del forro exterior y fragmentos de cuadernas, con todos los elementos que acompañan a estas.

En lo referente a elementos metálicos, en gran parte de los agujeros para la unión entre tracas se conserva bien el trozo de caña del clavo, bien la concreción que ha formado. A excepción de alguno aislado, la sección de los clavos es cuadrada; los agujeros de los clavos, sin embargo, son circulares, siendo su diámetro medio 1,1-1,2 cm. En el exterior de parte de las tablas se conserva la concreción de la cabeza redondeada del clavo, y en la mayoría de ellas su impronta; el diámetro medio de las cabezas de los clavos y de su impronta es de 3,9 cm, y la distancia media entre clavos es de 18 cm. En la cara interna de las tablas solo se conserva una de las arandelas cuadrangulares –con el extremo del clavo concrecionado, lo que hace imposible saber si el clavo estaba doblado o remachado–, mientras que en el resto solo ha quedado la impronta de esas arandelas. Respecto a las dimensiones de esas arandelas, la medida que más se repite es 3,4 × 4 cm, aunque también aparecen otras más grandes, de 4,2 × 5,4 cm.

En cuanto a los elementos de madera, las cabillas también están presentes en gran parte de los agujeros para la unión del forro exterior y las cuadernas; el diámetro de las cabillas es 2,8-2,9 cm, y la distancia media entre ellas es de 38-39 cm. En la anchura de las tablas, la medida más repetida es 22 cm, aunque hay algunas que superan los 29 cm, llegando incluso a los 35 cm. La zona de solape de las tablas mide 6-8 cm y el grosor de las mismas oscila entre los 3 y 5 cm. Las cuadernas tienen una anchura media de 25 cm.



Figura 1. Detalle de las improntas de las arandelas rectangulares del T-11.

En cuanto a la orientación de las tablas del forro, hemos seguido el procedimiento ordinario: la cabeza de los clavos o su impronta indicaría su cara exterior, a la vez que el borde inferior de las mismas; las arandelas cuadrangulares o su impronta señalarían la cara interior y el borde superior; su orientación hacia proa o hacia popa nos las da –caso de conservarse en alguno de sus extremos– el bisel para la unión con la tabla anterior o posterior, según sea la parte que se solapa –el bisel apunta a popa– o la solapada –en este caso el bisel apunta a proa–.

La mayoría de las maderas presentan restos de impermeabilizante, marcándonos, en algunos casos, en negativo, la anchura y situación de las cuadernas, y, en otros, el *land* o zona de solape.

Para terminar, su estado de conservación es bastante aceptable, aunque en algunos casos se advierte la presencia de *teredo navalis*, o signos de la desecación sufrida como consecuencia de los cambios de marea.

Estructura longitudinal

T-1

La longitud máxima conservada es de 105 cm. Uno de los extremos presenta el rebaje biselado para unirse a otra tabla para conformar la traca, mientras el otro está fragmentado. La anchura máxima es de 22 cm, conservándose intacta la parte inferior del madero, mientras que la superior está incompleta. Su grosor máximo es de 3,9 cm. En el borde inferior de la cara externa conserva 6 agujeros de 1,2 cm de diámetro. La distancia entre clavos oscila entre 11,3 y 18,5 cm. Conserva 3 agujeros de cabillas de madera de 2,5 cm de diámetro; la distancia entre ellas oscila entre 37,5 y 39 cm. Junto al agujero de cabilla más próximo al extremo biselado, se encuentra un orificio de 1,2 cm de diámetro, cuya función sería reforzar la unión con su homónima inmediata. En la parte inferior de la cara interior se aprecia un *land* o zona de solape de 8 cm. Así mismo, en su cara interior se aprecia, en sentido transversal, una impronta de alrededor de 22 cm, reflejo de que en su momento hubo una cuaderna. El canto inferior se encuentra biselado.

T-2

Fragmento de tabla incompleta en ambos extremos, cuya longitud máxima es de 94,5 cm. La anchura máxima conservada es de 20,8 cm, faltándole toda la parte superior. El grosor máximo que se aprecia es de 4,8 cm. Entre 2,8 y 3,7 cm del borde inferior se sitúan 5 orificios circulares de 1,1-1,2 cm de diámetro, cuya distancia entre ellos oscila entre los 16 y 17 cm. En su cara exterior presenta la impronta circular de la cabeza de los clavos. Además, en el centro de la tabla se aprecian 2 agujeros de cabilla de madera, de aproximadamente 3 cm de diámetro, y a una distancia entre ellos de 40,5 cm. En la cara interior se aprecia la zona de solape, de 6 cm aproximadamente. Al igual que en la T-1, el borde inferior se encuentra biselado.

T-3

Tabla completa, con una longitud de 182 cm y una anchura de 21 cm; su grosor máximo es de 3,8 cm. Presenta bisel en uno de sus extremos, probablemente el que apuntaría a popa. En la parte inferior, a una distancia de entre 2,5 y 4,3 cm del borde, presenta una hilera de diez orificios de clavazón, con un diámetro de 1,2 cm; la distancia entre ellos oscila entre los 16 y 19,5 cm. En su cara exterior todos ellos conservan la impronta de la cabeza redonda del clavo, cuyo

diámetro es de 3,9 cm. En el borde superior hay, a una distancia de entre 1,9 y 2,4 cm del borde, otra hilera de diez orificios de 1,2-1,4 cm de diámetro, cuya distancia entre ellos oscila entre los 15 y 20,5 cm. Ambos bordes están ligeramente biselados, y en el borde superior se aprecia claramente una zona de solape con una anchura de entre 5 y 5,5 cm. En el centro del tablón se disponen 5 orificios con sus correspondientes cabillas, cuyo diámetro es de entre 2,8 y 3 cm, y una distancia entre ellas de 28,5 y 38,5 cm. En la cara interior, en la hilera de agujeros del borde superior se aprecia la impronta de las arandelas cuadrangulares para remachar los clavos por el interior; estas arandelas miden 4,3 × 5,6 cm.



Figura 2. Vista del T-3 en el momento de su localización.

T-4

Fragmento perteneciente al extremo proel biselado de una tabla, cuyas medidas máximas –longitud, anchura, grosor– son 16,3 × 13,7 × 1,2 cm. Está fragmentado en tres trozos. En su centro transversal presenta un orificio, que, por la parte interna, conserva la impronta de una arandela cuadrangular de 3,3 × 4 cm. Por la parte interna también se aprecia un biselado de 1,4 cm en sentido longitudinal.

T-5

Fragmento de tabla incompleta en ambos extremos, pero completa en su anchura. Sus medidas de longitud, anchura y grosor máximos son 113,5 × 35 × 3 cm. En el borde inferior, a una distancia de 4,4-5 cm del borde inferior, se conserva una hilera de cinco agujeros de clavos de 1,1 cm de diámetro, y una distancia entre ellos de entre 11 y 19 cm. Alguno de estos orificios, en su cara exterior, conserva la impronta redondeada de una cabeza de clavo de 3 cm de diámetro aproximadamente. A una distancia de 2,5-3,5 cm del borde superior, se encuentra otra hilera de seis agujeros de 1 cm de diámetro para la clavazón, excepto el número 3, que aloja una cabilla de madera. La distancia entre orificios –a excepción del 3– oscila entre los 17 y 22,4 cm. Tres de estos orificios presentan, en la cara interior de la tabla, la impronta de arandelas cuadrangulares, cuyas medidas son 4 × 4,5 cm. En el borde superior de la cara exterior, se observa una zona de solape de unos 6 cm. En la zona central del tablón se dispone una serie de siete agujeros de cabilla, con un diámetro de entre 2,9 y 3,1 cm. Ambos bordes están biselados.

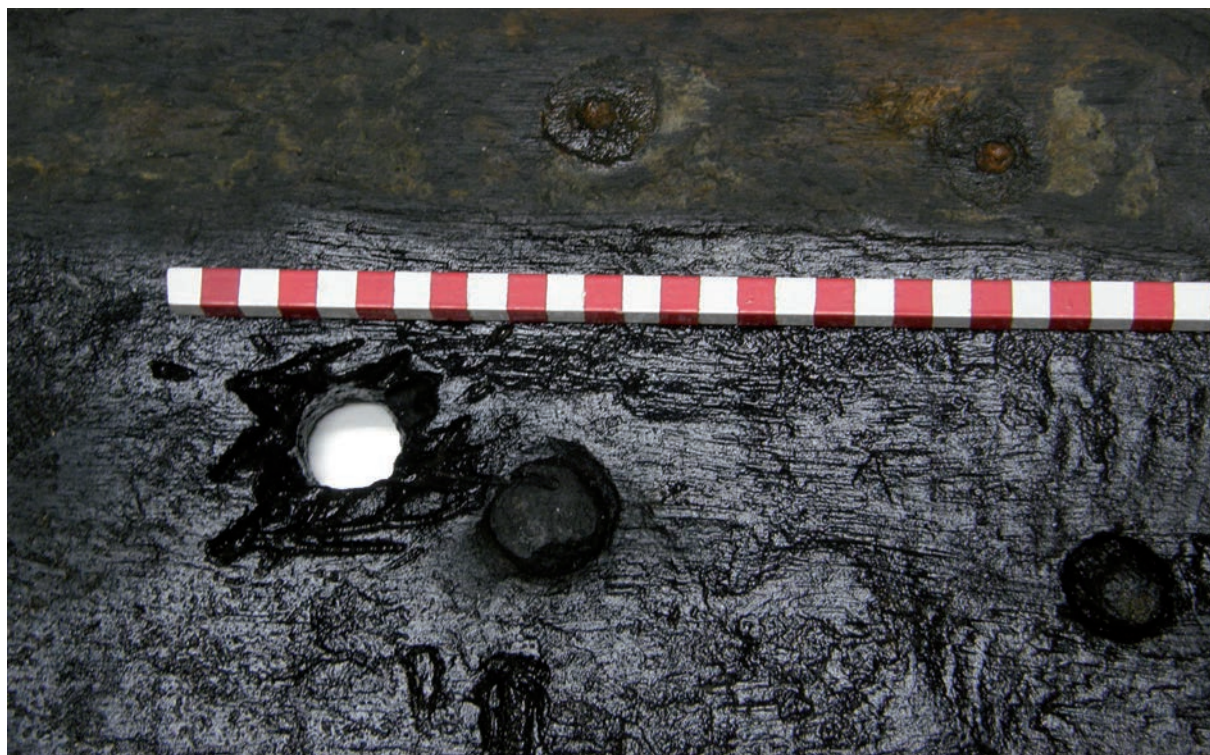


Figura 3. Detalle del T-5, donde pueden verse las improntas circulares y las cabillas.

T-6

Pieza de madera de difícil identificación, de 65,5 cm de longitud y 9,9 de anchura máximas; el grosor oscila entre 2,6 y 5,8 cm. En sentido longitudinal aparece partida en la zona donde hay dos orificios, que están dispuestos a 9 cm de ambos extremos laterales. El extremo longitudinal que se conserva aparece biselado, con lo que la sección actual de la pieza se asemeja a un triángulo. De los orificios, cuyo diámetro aproximado es de 1,4 cm, se conserva prácticamente la mitad.

En la cara superior presenta un rebaje cuadrangular, realizado con herramienta manual, posiblemente para alojar la cabeza de los clavos. Este rebaje tiene unos 6 cm de ancho, según se aprecia en el orificio donde el rebaje aparece más claro. El lado que está biselado no presenta un grosor regular.

T-7

Extremo popel biselado de una tabla fragmentada en dos trozos, cuyas longitud y anchura máximas son 36,5 y 13,8 cm respectivamente; el grosor oscila entre 1 y 2,8 cm. En su cara exterior presenta la concreción de la cabeza redondeada de un clavo. En uno de sus extremos presenta un agujero partido para clavija de madera de 2,7 cm de diámetro aproximadamente.

T-8

Fragmento incompleto de tabla, tanto en su longitud –66,5 cm–, como en su anchura –14,6 cm–; el grosor máximo es de 5 cm. A una distancia de entre 3,2 y 3,5 del borde inferior, se encuentran

situados cuatro agujeros de 1,3 cm de diámetro, cuya distancia entre los mismos oscila entre 16 y 20,6 cm. Por la cara exterior de la tabla, los cuatro orificios conservan la impronta de una cabeza redondeada, con un diámetro de 3,8-4 cm. En su zona central aparecen dos agujeros para cabilla de madera –de los cuales uno está incompleto– cuyo diámetro es de 2,9 cm; la distancia entre ambos es de 45 cm. El borde inferior se encuentra biselado.

T-9

Tablón sumergido y semienterrado de gran longitud (la medida mínima visible es 2,5 m aproximadamente) que permanece *in situ*. En la única inspección que se le ha podido hacer no se apreciaron restos de clavos, cabillas o cualquier otra particularidad.

T-10

Fragmento de tabla, uno de cuyos extremos aparece incompleto; su longitud máxima es de 228,5 cm. En cuanto al anchor, tampoco se conserva completa, puesto que aparece fracturada por la línea de agujeros de clavazón; su anchura máxima es de 19 cm. El grosor máximo es de 4,8 cm. En la parte central del tablón aparecen cinco orificios de cabillas de madera, de 2,5 cm de diámetro; la distancia entre cabillas varía entre los 42 y 54 cm. En el borde completo hay diez agujeros cuadrangulares de clavazón metálica de 0,9 cm de lado, la mayoría dispuestos en una hilera, a pocos centímetros del borde completo de la tabla. La distancia entre clavos fluctúa entre los 9,5 y 44 cm. En su cara exterior, uno de los agujeros dispone de un rebaje cuadrangular para alojar la cabeza de un clavo. Por el conjunto de sus características, posiblemente se trate de una tabla de una embarcación construida a tope.

T-11

Fragmento de tabla incompleta en ambos extremos, cuya longitud máxima es de 39,9 cm; en su anchura tampoco se conserva entera, y la máxima medida que arroja es de 10,9 cm. El grosor máximo es de 3,5 cm. A 3 cm del borde superior se encuentran dos agujeros de clavazón, a una distancia entre ellos de 18,5 cm; estos conservan la caña de los dos clavos, presentando, en la cara interior de la tabla, la impronta rectangular de dos arandelas (cuyas medidas son 3,4 × 4,2 cm y 2,9 × 4,2 cm). Por la cara exterior se puede apreciar la sección y medidas de la caña de los dos clavos citados anteriormente, que en ambos casos es de 1 cm de lado.

T-12

Fragmento, posiblemente, de tabla, cuyas medidas máximas de longitud, anchura y grosor son 38, 9,2 y 3,6 cm, respectivamente. A escasos centímetros del borde superior, por su cara interna, se aprecia la impronta de una arandela cuadrangular de 3,9 × 4,8; a 18 cm de esta, se dispone otro orificio en cuyo interior se conserva la caña de un clavo de sección cuadrada. En la cara exterior, aparece una concreción informe cubriendo uno de los orificios descritos en la cara interna.

T-13

Fragmento de tabla incompleta en ambos extremos, con una longitud máxima de 115,7 cm. Su anchura, que parece conservarse completa, tiene una medida máxima de 29 cm; el grosor máxi-

mo es 3 cm. A una distancia de entre 2,5 y 3,5 cm del borde inferior, se encuentra una hilera de cuatro orificios de clavazón de hierro, algunos de los cuales conservan en su interior la caña de los clavos; la distancia entre ellos oscila entre 13 y 23 cm. En su cara externa conserva las improntas de tres cabezas redondeadas de clavos, de 3,8 cm de diámetro. A una distancia de entre 3 y 3,7 cm del borde superior, se dispone una hilera de 6 agujeros de clavazón, cuya distancia entre ellos oscila entre 14,5 y 23 cm; los seis conservan en su cara interna la impronta de la arandela cuadrangular, cuyas medidas oscilan entre 3,7 y 4,1 cm de anchura, y entre 4,6 y 5,4 cm de longitud. En la tabla se conservan cuatro orificios de cabillas de madera –dos de ellas completas y dos incompletas– de un diámetro de 2,8 cm, y una distancia entre ellas de entre 26 y 30 cm. En uno de sus extremos, aunque incompleto, se conserva parte del borde biselado, con abundantes restos de material adherente, que correspondería a la parte de proa. En esa misma zona biselada se encuentran los restos de dos clavos, cuya distancia entre ellos es de 5 cm, que servirían para sujetar la unión entre tablas de la misma traca. Uno de estos clavos, por la cara interior de la tabla, conserva la impronta de una arandela rectangular, de 3,8 × 5,3 cm.

T-14

Tabla de madera aparentemente completa, cuyas medidas máximas –longitud, anchura, grosor– son 85,8 × 6,4 × 1,8 cm. No presenta restos de orificios ni clavos, por lo que de momento su identificación es difícil.

Estructura transversal

C-1

Fragmento de varenga incompleta en ambos extremos, cuyas medidas máximas de longitud, anchura y grosor son 110, 20 y 10 cm, respectivamente. En su cara superior se aprecian siete agujeros para cabillas, seis de los cuales atraviesan toda la pieza hasta la parte inferior; la cabilla restante solo penetra parcialmente. Todas las cabillas tienen un diámetro de 0,21 cm, a excepción de una de ellas, cuyo diámetro es de 0,27 cm. La distancia entre las cabillas oscila entre 14,5 y 18 cm.

C-2

Fragmento de cuaderna cuyas medidas máximas de longitud, anchura y grosor son 145, 26 y 13 cm, respectivamente. En su cara exterior presenta ocho entalladuras –cuyas medidas oscilan entre los 15 y 19 cm– para su encaje en otras tantas tracas del forro. En la zona inferior de cada una de dichas entalladuras se dispone un agujero para alojar la cabilla de madera, que traspasa hasta la cara interior de la cuaderna y cuya función sería la fijación de las tracas con esta estructura transversal; todavía se conservan en su interior algunas de estas cabillas, cuyo diámetro, bastante regular, es de 2,5 cm. Las distancias entre cabillas oscilan entre los 15 y 20,5 cm, aunque la medida que más se repite es 17,5 cm. El borde inferior presenta una zona de 40 cm en forma de bisel para la unión con el siguiente tramo de cuaderna.

C-3

Fragmento de cuaderna cuyas medidas máximas de longitud, anchura y grosor son 135, 25 y 11 cm, respectivamente. En su cara exterior presenta cuatro entalladuras –cuyas medidas oscilan

entre los 19 y 20 cm-. En la zona inferior de cada una de ellas se dispone un orificio para alojar la cabilla de madera, que también en esta traspasa hasta la cara interior de la cuaderna; aún se conservan en el interior algunas de estas cabillas, cuyo diámetro es, en todos los casos, de 2,5 cm.

El resto de la cuaderna no presenta entalladuras, aunque sí otros cuatro agujeros y cabillas –del mismo diámetro que las anteriores– para su unión a las tracas. La distancia entre estas cabillas oscila entre los 18 y 20,5 cm.



Figura 4. C-3. Típico perfil de cuaderna «a tingladillo».

C-4

Fragmento de cuaderna que permanece *in situ*, cuyas medidas aproximadas de longitud, anchura y grosor son 120, 22 y 13 cm, respectivamente. En su cara exterior presenta cuatro entalladuras –cuyas medidas oscilan entre 19 y 20 cm–, más una zona biselada para la unión con otro tramo de cuaderna. En cada una de las entalladuras presenta un agujero para alojar una cabilla de madera, más otros cuatro orificios en la zona donde carece de ellas.

C-5

Fragmento de cuaderna que permanece *in situ* y enterrada, lo que imposibilita una detallada descripción, aunque sí podemos ofrecer sus medidas aproximadas de longitud y anchura: 70 × 13 cm. En el momento de su localización asomaba una pequeña parte de una típica cuaderna a tingladillo, con sección escalonada, aunque de envergadura menor a las descritas líneas arriba.



Figura 5. Fragmento de C-5, que permanece *in situ*.

C-6

Fragmento de cuaderna que permanece *in situ* en el lecho marino; se encuentra parcialmente enterrada y concrecionada a las rocas. En algunas ocasiones hemos podido observar que tiene cuatro entalladuras típicas de una cuaderna a tingladillo, y una anchura similar a las cuadernas C-2 y C-3.

Valoración histórica

El principio de construcción a casco previo con la disposición de las tracas a tingladillo es un sistema de construcción de embarcaciones puramente atlántico, que aparece en las costas del mar Báltico y mar del Norte en el ocaso del Imperio romano, en la Alta Edad Media, desarrollándose durante el periodo medieval, y extendiéndose por toda la fachada atlántica europea por el Cantábrico y hasta el Duero, siendo este su límite meridional.

Esta forma de colocación de las tablas del forro escalonadamente comparte el principio de casco previo con el sistema utilizado durante toda la Antigüedad y hasta los siglos VI-VII d.C. en el Mediterráneo, pero difiere de este en el sistema de fijación de las tablas del forro. El principio de casco previo y a tingladillo es un sistema en el que la forma de la embarcación se concibe a partir del eje longitudinal (roda, quilla, codaste), añadiendo después la traca de aparadura y el resto de tracas montadas o solapadas una encima de la anterior, y fijadas con clavos y arandelas.

Mientras este sistema constructivo se desarrollaba en el litoral atlántico –hasta el Duero–, en el Mediterráneo, a partir de los siglos VI-VII d.C., se va desarrollando y extendiendo el sistema de construcción de principio de esqueleto y a tope. Este se basa en la concepción de la forma del casco a partir de las cuadernas, colocándose después las tracas a tope, canto contra canto.

Durante la Baja Edad Media se produce un intercambio de avances técnicos entre las dos tradiciones constructivas; pero hacia el final de este periodo, y ya en el Renacimiento, se impone definitivamente el principio de esqueleto y a tope para la construcción de embarcaciones de gran y mediano porte, quedando reducido el principio de casco previo y a tingladillo para la elaboración de embarcaciones auxiliares y de pequeño tamaño.

Para este periodo final del sistema de construcción a tingladillo contamos con numerosos ejemplos, que además son de origen cántabro occidental-aquitano, como son los dos pecios aparecidos en el Mediterráneo –*Cavalière* y la *Barceloneta I*–, así como *Aber Wrach'1* (Francia), *Newport-Casnewydd* (Gales) y el cercano de *Urbietta* (Gernika).

Hay que recordar que nos encontramos en el núcleo geográfico de una de las tradiciones constructivas que si bien sigue, según todos los autores, la tradición escandinava, tiene también algunas características propias. En este sentido, los ejemplos más cercanos geográficamente los tenemos en el citado pecio de *Urbietta* y en algunas piezas sueltas aparecidas en el *Boulevard de San Sebastián*.

En cuanto a los restos aparecidos en el entorno de Txatxarramendi, pese a haber aparecido de forma suelta e inconexa, podemos señalar que ofrecen una serie de características comunes. Las tablas presentan tanto la impronta circular exterior de la cabeza del clavo que une las tracas, como la de la arandela cuadrangular del interior; algunos de los maderos conservan restos de la clavazón metálica de hierro. Asimismo, se conservan gran cantidad de cabillas de madera, de sección circular, tanto en las cuadernas, como en la tablazón. Por otro lado, gran parte de los fragmentos están cubiertos por una capa de impermeabilizante. También aparecen las cuadernas típicas del sistema a tingladillo, esto es, con perfil de escalera para adaptarse a la forma trincada del forro.

Por el tamaño de las piezas y comparación tipológica, estaríamos ante una o varias embarcaciones de tamaño similar a los citados pecios *Barceloneta I*, *Aber Wrach'1*, *Newport-Casnewydd*, lo que significa una embarcación de porte mayor al de *Urbietta* (Gernika).

A modo ilustrativo, ofrecemos a continuación una tabla comparativa en la que se relaciona la anchura de las cuadernas y otros parámetros con la eslora de las embarcaciones.

Pecio	Txatxarra- mendi	Urbietta	Barceloneta	Cavalière	Aber Wrach'1	Newport- Casnewydd
Anchura cuadernas (cm)	22-25	6-13	15-25	15-25	15-25	—
Claros (cm)	15-16	50	8-16	15-20	13	—
Anchura tracas (cm)	21-35	15	20-25	—	23	—
Grosor tracas (cm)	3-5	2	2-2,5	—	3	—
Eslora (m)	—	11	20-25	16	25	35

Aunque la construcción de grandes embarcaciones a tingladillo se abandonó a finales del siglo xv, hasta que no se completen los estudios sobre los restos de Txatxarramendi no se puede descartar que se corresponda con alguno de los modelos de medio porte que subsistieron durante los siglos posteriores en el Cantábrico y otras zonas como el Báltico; nos referimos a algunas trincaduras, lugres, o embarcaciones como el pecio de *Selangersan*, de construcción mixta a tingladillo en la parte baja y a tope en la alta, de finales del siglo xvi.

Por último, no podemos terminar estas líneas sin incidir en la necesidad de un mayor grado de protección (control, legislación, financiación) para la ría de Gernika, que ha demostrado hasta la fecha su potencial arqueológico marítimo con la aparición de restos de importancia (pecios de *Urbietta*, *Laida I* y *II* y Txatxarramendi), a los que sin duda en el futuro se añadirán otros.

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La cultura material de comunidades
pesqueras medievales en el condado
de Flandes y el comercio internacional.
El caso de Walraversijde, un pueblo
de pescadores abandonado en el siglo XVII
(Ostende, Bélgica, costa del mar del Norte)

The material culture of medieval fishing
communities in the county of Flanders
and the international trade.

The case of Walraversijde, a fishermen's
village abandoned in the 17th century
(Oostende, Belgium, North Sea's coast)

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Resumen: desde 1992 hasta 2005, un proyecto arqueológico en la costa belga se concentró en la investigación del yacimiento arqueológico de Walraversijde, un pueblo de pescadores de los siglos XI/XII-XVI ubicado unos kilómetros al oeste de la ciudad de Ostende y abandonado al inicio del siglo XVII. La cultura material de esta comunidad se caracteriza por la presencia de varios productos exóticos y de lujo tales como corcho, mayólica española y granadas... La presencia de estos productos en el pueblo no significa que los pescadores fueran ricos, sino que tenían un acceso más fácil a estos productos a través de sus actividades complementarias a la pesca: comercio, pilotaje de barcos mercantes provenientes de la península ibérica (los pescadores conocían la ubicación de los bancos de arena y sabían guiar muy bien buques extranjeros hasta el

puerto de Brujas), piratería, servicio militar en la marina del duque de Borgoña, extracción de turba, andar al raque, etc.

Palabras clave: cultura material, pueblo de pescadores, Bélgica, comercio internacional, Baja Edad Media.

Abstract: A multi-annual (1992-2005) archaeological project to the east of Ostend on the site of «Walraversijde», a deserted late medieval fishing village, shed a complete new light on the material culture of late medieval fishing communities in the North Sea area. The typical aspects of the material culture of these communities can be explained by the diverse range of activities fishermen carry out besides fishing such as piracy, piloting merchant vessels, serving in the navy, trade, extracting peat... Especially the piloting activities can explain the systematic presence of imports from the Iberian peninsula such as majolica, cork, honey, spices and pomegranates. These communities seem to have an easy access to a wealth of commodities. That doesn't mean that they have to be qualified as being rich people. In any case they play a role in the international maritime trade probably thanks to their profound knowledge and understanding of the dangers of the sea.

Key words: Material culture, fishing village, Belgium, international trade, late middle ages.

Introducción

Desde 1992 hasta 2005, un proyecto arqueológico en la costa belga se concentró en la investigación de un yacimiento arqueológico de los siglos *xiv* hasta *xvi*, que pertenecía a la comunidad pesquera de Walraversijde ubicada en el condado de Flandes unos kilómetros al oeste de la ciudad (portuaria desde el siglo *xv*) de Ostende.

Esta contribución tendrá tres partes: una introducción breve sobre la historia del sitio y de la investigación del yacimiento; un resumen de los resultados más importantes de la investigación arqueológica durante el periodo 1992-2005 (Pieters *et alii*, 2013), y una discusión sobre la presencia de muchos productos exóticos y su significado en el cuadro del comercio internacional. Para terminar con una conclusión sobre el papel de los pescadores en el comercio internacional.

La historia de Walraversijde y de su investigación arqueológica

El pueblo de Walraversijde nació probablemente en los siglos *xi* o *xii*. La fuente escrita más antigua conocida hasta ahora sobre el pueblo es de finales del siglo *xiii* y habla literalmente «de los pescadores de Walraversijde». «Walravers-ijde» significa traducido literalmente al castellano «el puerto o el lugar para el desembarco (*ijde* en neerlandés o *hithe* en inglés) de (un hombre) Walraf» (un hombre desconocido en las fuentes escritas). Es un topónimo similar a topónimos anglosajones más conocidos como Rotherhithe o Queenhithe (ambos topónimos ubicados en Londres) por ejemplo. Este tipo de topónimo se refiere directamente al contexto marítimo del pueblo o de la comunidad (Tys, 1997; Tys/Pieters 2009).

Una ilustración esquemática de la zona arqueológica de Walraversijde situada en la playa actual y hecha en el siglo *xx* (Fig. 1) muestra muy bien la situación general del pueblo en la Baja Edad Media con la ubicación precisa de un canal de marea (probablemente el «lugar para el desembarco» de Walraf) y de muchas casas individuales (todos los cuadrados negros en la (figura 1) del pueblo de los siglos *xiii* hasta *xiv* (Chocqueel, 1950). Este canal ahora fósil podría probablemente esconder en el suelo restos arqueológicos de infraestructuras portuarias del pueblo medieval.

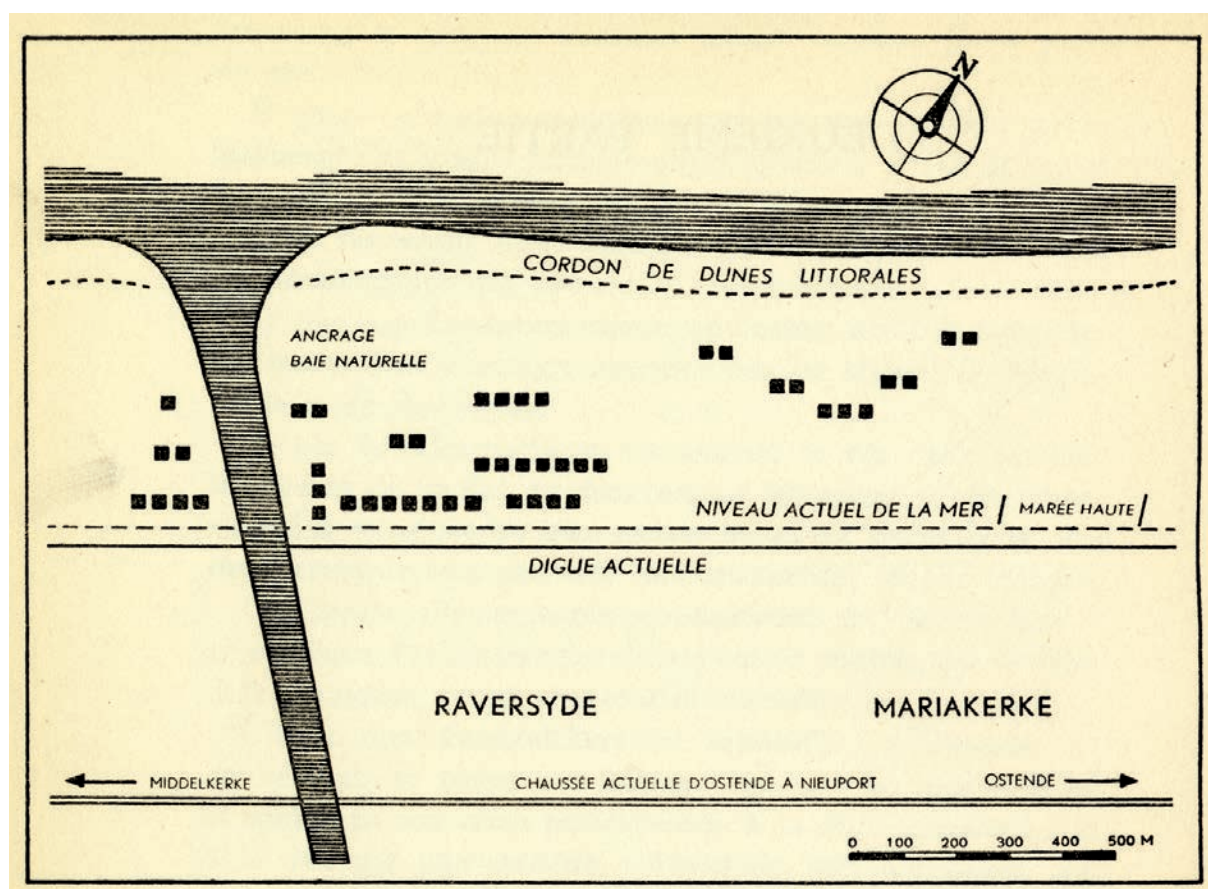


Figura 1. Ilustración esquemática de la zona arqueológica de Walraversijde de los siglos XIII y XIV con la ubicación en la playa actual de Raversijde de un canal de marea fósil y de muchas casas individuales (los cuadrados negros en el mapa) del pueblo (Ilustración: André Chocqueel © Agentschap Onroerend Erfgoed).

Al final del siglo XIV durante una tormenta, el mar sumergió este pueblo y, como consecuencia, los pescadores tuvieron que construir un nuevo pueblo algunos cientos de metros más al sureste en la dirección del interior del país en una zona protegida por un nuevo dique y por las dunas (Fig. 2).

Las investigaciones arqueológicas de los años 1992 hasta 2005 se centraron casi exclusivamente en esta nueva zona del sitio, ocupada desde el principio del siglo XV. El yacimiento arqueológico presenta en esta zona como consecuencia sobre todo estructuras arqueológicas, vestigios y objetos de los siglos XV hasta XVI (Pieters, 2002; Pieters, 2006; Pieters *et alii*, 2006).

El abandono general y casi definitivo del pueblo ocurrió al inicio del siglo XVII, cuando el pueblo de Walraversijde fue ocupado por la caballería española durante el asedio de Ostende (1601-1604).

Las Figuras 2 y 3 ayudan a visualizar el sitio y su contexto paisajístico: una fotografía aérea actual del sitio del nuevo pueblo con cuatro casas medievales reconstruidas (número 1 en la figura 2), el dique de los años 1400 (número 2 en la Figura 2), las dunas y la playa (Fig. 2), una fotografía aérea de la playa hecha en la década de 1970 (Fig. 3) mostrando vestigios del pueblo medieval (siglos XIII-XIV) sobre todo de extracción de turba, visibles durante una bajamar.



Figura 2. Una fotografía aérea actual de la zona arqueológica entera con cuatro casas reconstruidas (1) que forman parte del museo de Walraversijde (<http://www.west-vlaanderen.be/kwaliteit/Leefomgeving/raversijde/paginas/anno1465walraversijde.aspx>), el nuevo dique (2) de los años 1400, las dunas y la playa (Fotografía: Kris Vandevorst © Agentschap Onroerend Erfgoed).



Figura 3. Una fotografía aérea de la playa de Raversijde (nombre actual de la aldea) hecha en la década de 1970 antes de la construcción de espigones. En el centro de la fotografía se puede observar estructuras arqueológicas del sitio de Walraversijde, sobre todo estructuras que se refieren a la extracción de turba (Fotografía: Etienne Cools © Agnès Mortier).

Los resultados más importantes de la investigación arqueológica de 1992 hasta 2005

Aquí sigue un resumen de los resultados más importantes de la investigación arqueológica llevada a cabo entre 1992 y 2005 en la zona con vestigios de los siglos xv y xvi.

La zona investigada (Fig. 4) contenía los restos arqueológicos de 33 casas (24 casas son visibles en la Figura 4 y pertenecen más o menos a la misma fase arqueológica) construidas en ladrillo, en general de forma rectangular (longitud entre 12,5 y 17,5 metros y anchura entre 5 y 6,5 metros), más o menos dispuestas en filas perpendiculares o paralelas a la costa y más o menos del mismo tamaño. El plano general (Fig. 4) de las excavaciones muestra también zonas de extracción de turba, pozos de agua y zanjas de drenaje.



Figura 4. La zona investigada. Leyenda: 1 y 2: casas de ladrillo; 3: casas de madera; 4: pozos; 5: zanjas de drenaje; 6: superficie total construida; 7: zonas de extracción de turba; 8: zona investigada arqueológicamente (Figura: Marc Van Meenen © Agentschap Onroerend Erfgoed).

Exploramos un poco más en detalle las características más importantes de las casas:

- la morfología de las casas: rectangulares y en general subdividas en dos habitaciones: una pequeña y una grande;
- los materiales de construcción: ladrillos para los muros y para el pavimento, piedras naturales para los pavimentos al exterior, yeso de cal para cubrir las paredes al interior y quizás también al exterior de las casas, caña o paja para los techos;
- la ubicación de la chimenea: en el centro de la casa o adosada a la pared.

Utilizaban dos tipos de pozos de agua en el pueblo (Pieters, 2005): pozos en ladrillo y contruidos con una llanta de madera como base y pozos realizados en madera: es decir reciclan-

do barriles. Estos barriles servían originalmente para conservar arenques salados. El estudio dendrocronológico de las duelas de los barriles (Houbrechts/Pieters, 1999) facilitó el fechado de los pozos: básicamente de finales del siglo xiv y de la primera mitad del siglo xv. Según el mismo estudio, el origen de la madera para realizar los barriles se sitúa en la zona báltica en las proximidades de la ciudad de Gdańsk (en Polonia).

Además de pozos de agua, en el sitio también hay pozos negros o letrinas, importantes para la conservación excelente de objetos de naturaleza orgánica.

De los artefactos móviles solo presento aquí el artefacto a mi modo de ver más típico del sitio: las agujas en madera (sobre todo de madera del saúco) para la confección y arreglo de las redes (Fig. 5). Todas las agujas muestran marcas incisas, posiblemente identificativas de su usuario o propietario. Una de las agujas muestra una marca especial con tres peces entrelazados. Tengo la opinión de que este dibujo es un dibujo o un símbolo relacionado sobre todo con las comunidades pesqueras/marítimas y podría referirse a la Santísima Trinidad (Pieters, 2010).

Productos exóticos encontrados en el yacimiento

La última parte de este texto está dedicada a los productos exóticos encontrados en el yacimiento. Se trata de un montón de productos muy variados: piedras naturales de origen inglés (probablemente lastre para los buques) (De Paepe/Pieters, 1995), hulla de Inglaterra (también lastre para los buques y probablemente destinada a la producción de cal o de ladrillos en la zona costera de Flandes donde se encuentra la arcilla adecuada para producir ladrillos), madera (sobre todo en forma de barriles de arenques), alquitrán y brea de la zona báltica, cerámica de Inglaterra, de Francia y de la región del Rin, y sorprendentemente, un montón de productos o de materias primas importado de la península ibérica o por lo menos llevado hasta Flandes por buques de la zona del Mediterráneo, como peines de marfil, una gran cantidad de mayólica española de varios centros de producción: Sevilla, Málaga y Valencia (Fig. 6a) (Pieters/Verhaeghe, 2006-2008), de diferentes tipos de producción (dorada, azul y morada) pero como formas de cerámica sobre todo platos y escudillas, corcho de alcornoque para producir flotadores para la pesca, suelas de zapatos y tapones, granadas, pimienta malagueña o granos del paraíso,

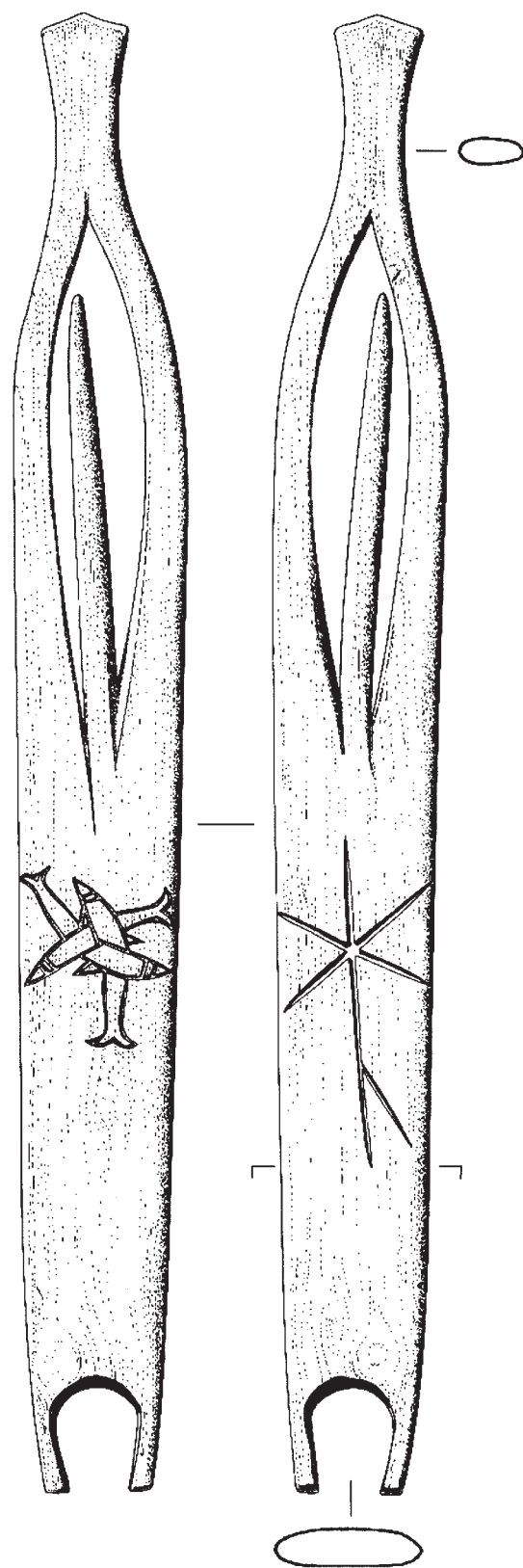


Figura 5. Aguja en madera para la confección y arreglo de redes para la pesca, marcada con tres peces entrelazados. Longitud y anchura de la aguja: 17 y 2 centímetros (Figura: Marc Van Meenen © Agentschap Onroerend Erfgoed).

miel del Mediterráneo. La identificación de miel está basada en la presencia de granos de polen del madroño (Deforce, 2013), encontrados en la parte subterránea de una de las letrinas del pueblo. Además de la mayólica española el yacimiento contenía también unos contenedores «misteriosos» (Fig. 6b), es decir, hasta ahora sin centro de producción conocido. Estos pequeños contenedores suponen un problema de identificación: son de pared gruesa, tienen un pequeño volumen y están hechos con arcilla de la península ibérica. Quizá puedan relacionarse con el transporte de mercurio durante el siglo xv o antes. La información histórica sobre las minas en Almadén por ejemplo está desgraciadamente limitada para la Edad Media (Matilla, 1958).



Figura 6a. Cerámicas encontradas en el yacimiento arqueológico de Walraversijde y procedentes de la península ibérica: fragmentos de platos y escudillas en mayólica española con grandes letras góticas (Fotografía: Hans Denis © Agentschap Onroerend Erfgoed).

Dos observaciones generales sobre los productos exóticos conducen a la interpretación de su significación.

- Casi todos los productos presentes en el mercado medieval y que puedan dejar rastros en el suelo están presentes en el yacimiento arqueológico de Walraversijde.
- Cada familia pesquera poseía probablemente objetos de lujo, como mayólica ibérica, tal y como indica el mapa de distribución de la mayólica ibérica en el yacimiento.

Conclusión

Estas comunidades pesqueras se encontraban generalmente al margen de la sociedad (tanto en el sentido literal como en el sentido metafórico), es decir literalmente en la costa pero metafóricamente al margen de la sociedad agraria que dominaba el campo en esa época. Estas comunidades no formaban parte de las estructuras de la sociedad rural.



Figura 6b. Contenedores «misteriosos» hechos en arcilla de la península ibérica y probablemente relacionados con el comercio de mercurio en la Baja Edad Media (Fotografía: Hans Denis © Agentschap Onroerend Erfgoed).

La cultura material de la comunidad de Walraversijde demuestra entre otras cosas una gran riqueza de productos exóticos como el corcho, el marfil, las granadas, los clavos, el pimienta, los granos del paraíso, la mayólica española (de Málaga, Sevilla y Valencia), la miel de la zona mediterránea, los barriles en madera de la zona báltica, la hulla y piedras naturales de Inglaterra, el ámbar, la brea, la cerámica de la región del Rin, etc.; esto es: objetos de varias regiones del mundo conocido. Además algunos productos pueden ser considerados como objetos de lujo: la mayólica española, por ejemplo.

La presencia de estos productos en el pueblo del siglo xv no significa que los pescadores fueran ricos, sino que tenían un acceso más fácil a estos productos a través de sus actividades complementarias a la pesca: comercio, pilotaje de barcos mercantes provenientes sobre todo de la península ibérica (los pescadores conocían la ubicación de los bancos de arena y sabían guiar muy bien buques extranjeros hasta el puerto de Brujas), piratería, servicio militar en la marina del duque de Borgoña, extracción de turba, andar al raque, etc.

Este estudio muestra de manera arqueológica el papel de los pescadores flamencos en el comercio internacional y la cultura marítima especial de estas comunidades. Una indicación adicional del carácter mercantil de la comunidad sería el hallazgo en el yacimiento de unas gafas hechas de hueso. Podrían mostrar a los pescadores como gentes que probablemente sabían leer y escribir, en contraste con el mundo agrario de la época generalmente analfabeto.

La comunidad marítima es a mi modo de ver también una comunidad más igualitaria como puede indicar la información del yacimiento arqueológico de Walraversijde: casas de dimensiones similares en las que todos tenían productos de lujo como los reseñados.

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ÉPOCA MODERNA Y CONTEMPORÁNEA

MODERN & CONTEMPORARY PERIOD

Maritime archaeology as a tool to understand a river town: the example of Bilbao (Basque Country, Spain)

La arqueología marítima como una herramienta para entender una ciudad fluvial: el ejemplo de Bilbao (País Vasco, España)

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Abstract: Bilbao is the result of a community of merchants, fishermen and mariners throughout history; from a small settlement in the 1200's, Bilbao managed to become the most important town in the province of Biscay during the Middle Ages and one of the most important ones in Spain in the 19th and 20th centuries. The town needed to improve its port facilities and to manage the riverbank and the estuary by dredging, reclaiming land, building quays, setting out railways... For the last three years, the need to repair or rebuild the quays within Bilbao riverbanks has allowed for watching briefs to be carried out; the combination of archaeology, photographs, paintings, records... has allowed to understand how a city managed its space. This paper will present its results to assess the evolution of the Bilbao estuary and town, placing maritime archaeology as a tool for recording the past in present times.

Key words: Bilbao, docks, port, management, maritime archaeology

Resumen: Bilbao es el resultado de una comunidad de mercaderes, pescadores y marinos a lo largo de la historia; siendo un pequeño asentamiento en el siglo XIII, Bilbao logró convertirse en la ciudad más importante de la provincia de Bizkaia durante la Edad Media y en una de las más importantes de España en los siglos XIX y XX. La ciudad necesitó mejorar su logística portuaria y manejar la orilla de la ría mediante el dragado de su cauce, el relleno de orillas con tierras, la construcción de muelles, el establecimiento de líneas ferroviarias... Durante los últimos tres años, la necesidad de reparar o reconstruir los muelles en la orilla de la ría a su paso por Bilbao ha permitido llevar a cabo controles arqueológicos de tales obras de reparación o reconstrucción; la combinación de arqueología, fotografías, pinturas, documentos... ha permitido entender cómo una ciudad gestionó su espacio. Este artículo presenta los resultados de evaluar la evolución de la ría y ciudad de Bilbao, situando a la arqueología marítima como una herramienta para documentar el pasado en la época actual.

Palabras clave: Bilbao, muelles, puerto, gestión, arqueología marítima.

Introduction

For the last three years several watching briefs have been carried out while repairing some of the riverbanks and frontwalls in the estuary town of Bilbao. Although there has not been a continuous repair of the whole riverbanks, on both sides of the river, the areas which have been repaired are allowing us to understand better the need for Bilbao to enlarge its harbour area by building bridges, new jetties, riverbank, frontwalls, reclaiming land on the river, dredging, setting up railway lines for the trains to load and unload the products and the same can be said for the cranes; with all this infrastructure, Bilbao was able to serve its province (Guimerá, 2006).

The repairs and rebuilding of some parts of the docks consisted in filling in the foundations of the docks to avoid them crumbling down, in repairing the pilings that hold the pier while the river flows up and down underneath. Due to this flow of salty water, the iron inside the reinforce concrete has been weakened and, hence, there was a possibility of such platform to collapse. To avoid such danger, the repairs were carried out and this gave the opportunity for the watching briefs to record any archaeological remains exposed during the repairs. At the same time, research in archives was done to find documents, photographs, blueprints to provide with a context and to understand how the town has changed. Similarly, previous archaeological reports were consulted (Gárate, 2005; 2006).

The main docks

The docks which were repaired are La Ribera, Ibeni y La Merced, Urazurrutia, Uribitarte, Botica Vieja, Curva de Elorrieta, and Arriaga; each one has its own problems and solutions of repairing; thus in Botica Vieja little archaeological information was recorded as the repairs there did not include the opening of the soil but to drill some piling inside the blocks of the dock to strengthen them. For Urazurrutia, the frontwall was filled up in its foundations, while in Curva de Elorrieta the work was done on repairing a sewage exit to the estuary. The docks which have provided with more and better archaeological information are the dock of Uribitarte and the docks of Arriaga. Although no archaeological visits were done to the La Ribera, Ibeni and La Merced docks, information about these docks will also be presented here as they are at the core of the old city center. This paper will mainly deal with the watching briefs carried out in them while information about the other docks can be found somewhere else (Matés, 2012a; 2012b; 2013a; 2013b; 2014).

The Uribitarte dock

This dock was the first one to provide with good archaeological information as several stratigraphic units were recorded. Furthermore, some artefacts were also found and recorded allowing to understand better the use of this space. The dating of such artefacts goes back to the last part of the 19th century as railways for the trams which transported the goods in and out of the docks and for the cranes which loaded and unloaded such goods from or into the vessels. Similarly, the 19th century pavement cobblestones were found, a pavement that is present in all the 19th century photographs. These photographs help us to provide a dating to the archaeological finds, as the pavement and railways can be seen and allow to understand how the waterfront has been transformed since (Esparza, 2002; Fernández, 1976; Ortega, 1976; VV AA., 1992).

Having said this, whenever was possible when the tide was low we got down to the riverbank to record the frontwall of the dock and the sheet pile of pine and beech, which we think it could be dated back to the end of the 19th century, or perhaps earlier because here there was a canal that made the area be called Uribitarte, a Basque place name which can be translated as the



Figure 1. Detail of the Uribitarte island in the center of the image and the line of cobblestones above, dated to the 19th century. Once the space was no longer needed, the bottom levels were covered with new ones in the 20th century (Photo J. M. Matés Luque).

‘place between the water’, due to the fact that there was an island from 1654 in this area in the middle of the estuary, creating such canal. This canal was closed by reclaiming the area to create a bigger working space for the port activities, creating the frontwall of the dock that can be seen today behind the piling which needed repairing. Such reclaiming took place in 1870 (JOP: 56) and it costed so much money that it was called «the Silver river» (JOP: 24-25). The island was recorded during the watching brief and it can still be perceived in the current Bilbao street map (Fig. 1, 2).



Figure 2. General view of the Uribitarte Dock. The entrance to the canal which created the Uribitarte Island on the right was between the arrows. The arrows mark buildings which can be seen in some contemporary photographs; on the left the Custom Office, built in 1890 (Photo J. M. Matés Luque).

This area is at the heart of the expansion district of Bilbao from the late 19th century, when the middle class –which had been improving its social status– crossed the river for having new land to build houses. Thus, this area became the place for new transport infrastructure, such as the main train station and new docks, and bridges to connect the areas down the estuary. This need to set up such space at the waterfront required from the Old Port Authority (called then Junta de Obras del Puerto or JOP for short) to build such docks, to close the canal, to set up new railways and trams connections, to dredge the river as there were some rock sediments (called *churros* in the contemporary sources) which were an obstacle for ships at low tide, and to provide a wider area in the estuary for ships to turn around. It is important to remember that the industrial revolution made possible the construction of larger ships, so traditional ships docked at the entrance of the estuary, around 15 km down the river and whose cargo was transported to small flat bottomed barges which were towed up the river to the city center (Alemany, 1991: 207), an activity carried out mainly by women (Barberia, 2006).

Thus, in 1880 the area between Zorroza and Achuri (about 3 km of the river) was dredged, the bend in the river at La Salve was enlarged so bigger ships could turn around there and more loading bays were created (JOP, 1908: 60-61; Alemany, 1991: 209-210); this area was better equipped in 1886 with eight manually operated cranes, with another eight steamed operated cranes of three tons and the addition of a 25 tons crane to allow the operations in the dock (JOP, 1908: 104). All this working area was covered up with cobblestones wherever there was a need (JOP, 1908: 105) and those cobblestones are the ones which have been recorded during the watching briefs.

This entire infrastructure, however, will not be enough. The lack of docking area for the goods awaiting transport either on ships or on trams forced the Port Authority to move the British Cemetery (which is where the Guggenheim museum is based) in 1905 to set up new docking areas down the estuary. The so called Grúa Grande (Big Crane) was installed, the opposite riverbank was prepared and more dredging was carried out (JOP, 1906: 34-36). Similarly, the need to connect such area with the main train station that connected, and still does nowadays, Bilbao with the rest of Spain, mainly the center, required new railways, new streets to be built. During



Figure 3. Detail of the rails recorded. The union of Vignole type for the cranes next to the riverbank and the Phoenix for the trams is common in Bilbao (Photo J. M. Matés Luque).

the watching briefs this area was widely recorded and the different rails (Vignole type for the crane and Phoenix type for the tram) (Fig. 3) were recorded as there were still in situ, along with some other artefacts related to the rails and which can be seen in contemporary photographs (Matés, 2012a; 2012b; 2013a; 2013b). Sheds and warehouses were started to be built from the beginning of the 20th century and considering that the weather in the Basque Country is filled up with many days of rain that was something needed. Some of these installations can be seen today in the city but the use has been changed and adapted to new uses not related to dock activities.

It was in the 1920's when the current façade of the docks was built by installing the piles –those which were repaired recently– to create a sort of floating platform for increasing the space for goods to be stored. This allowed the installation of new rails, cranes and bigger ships to be moored by the frontwall but without hitting and damaging such wall, and allowing deeper dredging –should they be needed– without the risk of collapsing the foundation piles of the main frontwall. This platform was also built in the Arriaga dock, the other dock which provided with archaeological features which allowed a better understanding of the evolution of the town.

The Arriaga dock

The archaeological brief took place in 2013 following the same procedure as done in the Uribitarte dock and other docks. The Arriaga dock is at the heart of the old part of the town, the so called *Casco Viejo*. A blueprint dated in 1885 allowed to understand the evolution of this space. The Arriaga dock is named after the theater next to it, which is also named after a famous Bilbao-born musician called Juan Crisóstomo de Arriaga. This theater is nowadays the most important one in Bilbao and it was built in 1890 on the same place where the old early 19th century theater was built. This area was outdoors the old Middle Ages original town enclosed by the city walls which were removed in the 16th century.

The old theater was big enough when it was built in 1817 for the needs of a town such as Bilbao, but it was clear that, by the end of the century Bilbao, a town which was becoming one of the most important towns or cities in Spain could not bear not to have a bigger and more prestigious theater, hence the need for a new one. This project affected the area as a bigger theater required bigger foundations and a larger area to withstand the weight of such a big theater. To achieve this, the ramps that were the traditional maritime landscape for the riverbank in the Arriaga dock during the 19th century were covered to allow for a flat and vertical frontwall forward such ramps; this way, there was a larger area for storing and for setting up the railways for the trams. The old ramps can be seen in the contemporary pictures by Pedro Telesforo de Errazquin, dated to between 1860 and 1880. The new vertical frontwall is, therefore, dated to 1890 and it contained staircases to get down to the estuary. One of these staircases was covered with concrete once the new enlargement of this dock was carried out by building up piling for supporting a platform in 1927, while the other staircase was not altered but, obviously, it would not be used again. Such staircases can be identified in the contemporaneous blueprints (Fig. 4).

Several bollards appeared in the works, one still in situ as it appeared at the edge of the area to be repaired and was left there, covered with the new cobblestones. Some mooring rings are still in the frontwall; one like this was found some years ago in another part of the town while doing some building and it is now in the Basque Museum of Bilbao.

The different types of rails –mentioned above– were also used for the Uribitarte dock. Such rails were recorded in this dock and they allow us to understand the need for reclaiming land in the estuary. Similarly, the old cobblestones which appeared were, according to the documents, from the quay of either Deba or Orozco (Fig. 5).



Figure 4. Frontwall of the Arriaga dock being repaired. 1) detail of the staircase being blocked once the platform was built; steps are visible; 2) detail of the rails, platform built in 1927 and the 1890 frontwall with the top of the staircase blocked; 3) detail of the mooring ring inside the frontwall; 4) Phoenix rail; 5) detail of the frontwall where the mooring ring is; 6) bollard found in situ (Photo J. M. Matés Luque).

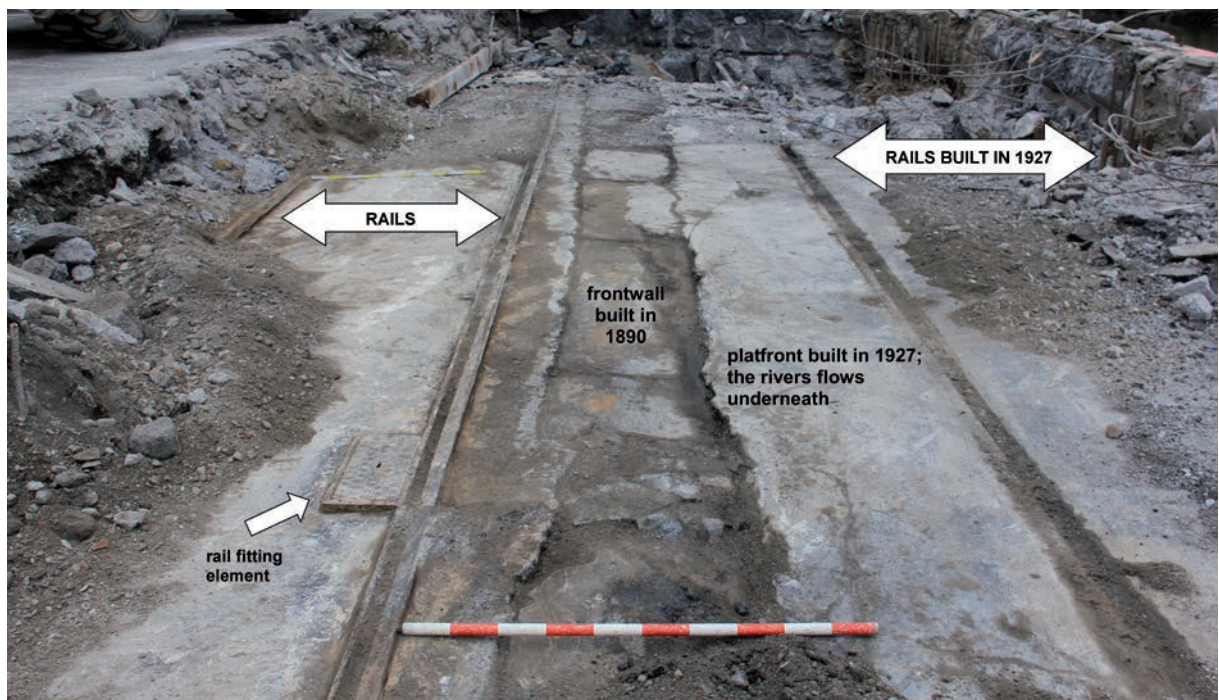


Figure 5. Detail of the Arriaga dock; the different pairs of rails can be seen as well as the 1890 frontwall, and the platform built in 1927 (Photo J. M. Matés Luque).

La Ribera, Ibeni and La Merced docks

For these docks, little archaeological record was carried out in 2012 as the repairs were directed to fill in the gaps in the foundations of the frontwall, and the activity was carried out by commercial divers. However, by comparing engravings from the 16th century, photographs and documents, the evolution of these docks can be fully understood.

The first image of Bilbao is in the *Civitates Orbis Terrarum*, by Braun and Hogenberg in 1572, which despite some idealistic representations, it helps to identify some maritime elements; along the years more paintings by some artist, like Luis Paret in 1783, allow a better understanding of how Bilbao had to deal with its needs and the estuary (Cenicacelaya/Román/ Saloña, 2001; Sazatornil, 2006: 91, 101-102). Here, the old ramps were also replaced by a vertical front-wall in 1912 allowing the near train station to have more space for rails.

It is in this part of the docks where the oldest church of the town was built as a gate with a bridge to control the access from across the river; ships could reach up to this point and it must have been some sort of wooden jetty for cargo vessels to load and unload their goods (Fig. 6). This area has become the market of the town since, with the so called Mercado de la Ribera (or in English the *Riverbank market*) (García, 2002; García/Plata, 2003), and therefore it has been a core of the economy in the town; still in the 19th and 20th century there were some small boat-yards here (Guiard, 1968: 245) and rails for the tram connecting the center and other towns inland also used this nearby space (Olaizola, 2001). It is clear that this area has suffered a lot of transformations through the centuries due to floods, need to change the riverbank or to any other development carried out by the Town Council. The transformation which fixed the riverbank as it can be seen nowadays is from the 1920's, and the pine or beech piling that can be seen at low tide must be from that period. Such type of wood was recommended for piling foundations from the end of the 19th century (Plá, 1897: 37; 2002, 44).



Figure 6. La Ribera dock. The current church is placed on top of the old medieval gate. The left part of the bridge was placed between the bridge and the market, now on the left of the picture. Behind the bridge is the Ibeni dock. Opposite the La Ribera dock is La Merced dock (from where the photograph has been taken). This area has been widely transformed, from a natural riverbank to slopes to get to the river and to vertical walls, removing or covering the old slopes (Photo J. M. Matés Luque).

Conclusion

The watching briefs carried out have allowed to match the contemporary documents with whatever archaeological remains have been uncovered and recorded due to the new civil working repairs. It is clear that this is not going to modify the history of Bilbao. No significant artefact has appeared; however, one never knows what can be buried and archaeology has always un-

covered superb artefacts –sculptures, pottery, anchors, guns or even ships– which give an opportunity to understand our past better. Archaeology can identify stratigraphic units and the artefacts found in them with the photographs, engravings and documents and link them (Good/Jones/Ponsford, 1991; Heard/Goodburn, 2003; Jackson, 1983; Pinheiro, 2003; Stammers, 2007).

By going hand in hand with the civil engineering works carried out by Town or Regional Councils, or any other developer, archaeology provides a tool record what is under our feet. In this case, the archaeology carried out in maritime and river towns allows for a better understanding of how humankind has been adapting the natural environment for its needs. Bilbao is a small town on the top zone where the tide can go up to; it is a town surrounded by medium high hills (and which were inhabited in ancient times, during the Bronze and Iron Age); officially founded in 1300 on a previous fishing harbour, which was already in use from 1200, it has suffered the need to extend its area for housing, docking and any other activity which required land. For the last 20 years, the traditional Bilbao harbour activities carried out in the center of Bilbao have been moved to the new dock installations at the mouth of the estuary on the sea for bigger vessels and for taking out, from the city center, any industrial activity (shipbuilding, factories...) which has been common since medieval times. The estuary has been used to enlarge the land area and it cannot take any further reduction, hence the need to search for wider spaces on the seacoast. Fortunately, the developers in the estuary of Bilbao have realized how important their projects are to achieve this goal: understand how a maritime town grows and breaths. And archaeology is the right tool.

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Muelles antiguos de Santander: estructuras portuarias de los siglos XV-XVI y sus obras de ampliación del siglo XVIII

Santander's ancient wharves:
port structures of the 15th-16th centuries
and its expansion works of the 18th century

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Resumen: estudiaremos las infraestructuras del puerto antiguo de Santander para entender su evolución, durante el periodo comprendido entre el siglo xv y el siglo xviii. Analizaremos los momentos de ruina y reconstrucción, sus diferentes ampliaciones...; ubicaremos sus diques y muelles gracias a los hallazgos arqueológicos recientes, con el fin de valorar nuestro patrimonio arqueológico, así como, la historia de la ciudad y puerto de Santander con sus inmejorables condiciones para la navegación y el desarrollo de las actividades humanas ligadas a ella.

Palabras clave: Santander, puerto, muelles, diques, estructuras portuarias.

Abstract: The infrastructures of Santander old port will be studied in order to understand its evolution between the 15th and 18th centuries. We will analyse its period of ruin and its reconstruction, its different extensions, and so forth. The dikes and wharves will be also placed thanks to the latest archaeological finds. Being the aim of this lecture the appraisal of our Archaeological Heritage value as well as that of the history of the town and of the port of Santander, with its unbeatable conditions for navigation together with the development of human activities linked to Santander.

Key words: Santander, port, wharf, dike, port structures.

Antecedentes

La bahía de Santander, por sus especiales características, siempre ha constituido un área humanizada. Los navegantes que arribaban a la bahía de Santander en busca de refugio de los mares y vientos de norte lo hallaban, después del abra del Sardinero y la ensenada de la Magdalena, en la llamada Puebla Medieval con sus indiscutibles e inconfundibles estructuras portuarias, bajo el amparo y protección de la abadía de San Emeterio; nombre del que deriva etimológicamente Santander, tal como se lee en un documento fechado en 1068 «in porto Sancti Emeterii», y en el texto foral otorgado a Santander en 1187, que menciona la «villa Sancti Emetherii» (Ramírez, 2003: 168).

Con anterioridad al año 1187, sobre el origen del núcleo poblacional primitivo, contamos únicamente con las actuaciones arqueológicas, básicamente centradas en la cripta de la antigua abadía, cuyos hallazgos parecen corroborar la localización del asentamiento romano *Portus Victoriae Iuliobrigensium* (Plinio el Viejo, *Naturalis Historia*, 4, 111); según los trabajos realizados por González Echegaray y Casado Soto en sus campañas arqueológicas de 1982-83 y 1994. En dichas excavaciones se identificaron unas instalaciones termale, una calle y una robusta fortificación; pero ninguna estructura que nos permita ubicar el puerto romano bajo imperial de Santander.

Los vientos reinantes, factor determinante para la ubicación de un puerto, en la bahía de Santander son y eran los del tercer y cuarto cuadrantes, además, en verano los del primero. Los vientos del sur son los más violentos y los que más marejada levantan en la bahía, dificultando e imposibilitando en ocasiones la navegación de embarcaciones menores. Son relativamente frecuentes a principios de la primavera y durante el otoño.

La zona de la bahía protegida de todos estos vientos y con calado suficiente, es donde se ubica el puerto de la villa de Santander, al menos desde el siglo xv, protegido de los nortes por las laderas de la ciudad y de los noroestes por el cerro de Somorrostro, necesitando de diques para protegerse de los violentos sures y del menos tumultuoso este, completando el conjunto con muelles para las tareas propias de una actividad portuaria.

El puerto en el siglo xvi

Esta panorámica de la ciudad de Santander vista desde uno de los extremos de la bahía, incluida en la obra de George Braun *Civitates Orbis Terrarum*, primer atlas de ciudades del mundo, publicado por primera vez en 1572 como complemento al *Theatrum Orbis Terrarum* de Abraham Ortelio, realizado del natural en 1565 por el dibujante Joris Hoefnagel (1542-1600) y grabado por Frans Hogenberg (1535-1590), nos proporciona la primera imagen que nos muestra un nexo de unión entre el puerto y la ciudad.

En la descripción de Santander, traducida por don Marcelino Menéndez Pelayo de la que publicó Braun junto al grabado, se dice a propósito del puerto:

«[...] Situada a la falda de una colina de suave pendiente, desciende al mar, cuyas aguas pasando por la derecha del castillo se extienden más allá de la población; por la izquierda la tocan en su mayor parte, y penetran en su interior por un canal que llaman la Ribera, cuya entrada se conoce vulgarmente con el nombre de boquerón.

»Por otra parte hay un terraplén extendido a manera de brazo hacia las olas; llámenle muelle viejo, y tiene al extremo una máquina que facilita la carga y descarga de los navíos y llamada comúnmente la grúa. Toda esta ensenada puede considerarse como un solo



Figura 1. George Braun, Frans Hogenberg (1575): *Civitates Orbis Terrarum*. Colonia.

puerto. Aquí penetra el mar por un estrecho a manera de boca, y el puerto está naturalmente defendido y cerrado por todas las demás partes. Enfrente de la ciudad hay otro muelle, un poco encorvado para mayor comodidad del puerto; tiene dos objetos: defender la población de los furores del mar y ofrecer a las naves lugar para la descarga y refugio. En la boca de este puerto hay un escollo llamado Peña de Mogro [...].

El grabado muestra la colegiata y el castillo situados en el cerro de Somorrostro (Puebla Vieja), así como la muralla que, partiendo de la torre sureste del Castillo, desciende de forma escalonada por una importante pendiente hasta el nivel del mar. Esta finaliza en una torre que cerraba el perímetro defensivo, uniéndose al espadón almenado, situado sobre el dique sur del muelle de la Naos, con su inconfundible aspecto encorvado, pretendiendo ofrecer el máximo abrigo con la mínima estructura. Todo ello nos presenta la secuencia defensiva bajomedieval de colegiata, castillo, muralla y muelle.

Se observa también en el grabado la puerta de Somorrostro, la Casa de la Bastida, el Boquerón con sus torres defensivas protegiendo la entrada de la ría de Becedo y la navegación

hasta las Atarazanas Reales. Atravesando la ría hacia el norte (Puebla Nueva) vemos las puertas de la Ribera y del Mar, y situándose entre ambas el portillo de D. Gutiérrez. Puertas y portillo que permitían el acceso al Cay, nombrado en documentos municipales como «cae», posteriormente «cay», en clara alusión a los muelles construidos con troncos y tablas sustentados probablemente sobre rollizos.

Enfrente del comienzo de la calle del Mar nos encontramos con el Muelle Largo que realiza el cierre este del puerto. Situada en el extremo observamos una grúa de rueda utilizada para la construcción del muelle, que se avanza con el progreso de este a diferencia de lo que se nos dice en el texto. Sabemos que en 1542 el Consejo de Castilla autorizó la construcción de nuevos muelles, que ampliaran los ya construidos en época medieval, «[...] e para remedio desto combenia que se hiziese vn muelle e contramuelle que començase de la Yglesia de los Cuerpos Santos hasta las peñas de Herbosa, que podría aber quatroçientas braças poco mas o menos [...]», lamentablemente no tenemos información alguna sobre el comienzo de estas obras; pero en 1551 se puso en marcha un nuevo proyecto con modificaciones, se trataba de construir un largo contramuelle un espigón que desde el principio de la calle del Mar se dirigiera hacia la cabeza del muelle de la Naos, detallándose en los documentos reales sus características técnicas constructivas y las especificaciones para el equipamiento del contramuelle:

«[...] quatro o cinco escalas por la parte de dentro [...] de dos pies y medio de largo y pie y quarto de ancho [...]. Se pongan seys o siete marmoles de piedra entera donde se amarran las naos e navios e otras fustas de la parte de dentro [...]. Se an de hazer e poner de la parte de dentro seys argollas de piedra questen escondicas de dentro de la obra [...] y que tengan ally dentro son cocavydad e lugar para meter cables y se amarrar qualesquiera naos e futas. Y se ha de hazer otra argolla de piedra grande en la cabeça del dicho contramuelle [...]».

«[...] Ytem que todas las dichas obras de los contramuelles y traves y servicio del vaya muy bien asentado y anivelado y con muy buenas juntas y con muy buenas legazones y que baya puesto e asentado por mano de muy buen asentador [...]. Y que las piedras que en ello se asentaren bayan una a la larga e otra a tyzon, corta al traves, y que todas alcancen un pie la una y la otra, asi de largo com de traves. Y que entre las dichas piedras vaya muy bien rripiado y enmynonado de piedra menuda de suerte que el agua no tenga lugar de hazer dentro concavidad. Y todas las juntas de las dichas obras de las caras de dentro y fuera vayan labradas a punta con rregla y escuadra [...]».

El dibujo de Hoefnagel, realizado en torno a 1565, nos muestra la diferencia entre lo proyectado y lo ejecutado hasta el momento; así tenemos, el muelle largo con un progreso aproximado de sus dos terceras partes y sin comenzar su fábrica el nombrado «traves» en la documentación, que a lo largo de la calle del Mar se uniría a él prestándole servicio. Algunos autores sostienen que la construcción del contramuelle se inició en 1561 y establecen la fecha de la visita de Hoefnagel en 1563 (Aramburu/Alonso, 1994: 154-155). Esto supone que el muelle de 100 m habría sido construido en dos años, lo que consideramos un tiempo demasiado corto, a juzgar por proyectos posteriores y la complejidad de la obra, cimentada en el agua.

Tanto el proyecto como la obra que se llevó a término eran muy ambiciosos, en un momento de grandes expectativas para el puerto santanderino; tanto es así, que hasta mediados del siglo XVIII no fue necesario ampliar o reformar esta estructura portuaria.

El proyecto de Llovet

El 25 de marzo de 1765, el Ayuntamiento recibe una orden del rey en la que se dispone que el ingeniero don Francisco Llovet pase a la ciudad y levante con exactitud el plano de las obras, «y sondeando y examinando el fondo que proyecte, determine el costo de las mismas». Era condición precisa el restablecimiento del puerto como lo estaba de antiguo. El 26 de noviembre de 1765 se recibe carta del marqués de Esquilache por la que se comunica que el rey, para fomentar el comercio por el puerto de Santander, ha mandado formar el plano de esta obra y ha encargado de su ejecución al ingeniero redactor del proyecto.

De la copia manuscrita del proyecto por él redactado y de los libros municipales consultados, podemos deducir con bastante claridad en qué consistían las obras; limitándonos en lo posible a lo concerniente a estructuras portuarias, pues en estos documentos, y más aún en los posteriores, no se diferencia entre obras del puerto y obras de la ciudad, mostrándonos una visión unificada de la evolución puerto-ciudad, imposible de entender por separado.

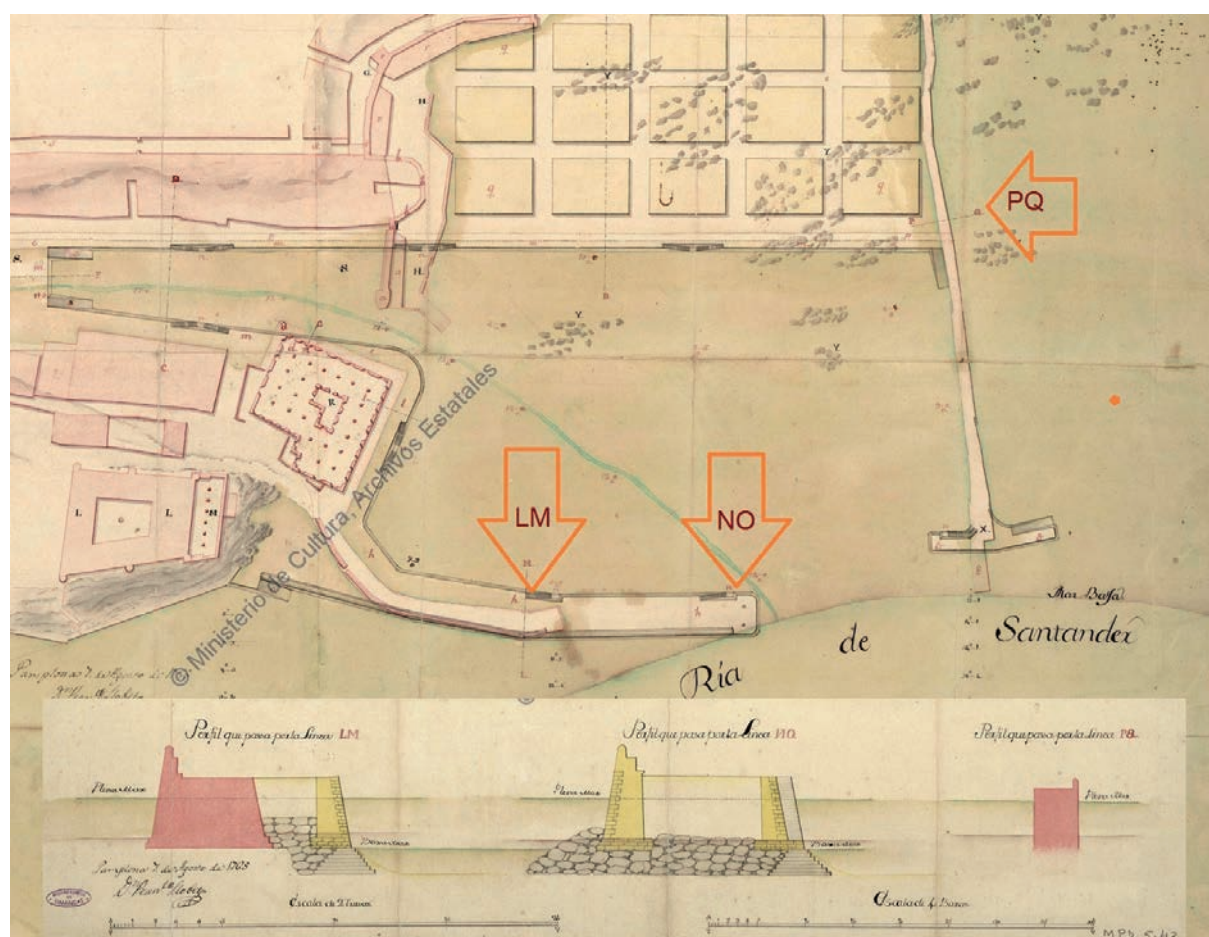


Figura 2. Ministerio de Cultura, Archivo General de Simancas: MPD, 04,047 y MPD 05,043.

«Plano de parte de la ciudad de Santander y su Puerto, conforme hoy día se halla, con proyecto de las obras que se consideran necesarias para ponerle en el debido estado, y facilitar à las Embarcaciones mercantiles su alixio y cargamento, como igualmente el mayor abrigo en los bientos tempestuosos».

El detallado proyecto del ingeniero Llovet nos obliga a centrarnos en las obras portuarias, que nos permitan ubicar los muelles antiguos. Esta tarea facilitada por la minuciosidad y secuencia de planos que a modo de certificaciones de obra, nos permiten realizar un seguimiento desde el 7 de agosto de 1765 a diciembre de 1769 del «Puerto de Santander y adelantamiento de sus obras levantadas por D. Francisco Llobet», depositados en el AGS. Secretaría de Guerra, Legajos 00390.

«Muralla que ha de construirse desde el Cay a unirse al muelle largo arreglado en su longitud y latitud al que manifiesta el plano y su altura quedará manifestada con los dos extremos del Cay y Muelle largo,[...] para la formación de los andenes de la Dársena y Puerto». Muelle que junto con las alcantarillas proyectadas permitirán la edificación de las futuras viviendas de la burguesía mercantil santanderina.

«Extensión y ensanche que debe darse al muelle de las Naos, ejecutando esta obra con la misma longitud, latitud y forma que manifiesta el plano y arreglando su altura a la que tiene el muelle antiguo con el que debe unirse; y concluido con el mismo género de obra que este tiene». Como vemos, se proyecta un nuevo dique sur siguiendo la línea del antiguo, al menos en el tramo que coincide con él, prologándose en dirección este en busca de la canal y del muelle Largo. El perfil de la línea LM del muelle de la Naos nos muestra en encarnado y color tierra la obra según se encuentra a 7 de agosto de 1765 y en amarillo la que se proyecta. El perfil nos documenta la intención del ingeniero de realizar una cimentación sobresaliendo del dique; un cuerpo central de fábrica formado a base de hiladas de sillería con buenas juntas en la unión de sus superficies de contacto; sobre el que se proyecta un espadón en tres cuerpos y gran altura para minimizar el rebase; mejorando la interacción dique-olaje y protegiendo la dársena y el dique de atraque, dibujado de color amarillo, del que reconocemos su disposición en talud. Tenemos por tanto documentado el dique sur de rompeolas y el norte de atraque, quedando el antiguo muelle de las Naos embutido entre los dos, a modo de ripio y mampostería para el relleno del andén resultante o muelle.

El perfil de la línea NO, no localizado en el plano pero que suponemos al este del anterior en las escaleras del extremo sin el muelle de la Naos entre los dos diques, con una bermascolera de protección y una cimentación sobresaliente, que parece realizar embebida en la berma una función de bloque guarda antisocavación, debido a la mayor profundidad que se alcanza en busca de más calado. Con el perfil PQ identificamos al muelle Largo, el representado en el grabado de Braun con la grúa, sobre el que se dispone un espadón simple que protege la dársena de los vientos del este. En su extremo distinguimos al «martillo que se propone [...] para el abrigo de lanchas y otras embarcaciones», buscando el canal tenemos la «rampa que debe quitarse por el perjuicio que puede ocasionar a las embarcaciones a causa de no descubrirse sino en bajamar», demostrándonos de esta manera que el muelle Largo fue ampliado en toda su longitud con anterioridad a 1765.

Sobreponiendo el plano de Llovet a la cartografía más reciente el PGOU del 2012, obtenemos por la adaptación de las escalas de ambos planos sobre el primer edificio frente a las casas de la ribera, una medición de 14 toesas equivalente a 27,24 metros; y adaptando la longitud del barrio proyectado –girando el norte actual 7° al oeste (-7° W)–. Y confirmando con la ubicación de los restos arqueológicos hallados: por el norte con la puerta del Mar/Cay –localizada en 2006 en el Centro de Interpretación de la Muralla Medieval–; por el sur con el muelle de la Naos –localizado con el Centro de Interpretación de los Muelles Antiguos de Santander–; y por el este con el «caño cubierto para las aguas de los vertientes circumbezinos» que atravesando el muelle Largo desemboca en la confluencia paseo de Pereda-Marcelino Sanz de Sautuola, existente en la actualidad.



Figura 3. Interpretación muelles antiguos, cartografía PGOU 2012.

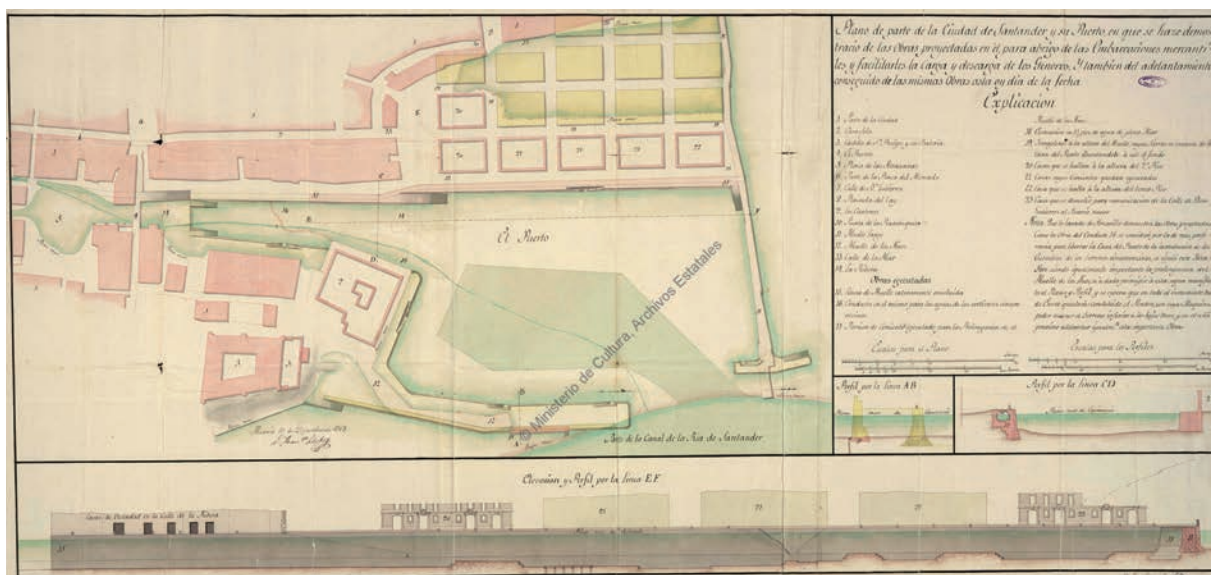


Figura 4. Ministerio de Cultura, Archivo General de Simancas (AGS): MPD, 02,062.

«Plano de parte de la ciudad de Santander y su puerto, en que se haze demostracio de las obras proyectadas en él, para el abrigo de las Embarcaciones mercantiles y facilitarles la Carga y descarga de los Generos. Y tambien del adelantamiento conseguido de las mismas Obras asta oy dia de la fecha». Madrid 31 de diciembre de 1769.

En el último plano del ingeniero Llovet observamos al muelle de la Ribera completamente finalizado; al barrio nuevo con sus edificios en diferentes fases constructivas; la alcantarilla finalizada y atravesando el muelle Largo; al muelle del Cay desaparecido y convertido en plazuela. En el muelle de la Naos tenemos una porción de cimientto ejecutado para su prolongación, adelantándonos que en el mes de enero próximo quedará concluido el pontón, con cuyas máquinas poder excavar el terreno inferior a la bajamar y adelantar las obras. Del perfil AB vemos en alzado la parte del dique ejecutado.

La prueba arqueológica de la prolongación del muelle nos la ofrece una noticia aparecida en *El Diario Montañés* el 6 de octubre de 2013: «[...] Cuando las máquinas habían avanzado 70 metros de los 219 metros que medirá el paso, apareció un muro datado en el siglo XIX», ratificándonos la arquitecta y responsable de la ejecución del proyecto que «no es la primera vez que los diversos trabajos en el subsuelo del túnel y accesos sacan a la luz restos de antiguos muros», y confirmando que así sucedió recientemente con las obras del murete guía norte/sur, con una construcción similar. Una semana más tarde se nos dice que este periódico ha tenido acceso a las conclusiones del informe, en el que se atestigua que el hallazgo «no posee un interés patrimonial relevante, debido a su cronología contemporánea y al hecho de que ya ha sido debidamente documentado y que otros restos pertenecientes a la misma estructura también fueron descubiertos en 2006». Es decir que tienen un «escaso valor». El especialista que firma el documento propone, por esa razón, «su completa retirada».

El artículo continua aportando datos: «Además de la construcción de piedra, también se encontraron algunos restos de una estructura de madera en su parte más baja, relacionados con toda probabilidad, con la cimentación del dique. Se trata de una línea de vigas dispuestas de forma horizontal –pegada a los bloques inferiores del dique– y que estaban sujetas por una estacada de pilotes de madera clavados en el fondo marino. La mencionada cimentación estaba formada por las dos hiladas de bloques inferiores, de mayor tamaño que el resto, que sobresalían ligeramente del frente del dique». Esta información confirma la no utilización por Llovet del sistema constructivo de encajonado en la cimentación, probablemente por la experiencia negativa que tuvo en la construcción del Arsenal del Ferrol, ya que, la trabajabilidad y el resultado obtenido con la cal bajo el mar no era bueno, produciendo unos cajones endebles y quebradizos; y sí nos demuestra una cimentación de grandes bloques de sillería desbastados dispuestos en graderío, y en la zona que así lo requiriera una pilotación semiprofunda sobre la que se disponen vigas de madera, datadas en 1760 por dendrocronología, en la intervención del 2006 del aparcamiento subterráneo.

En cambio nada sabemos de la cara interna del dicho dique y menos aún del contradique, del relleno del andén y la existencia o no de la berma-escollera. Tampoco tenemos prueba arqueológica del muelle Largo afectado con toda seguridad por las mismas obras de soterramiento de la circulación en el entorno del Centro de las Artes Botín, en construcción en la actualidad según proyecto del arquitecto Renzo Piano. Vacío arqueológico que únicamente nos permite aventurar la hipótesis de que el resto de los materiales de la cara norte del dique encontrado, todo el contradique, el ripio y la mampostería del muelle, la presumible escollera y el muelle Largo en su totalidad, se desmantelaran para reutilizar su piedra. Probabilidad muy descartable, pues este tipo de estructuras dejan indudablemente algún tipo de impronta arqueológica.

Como vemos es en 1770 cuando Llovet abandona el proyecto y más concretamente don Lorenzo de Alvarado que lo dirige a pie de obra, cuando este último es reclamado para la dirección de las obra del puerto de Cádiz. Le sucede en la dirección, ese mismo año, el ingeniero don Gaspar Bernardo de Lara que continúa las obras siguiendo las directrices de Llovet. En 1779 son nombrados directores don Juan de Escofet y Fernando de Ulloa para trazar un nuevo proyecto que no se materializa en obra portuaria alguna.

El último impulso a las obras del puerto en el siglo XVIII

El 24 de enero de 1788 el rey aprueba el proyecto realizado por el capitán de fragata don Agustín de Colosía encomendándole su dirección, estando a sus órdenes los arquitectos de Marina don Francisco y don Juan Solinis. Para la realización del proyecto se tomarán a don Juan de Isla y otros particulares terrenos y casas, resarciéndolos el daño causado. La expropiación y derribo de la casa-Sola, propiedad de don Juan de Isla, permitirá construir en su lugar una parte de la dársena, alineándola definitivamente con el muelle de la Naos, siendo descubiertos sus restos arqueológicos durante las obras del aparcamiento subterráneo en noviembre de 1976.

La línea de color negro nos muestra el muelle finalmente construido que realizaba el cierre de la dársena de la Ribera.

En 1792 se produce el primer parón de las obras por falta de caudales, como nos refleja la carta dirigida por don Agustín de Colosía al cabildo el 30 de noviembre «[...] hoy no puedo hacer frente a los pagos pues nada se ha ingresado en caja. Pero no es esto todo el mal, Havien-

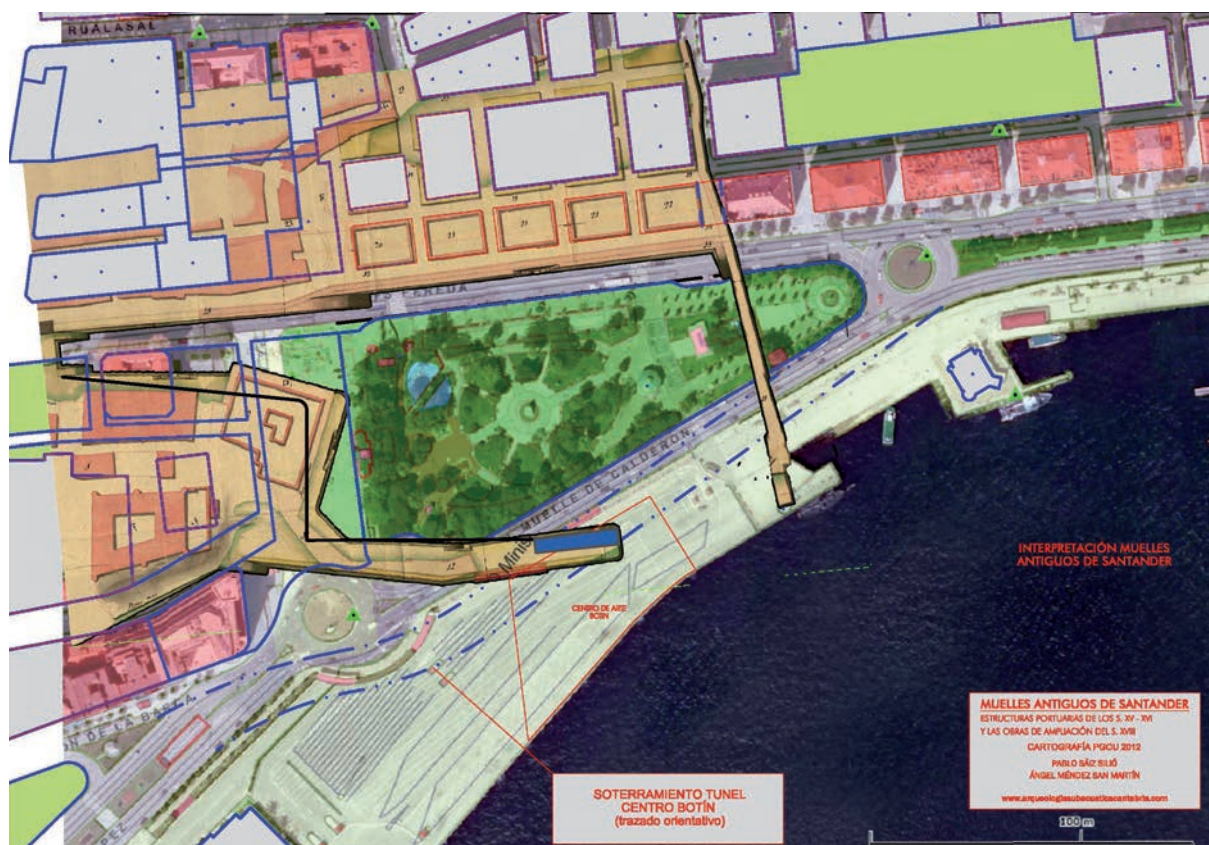


Figura 5. Interpretación obras de don Agustín de Colosía (1794).

do V.S. prometido a S.M. tomar a censo sobre propios y arbitrios no tan solo los dos millones (a igual con el Consulado), sino también las demás cantidades que se necesitan hasta concluir las obras, mientras las dos comunidades se convienen, tengo setecientos ochenta hombres trabajando sin jornal para comer [...]. El 14 de mayo de 1794 en cumplimiento de una real orden fechada en Aranjuez a 2 de mayo, se dispone la paralización de las obras de los muelles, y por tanto la retirada de su director junto con los dos arquitectos a sus órdenes; la ciudad y el Consulado deben pagar lo que se les adeuda a los arquitectos –Colosía había renunciado a la gratificación con anterioridad–; así como a los jornaleros y proveedores. Las máquinas, instrumentos, materiales y demás enseres se entregarán, bajo inventario, a un guarda almacén que se nombrará de acuerdo con el Consulado.

De esta forma se concluyen las obras del puerto en el siglo XVIII. El proyecto de Colosía sobre el martillo del muelle Largo, ha dejado un legado en el callejero santanderino, el nombre de la calle del Martillo desde la que partía el muelle, conocida hoy como calle Marcelino Sanz de Sautola y situada bajo el arco del Banco Santander.

Por lo anteriormente expuesto podemos deducir que es el proyecto de Llovet el que marca las directrices generales de las obras ejecutadas en el puerto y en la ciudad durante el siglo XVIII, completando los sucesivos directores el plan marcado con pequeñas modificaciones, fruto muchas de ellas por las protestas vecinales surgidas por la conveniencia o no del cierre de la navegación por el arroyo de Becedo.

La dársena Chica se cerró en 1860 acabando definitivamente con un pleito que duró más de 100 años, comenzándose en 1880 los planes para rellenar la dársena de la Ribera quedando finalizada en 1898 con la terminación de los jardines de Pereda, preservando los restos de los antiguos muelles medievales y sus ampliaciones del siglo XVIII hasta la actualidad.

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Underwater Cultural Heritage in Lagos Bay, Portugal. 2014 field work results: The anchor collection

Patrimonio cultural subacuático en la bahía de Lagos, Portugal. Resultados del trabajo de campo de 2014: la colección de anclas

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Abstract: The underwater cultural heritage in Lagos has been researched in order to obtain further knowledge of Lagos history. Lagos was one of the main ports of Algarve from the late antiquity to the late modern age. As the city developed across the ages, anchorage, fishing and maritime trade practices adapted to the ever changing environment. Although that much of the maritime interface of Lagos now lies under its urban foundations, part of it resides in the sea bottom of the bay of Lagos. We intend to demonstrate the recently discovered Underwater Cultural Heritage and how it is allowing us to understand some of Lagos shipping and fishing activities.

Key words: Nautical archaeology, anchors, Iberian seafaring.

Resumen: el patrimonio cultural subacuático en Lagos se ha investigado para avanzar en el conocimiento de su historia. Lagos fue uno de los principales puertos del Algarve desde la Antigüedad tardía a finales de la Edad Moderna. A medida que la ciudad se desarrolla a través de los siglos, fondeaderos, prácticas de comercio marítimo y pesca se adaptaron a un entorno cambiante. Aunque gran parte de la interfaz marítima de Lagos se encuentra ahora bajo sus cimientos urbanos, parte de ella reside en el fondo del mar de la bahía de Lagos. Proponemos mostrar el patrimonio cultural subacuático recientemente descubierto y cómo este nos permite comprender algunas de las actividades marítimas y de pesca de Lagos.

Palabras clave: arqueología náutica, anclas, navegante ibérico.

Introduction

This article aims to present the Project's 2014 field work preliminary results within their broader scope, together with the background and procedures used. We intend to describe the various results presented, but focusing on the discovery of 106 anchors in Lagos Bay. Within the historical background and based upon archaeological evidence we present our proposals regarding anchorage areas and old tuna fish traps in use in Lagos since the 14th century. One must consider that the Lagos Bay, is one of the largest in Europe, and the project only has surveyed about 30%. We hope that in the coming years, with the help of remote sensing methods, to achieve a wider coverage of the area and increase archaeological findings that help to understand the role of Lagos as a city and port with an activity that spans two millennia.

Location and geomorphology

Lagos Bay is located in southern Portugal, in the region of Algarve (Fig. 1).

It extends for 11.5 km and is the largest bay in Portugal (C.E.G.E., 1996). Two cities are established in the bay, Lagos and Portimão, whom divide the bay's shoreline into their two municipalities. It belongs to the Barlavento Region of Algarve, an area composed mostly of cliffs with some sheltered coves. Weather in the region is considered mostly Mediterranean (Cunha, 1988). The prevailing winds come from northwest in the winter time and from southwest in the summer (Cunha, 1957). Lagos bay presents a cliff side from its northwest border and has an extended stretch of beach going from the border of Lagos to the next cliffs near Portimão. The back countryside in this area is a long plain up to the hillsides of the Algarve's hillside. The bay offers protection from the dominant winds near the northwest area, where Lagos is located.

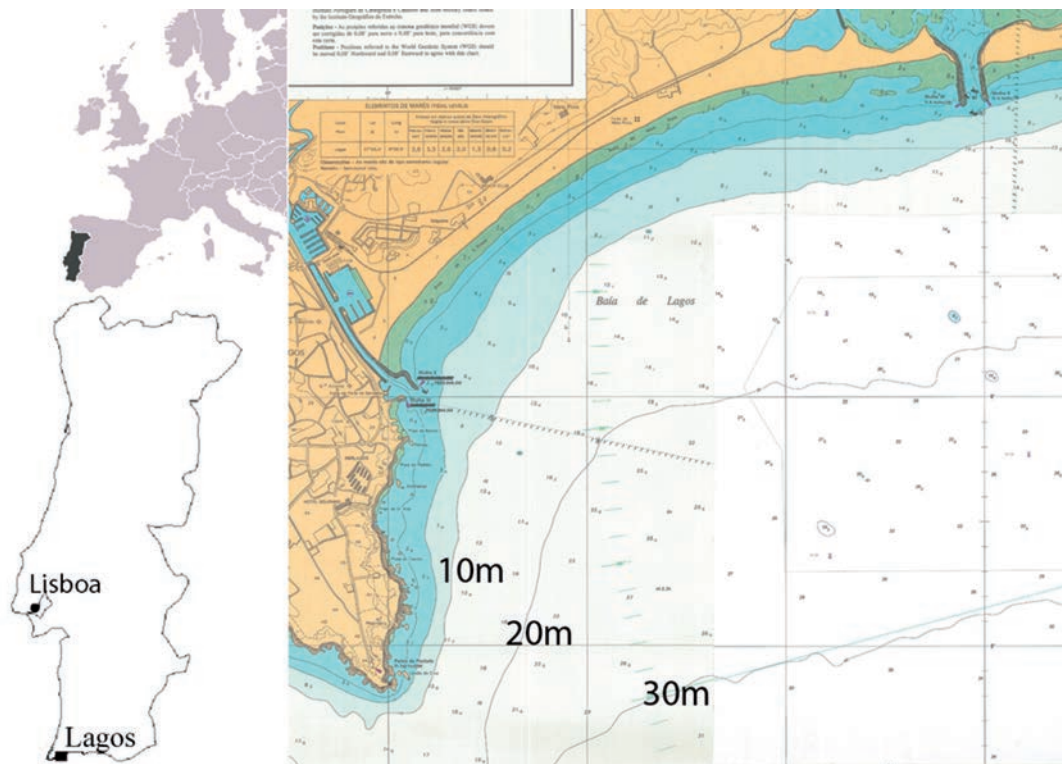


Figure 1. Location and morphology of the Lagos Bay.

Three rivers flow into the bay, Odiaxere-Besafrim river, that bathes Lagos, Alvor-Arão river where Alvor village is located, and Arade River. At this river mouth is located Portimão and the river was the main maritime access to the Islamic Capital of Silves situated inland (Relvas/Loureiro, 1976). The seafloor is depth related. From the shore to about 20 meters it is mostly composed of sand, with pockets of coarse sand and rock outcroppings. This is because of erosion process of calcareous stone that compose the majority of the shore's substrate. From 20 meters deeper the sea bottom is composed of fine mud, originating mostly from biogenic processes, which is easily disturbed by the intensity of the water discharges from the rivers when they are at their peak.

Historical Background

The development of human occupation in the bay of Lagos can be traced back to pre-historical times (Morán, 2006). When those occupations became more secure, networks developed between neighboring centers. This allowed for urban development and maritime trade, especially in the areas near the estuaries of Alvor and Besafrim. Archaeological evidence in the Besafrim suggests the development of a pre-Roman maritime city (Blot, 2003). However, is only in the Roman period that we can state the existence of a well-developed trade, Lacobriga (Lagos) is considered one of the main ports in the Iberian Peninsula at that time (Formosinho, 1992). During this classical period the Lago's main settlement was in Monte Molião, inland of the Bensafrim river, 5 km north of the modern city. This settlement grew with the progressive occupation of the river banks and with the appearance of *uillae* along the coast. This settlement was later abandoned and resettled in its present location for reasons unknown (Arruda, 2007). During the Islamic-medieval period, Lagos was one of the fortified towns that protected the Muslim capital of Silves (Coutinho, 2001). Major maritime traffic would continue inland, through the Arade River up to the capital (Blot, 2003). During the Islamic period, al-Gharb (Algarve), was mainly an agricultural export region, but with some specialized maritime products, anchors. Those where manufactured in the region and exported to the Maghreb (Picard, 1999). During the Christian-medieval period, gradual silting of the Arade River, from A.D. 11th century onwards, led to the shifting of the maritime traffic towards Portimão and Lagos (Blot, 2003). With an economy based most of all on fishing and trade (Loureiro, 1991), Lagos with a city charter granted by King Alfonso III, is released from the jurisdiction of Silves in 1361 (Martins, 2001). The bay's natural conditions aided Lagos in gaining prominence in relation to other urban centers. Because Lagos had a strong population of experienced sailors accustomed to North African seafaring, it was chosen as a port for the Portuguese military expeditions to North Africa in the 15th century (Barbosa, 1993). The wide range of expertise among Lagos' mariners was also a factor for choosing this city as the maritime base for the famous voyages of discovery, by the Infante D. Henrique (Coelho, 1991).

With the Portuguese conquest of North Africa and exploration of Africa's western shore by Lagos' seamen, fleet assembly in Lagos became a common action for military naval expeditions to North Africa (Coutinho, 2008). Furthermore, the first trade houses, responsible for the riches of Arguim and Mina in North Africa, were headquartered in Lagos (Coelho, 1991), and by the 16th century Lagos became the capital of the Algarve Kingdom, replacing Silves.

During the 18th century, Lagos began to decline as the Algarve's principal maritime city due to the destructive earthquake of 1755. In addition to completely destroying the city of Lagos, the earthquake also silted the port to the point of restricting access (Costa *et alii*, 2005). It also has had an after effect of lowering the average sea water temperature, resulting in the decrease of fish close to the shore (Mendes-Victor, 2006).

Although reconstruction of the city started immediately, it lasted until the beginning of the 19th century, but the city kept most of its original urban blueprint (Paula, 1992; Pereira, 2013).

After the earthquake, political power was transferred to Faro, which became the political capital of the Algarve Kingdom. Relevant maritime trade continued in the bay, however, all major port functions were shifted to Portimão. The decrease in fishing and the loss of the cities maritime infrastructure also led to a gradual decline in fishing activities but these lasted until the 20th century (Santos, 1989).

Project Background

This millenary maritime tradition in Lagos Bay was one of the primary reasons for the development of underwater cultural heritage surveys in the area.

In the latter quarter of the 20th century the National Archaeology Museum started to undertake fact finding missions in the field, triggered by news of fortuitous finds of underwater cultural heritage in the area (Alves, 2002). Some of these finds came from the visual surveys of two amateur diving associations dedicated to the study of cultural heritage, Grupo de Estudos Oceanos, based in Portimão, and Centro de Estudos Marítimos de Lagos based in Lagos. While in operation they discovered several isolated finds in Lagos bay, mostly anchors and pottery shards, but also started an ethnographic gathering of shipwreck sightings by the local fishing communities (Fraga/Marreiros/Jesus, 2007).

In 2006, «Projecto de Carta Arqueologica Subaquática do Concelho de Lagos» (PCASCL) was started, under the purview of the Council of Lagos (Fraga/Marreiros/Jesus, 2007). This was a systematic survey project intended for an understanding of Underwater Cultural Heritage present in the bay. It had the following goals: 1) Study the underwater cultural heritage as an indicator of maritime traffic; 2) Locate shipwrecks that would help increase our knowledge of shipbuilding and maritime life; 3) Ensure the protection of the underwater cultural heritage; 4) Study the maritime interface of Lagos.

PCASCL operated until 2009 and resulted in the discovery of five wrecks (Lagos A to E), plus discovery of isolated artefacts (Fraga, 2007a; 2007b; 2008; 2010; 2012a; 2012b). The project also was responsible for collaboration works as a Texas A&M University field school 2006 (Castro *et alii*, 2006), and a spin-off project focused on the study of the presumed *Canhoneira Faro* wreck (Fraga/Martins, 2009; 2011). From this project came the first proposal for the development of Lagos maritime interface (Fraga, 2013c).

Due to a change in the funding parameters PCASCL came to an end in 2010. However the local diving community started to view the project as their own and took upon themselves to continue the project. From such civil action came into play, *Carta Arqueológica-Baía de Lagos e arredores* (PCASBL). A project sponsored by Associação Dinamika with the help of local business, working under the purview of a research line of Centro de História d'Aquém e d'Além-Mar.

2014 Field Work

Our 2014 field work season relied in a volunteer-driven team oriented by two archaeologists. Our field work occurred from May to December and was composed mostly of visual surveys. It was very productive although required a few adjustments to the initial plan. It was concentrated around previous discoveries or remote sensing anomalies obtained in early years of the project (Fraga, 2008).

The discoveries were mostly anchors of all ages that appear to follow the 12 to 14 meters bathymetry beginning in the southern part of Ponta da Piedade and continuing up to Porto

de Mós. The anomalies come from the remote sensing missions done by ESGEMAR in 2006, and by IST/Blue Edge Systems in 2008, this gave more than one hundred anomalies for ground truth (Fraga, 2010).

The study of the anomalies came under the scope of our main goal, charting of UCH in the bay and focused especially in the location of shipwrecks of relevant scientific interest. Between 2006 and 2012, we had successfully located five shipwrecks from Lagos A to Lagos E. These discoveries resulted mostly from the ground truth of such anomalies. It was our expectation to proceed this type of work and locate more shipwrecks in the bay. However In 2013 in a fortuitous manner, during a scuba amateur dive it was located a cluster of artefacts. This cluster, with the discovery of hull structural pieces later became Lagos F, which is considered in lieu of present research an 18th-19th century shipwreck.

The resulting follow up of this find and of several others that occurred shifted our field focus from a ground truth approach to specific survey methodology. As such in 2014 we concentrated mostly on surveying the fortuitous finds. The only exception was Lagos B, a deep wreck composed of an exposed mound. Only was possible to devote one field day for a visual recording of the mound and any exposed features.

The vast majority of our field season was on the several anchors discovered in 2013, around 30 anchors. Initially as fortuitous finds, subsequent surveys allow to pinpoint an increased number, we located more than one hundred anchors. Being scattered in a wide field (more than 10 Ha) we decided a two pronged approach. Specific recording of each individual anchor, with attention to size, orientation and typology and a broader context view through their geo-referencing. Such approach intended to answer questions regarding their function in the context where they were found and the chronology of the sites. The project did have some setbacks, especially regarding pledged funding, which did not allow to develop some of the tasks initially proposed (especially regarding archaeometallurgy studies). Without those, our chronology proposals are mostly based upon morphological comparison of known parallels.

The field work concentrated in three specific areas, Porto de Mós, Ponta da Piedade and Meia Praia. To plot the concentration and variety of anchors at Porto de Mós and Ponta da Piedade survey was concentrated mostly in the 8 to 12 m ZH depth and at Meia Praia 16 to 18 m ZH depth. Shallower or deeper dives have to present day yielded no results. Was hoped that by plotting each individual anchor through special projection would be possible to ascertain anchorage concentrations and build parallels regarding vessel types (tonnage) and ascertain the reasons behind the selection of this anchorage sites. The initial amount of anchors was deemed significant enough to merit academic study as of a Master thesis (Baço, 2015).

As such, Geo-referencing of each anchor was paramount to this study, in a manner allowing their placement into a GIS platform. Being that GPS signal does not penetrate more than half a meter in water, geo-referencing was done through a buoy, laid vertically from the artefact to the surface. GPS plotting was done using a hand held GPS. Although error is normally high when not using DGPS systems, using a normal variety GPS was possible in specific case of Lagos. This is because the new EGNOS station of the Algarve is located in Lagos, differential corrections using that station connected to our GPS allowed for a 0.5 m resolution. Regarding that our survey areas extend from several hectares, this resolution is sufficient for our current research needs.

Meia Praia survey initially started in the same manner, with emphasis in anchors. However it is firmly believed that this area was used for anchorage and for line fishing. The pattern and diversity of finds seems to corroborate such usage. Mostly we have small to medium size anchors, smallest being made of stone and medium-sized of iron. They are gathered in tight clus-

ters and often discarded materials pepper the area, from plastic chairs to fragments of roman pottery. Wanting to increase our resolution and plot each individual find, using a vertical buoy for each and every located piece was impractical. A classical approach using a grid system for each major cluster was considered. However the finds tend to follow natural walls, either because of post deposition processes or not, the fact is that this terrain morphology makes the setting up of any kind of grid a challenge. As such we opted for a radial approach instead. Specific anchors were georeferenced and used as datum points. From those radial length and bearing was taken to surrounding artefacts. This method worked very well.

2014 Preliminary Results: Anchors

In the end of 2014 we had discovered, plot and recorded 106 anchors in Lagos Bay, This allowed unprecedented access towards the understanding of Lagos maritime activity. Identification and classification of the majority of these artefacts was a simple matter of applying good archaeological methodology together with research hours.

The main result of this work is the identification of four major groups, stone anchors, manually forged anchors, mechanical forged anchors and Court's process forged anchors. Some stone anchors can date back at least to Phoenician times, however at present time we are comfortable with a chronology rage between late-republican Roman (1st century B.C) to early 20th century. Specifically within iron anchors we have identified at least, ten different typologies of anchors in the researched areas (Baço, 2015).

For stone anchors the analysis was very basic, besides their georeference, simple measures and size estimate was done, the most significant or distinctive decorations were recorded, for example: a decorated stone anchor with a Christian cross or a stone anchor with a bag shape (Fig. 2).



Figure 2. Stone anchor with antropological motive (Author).

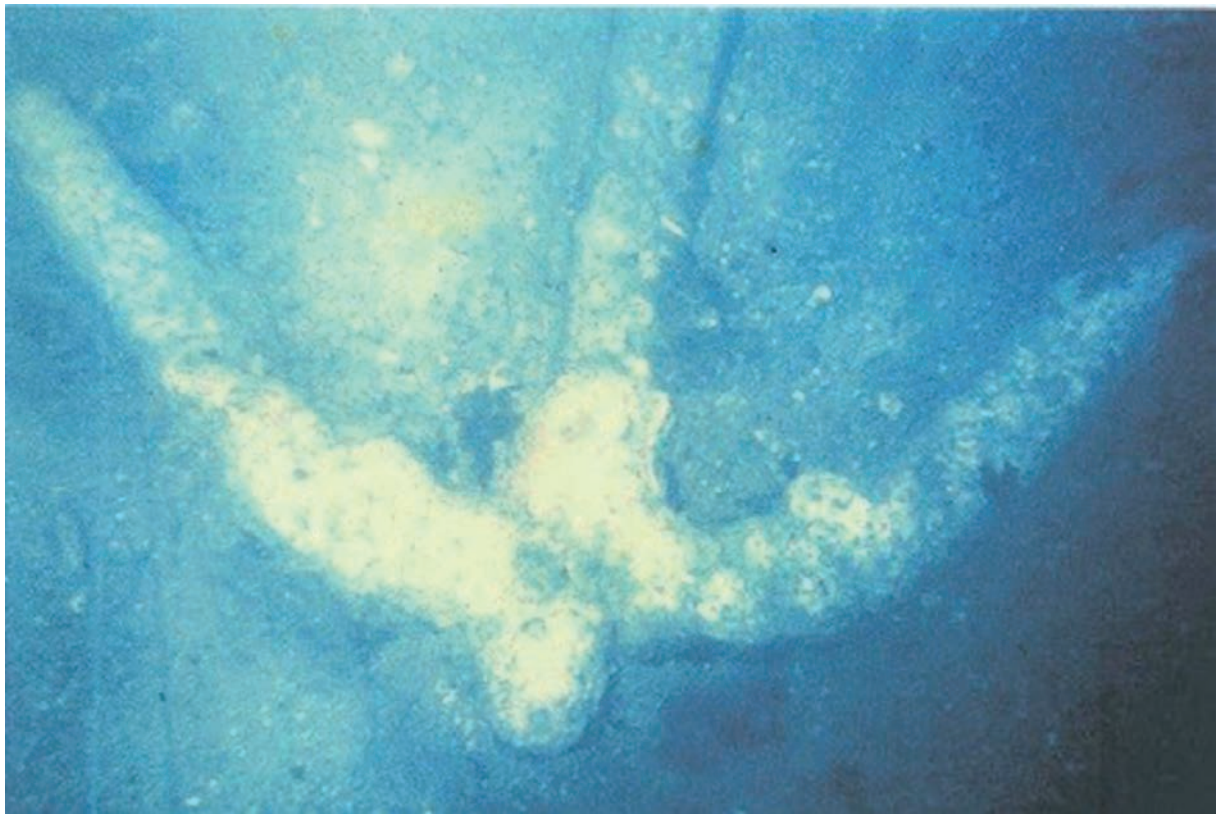


Figure 3. Roman Iron Anchor (Courtesy Cemal).

The second group, manual forged anchors, includes the lead-stock roman anchors and the «T» and «Y» shape anchors. At present we located and retrieved two roman lead stocks (Kapitan III-C and a Kapitan III-A/B). One find was at the Ponta da Piedade Area and one at Meia Praia (Fraga, 2013b; 2013a). The relative small size of these lead stocks points to small craft. This adds to the presumed late roman iron anchor, located in 1982 (Baço, 2015). Although photographic proof exists of such anchor, it has yet to be relocated by the project (Fig. 3).

In the mechanical forged, based upon known parallels we propose five typologies (Baço, 2015). We have sixteen anchors within iberian-atlantic traditions, one Batavia-type anchors, eleven English type- anchors including Admiralty Long Shank type anchors, one French Accolade type anchor and two «Gatas», a Portuguese typology of one armed anchor. The data range for anchors in this group goes from the 16th century up to the 18th century.

The last group is composed by anchors made with Cort's process anchors. This includes three Pering type anchors and six Admiralty type anchors,

Besides the classified anchors we have several grapnels still to be classified and five currently of unknown typology. The unknown anchors were a group a five anchors with similar measures and features (Baço, 2015). We called them Fang Anchors, because of the resemblance between the arms of this anchors and the spider fangs (Fig. 4).

These anchors have a straight shaft, two curved arms that separated one from the other over the end of the shape. Usually they have rhombus shape palms. They have a stock and a ring at the beginning of the shaft. Parallels for such specimens have been difficult to find. The closest match so far are Dead Sea anchors of northern medieval Europe design.



Figure 4. Fang type anchor (Photo Lolita Petriconi).

Understanding this anchor type merits further research, furthermore the grapnel anchors also are of enough substance for increased investigation. Some of the grapnels are of very recent chronologies, but this type of anchor was used extensively in medieval times and it is possible that some of the oldest examples of our present collection are of that time period. At present time, the level of concretion on older examples, allied with lack of any known parallels in the region or in the country for morphological comparison negate any possibility for classification by current means. In-depth study would require raising either the anchors or taking samples for archaeometallurgy studies.

Interpretation

In addition to the integration of most anchors in timelines and specific typologies, it is important to understand what is doing this set of anchors in this bay. We know it was widely used as anchorage for centuries which would explain the diversity of typologies and timelines, but through the maps prepared by us with the GPS position of each anchor, other conclusions can be drawn (Fig. 5).

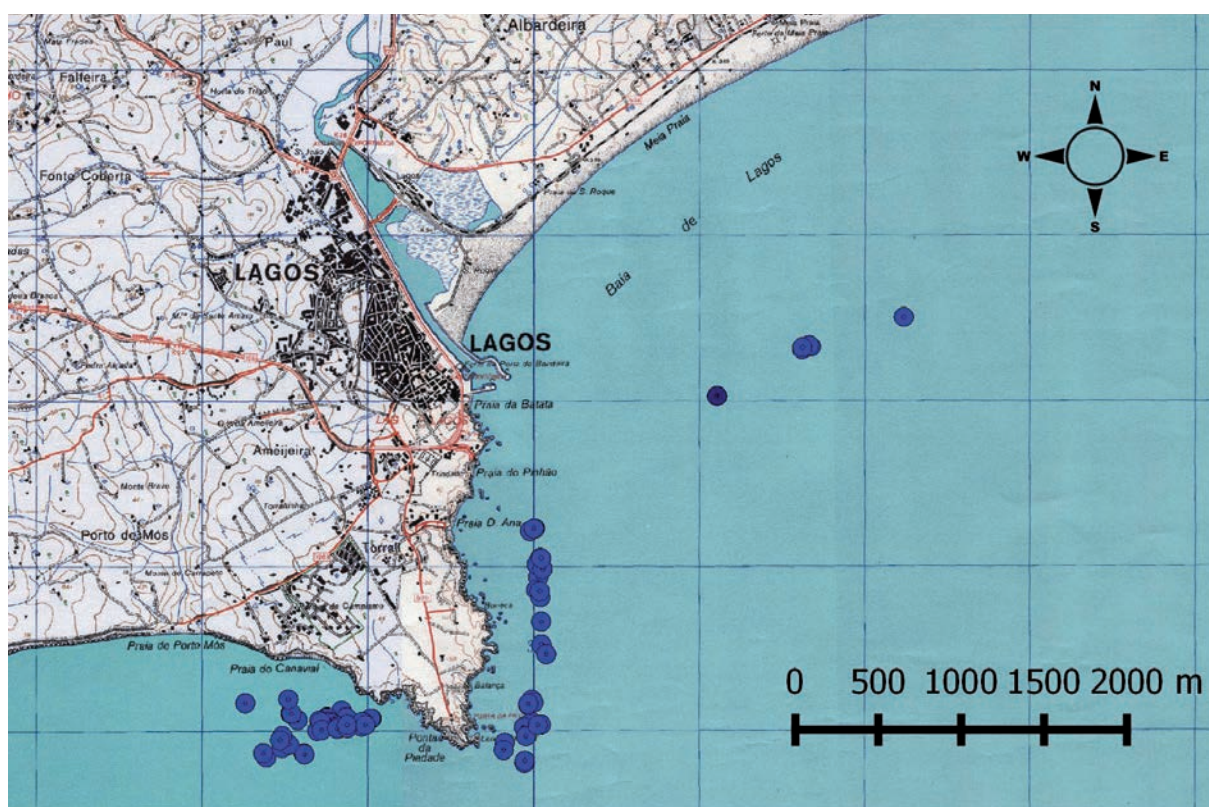


Figure 5. Location of anchors in the bay (Author).

Several of the present maritime activities have secular origins, such as fishing and anchoring. Judging from the written sources, tuna fishing frames exist since the xiv (Lopes, 1841). However already in Roman times tuna fishing was highly profitable and fed an export industry along the Algarve coast. Archaeological evidence in the Lagos Bay comes from fish processing centers and the amounts of ceramics associated with this type of trade (Fabião *et alii*, 2010; Morán, 2006; Morán/Parreira, 2010). Also in Islamic medieval times, tuna fishing is reported, being the tradi-

tional name of this fishing gear «almadravas» of Islamic origin. By Cristian-medieval times and continuing to modern times, this lucrative fishing becomes a king's monopoly. Regarding anchoring simply put this bay is described as a place where more than 200 ships can anchor safely (Loureiro, 1991: 44). This, as stated previously, is due to the dominant winds protecting effect and before the earthquakes in the 18th century, also hosted a large estuary. From the historical background we can assume a series of anchorage practices in the bay of vessels, domestic and abroad, since the 1st century A.D, and it is not unlikely that this activity was even older, dating at least to pre-classical times.

Judging by these descriptions and activities related to the use of anchors, we face two scenarios: what are the fishing areas and which anchoring zones? To this end we propose three distinct areas (Porto de Mós, Ponta da Piedade and Meia-Praia).

The area of Porto de Mós is historically referenced as the location of one of tuna fish trap named Torrealta. This trap is described at entrance to the Bay of Lagos, west of Ponta da Piedade (Côrrea, 1994), another author states that this set-up would be also known as the almadrava of Porto de Mós (Santos, 1989). Our best evidence for its location is Vasconcellos (1795) map, where the trap is depicted in front of Porto de Mós beach. Historical opinions differ in the exact location but agree in the existence of such trap in the area. However, to ascribe anchors to this practice cannot be done without some level of uncertainty because Porto de Mós (Harbour of Milstones) does indicate anchorage practices within its area. As almadravas would be netting that extended for several km and required the placement of one hundred to two hundred anchors in specific patterns (Fig. 6), our belief that these anchors are part of the almadrava comes exactly from the dispersion pattern, together with the shallow depth in that these are located.

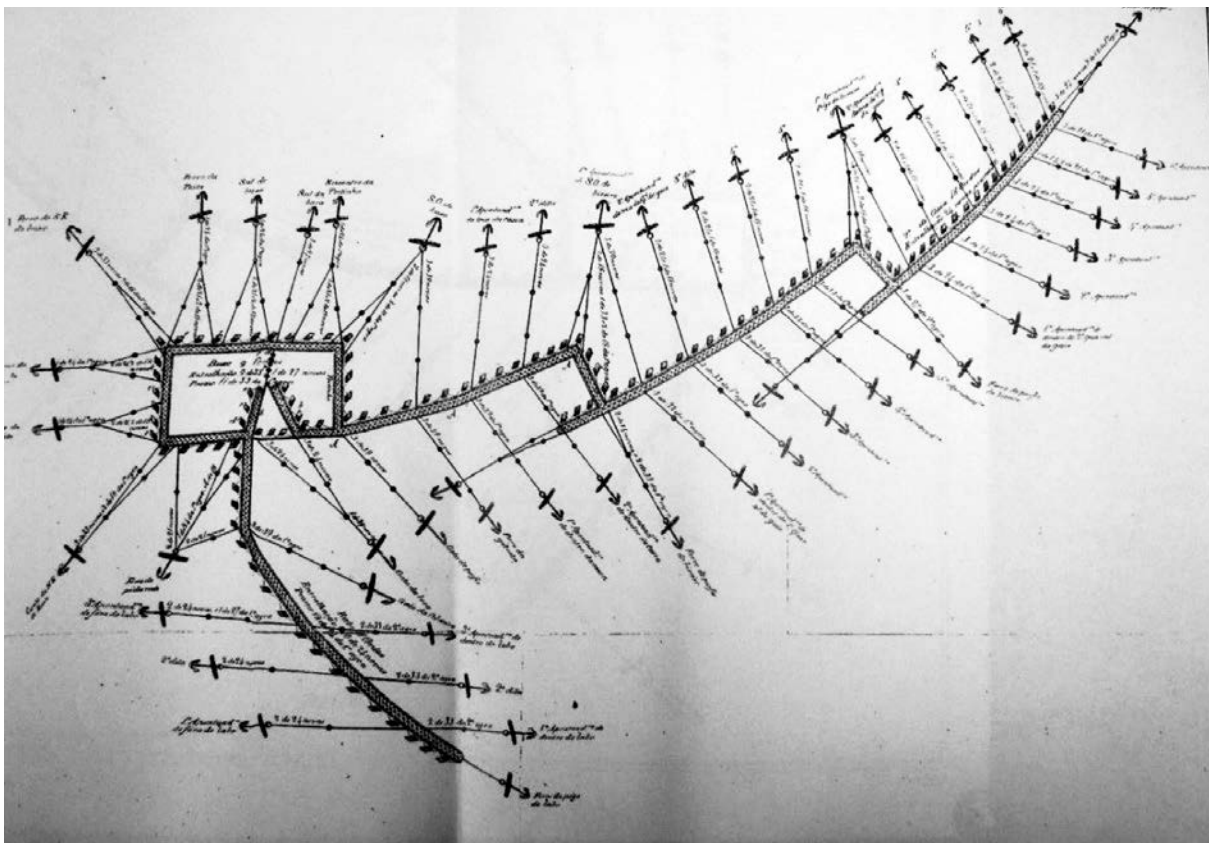


Figure 6. Torre alta tuna fish trap (after Lopes, 1841).

Our second group is East of Ponta de Piedade, again historically referenced as the location of the second tuna fish trap of Lagos, Torrealinha. This cluster of 36 anchors is being associated with the tuna fish, due to the shallow depth of their placement, and also because the area matches the protected zone given by the existing artillery batteries of the modern age. It is known that several of these were constructed to protect this lucrative activity (Martins, 2001: 161). Furthermore their dispersion pattern does suggest, as in the case of Porto de Mós, to be related to tuna fish traps. If it is also possible that these represent small craft anchorage practices, if taken in account that by the Modern Age, separation between anchorage and fishing areas in the northwest part of the bay was given by an imaginary line of a bearing. This required the alignment of two churches seen from the bay, S. Sebastião and S. António. If traced into the present map of our study most of our anchors fall into the fishing area. For these reasons it is our opinion that these are related to Torrealinha tuna fish trap.

Our final area is located along the front of the Meia-Praia, there we have found the larger anchors, plus assortments of scattered findings of glass, ceramic and concretions. These anchors appear to be caught on natural crevice. This crevice creates a natural wall up to two meters high and presents a perfect anchorage area, even today is a preferred fishing spot for small craft. The depth of the area, plus the amount and diversity of small finds in conjunction with historical cartography (Banha, c1788), does indicate that we are present in an anchorage area. The wide chronology of the finds does indicate that this area is in use since the Roman Period to present day (Baço, 2015).

Conclusions

Through a historical research work for the maritime activities of Lagos, we are faced with two tuna fishing traps operating in Lagos since the fourteenth century. Our survey does indicate that we came across three distinct areas of activity. Two clusters of anchors appear to be a legacy of tuna fishing traps operating in those areas, at least from -modern age. The third area in front of the Meia-Praia, related to anchorage practices.

To ascertain if this hypothesis was plausible, in the survey of the area, we became more focused in the anchors morphology, and their orientation and less in size and quantity.

Although this is the first in-depth study of the shape of tuna fish traps in the Algarve, and there is, to date, no historical reference on the size and design of early-modern traps, there are in historical records some preserved layouts of this type of traps for 19th century. They are specifically regarding tuna fish traps located in front of Ponta da Piedade.

It was our belief that the design and size of the traps did not change substantially at least going back until the late-medieval period. Being composed of hundreds of anchors, laid in specific patterns we operated under the assumption that it would be possible to plot each surviving anchor and patterns would emerge that would fit the known designs. Afterwards concentrated excavations in the areas of the copejo would substantiate our conclusions with findings of cultural heritage assemblages (as knives, spears, pieces of small vessels, tuna fish bones) related to the tuna fish capture operations. However this is a task that we hope to work in the following years.

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Life on board in North-Western Mediterranean. An approach by analysis of ceramic artefact during the post-medieval period

Vida a bordo en el Mediterráneo noroccidental. Una aproximación a través del análisis de las cerámicas durante el periodo post-medieval

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Abstract: Underwater archaeology is a way to obtain data directly related to maritime society. It is clear that unlike many material testiness discoveries in underwater site, the written sources bring few information about terracotta objects that belong to endowment of board or personal property. The ceramic study may help to have a better representation of the fair trade products, dishes and on board *instrumentum*. However, the artefacts from anchorage completed our knowledge of the maritime material culture. The corpus from the Mediterranean French can be performed to fill the gaps the study of wrecks does not allow on one hand. The «times capsules» represents by wrecks, offer a snapshot of material culture on board and the harbours, as «open space», offer a diachronic vision of the ceramics used by the sailors. We identified the chronology, the origins of artefacts, and their uses that could be collective, personal or for a commercial destination.

Key words: Ceramic, material culture, underwater archaeology, harbour, Mediterranean Sea.

Resumen: la arqueología subacuática proporciona datos directamente relacionados con la sociedad marítima. Está claro que a diferencia de muchos testimonios materiales descubiertos en yacimientos subacuáticos, las fuentes escritas aportan poca información acerca de los objetos que pertenecen a la dotación de a bordo o son propiedad personal. La cerámica puede ayudar a tener una mejor representación de los productos de comercio e *instrumentum* a bordo. Los

artefactos de anclaje completan nuestro conocimiento de la cultura material marítima. El corpus de análisis en el Mediterráneo francés se puede usar para completar el estudio de restos de naufragios. Las «capsulas del tiempo» representadas por pecios, ofrecen una instantánea de la cultura material y en el otro lado el puerto, como «espacio abierto», ofrece una visión diacrónica de los artefactos utilizados por los marineros. Identificamos aquí la cronología, los orígenes de los artefactos, y sus usos que podrían ser colectivo, personal o para un destino comercial.

Palabras clave: cerámica, cultura material, arqueología subacuática, puerto, mar Mediterráneo.

Within the framework of this article, we wish to present the life on board of ships in the northwestern Mediterranean. On the basis of the works undertaken during our PhD, we present the collective and personal objects from shipwreck and anchorage. In fact, the underwater archaeology is a way to obtain data directly related to the activity of maritime society. It is clear that unlike many material testimonies discovered in underwater archaeological sites, the written sources bring few information about dishes or terracotta objects that belong to endowment of board or personal property of a crewmember.

The ceramic artefacts often represent an additional load and an extra product transported from port to port to complete the trading operations. It can also serve as a container for transport and packaging, belong to the on board furniture, and could be a personal property. As one major archaeological artefact, ceramic may help to have a better representation of the fair trade products, dishes and on board *instrumentum*. However, the artefacts from anchorage completed our knowledge of the maritime material culture from shipwrecks. As a matter of fact, indications on the personal goods or popular furniture on writing sources are sporadic. Indeed, unlike artillery or a boat's gear, the cheap personal or collective goods are rarely mentioned in the inventory or log book. However, a material culture is well known and ceramic artefacts are present in quantity, whether on board or in harbour. In this context, the distinction between a commercial object one or used on board can be elucidating by confrontation of different corpus, by quantification of ceramic, by an analysis of the methods of acquisitions and by an analysis of the pottery origins.

The corpus of analysis was selected in two principal contexts, the shipwrecks and the harbour dumps sites discovered on the Mediterranean French coast and between the Balearic and the Tyrrhenian seas. In fact, many artefacts have been discovered on board shipwrecks or in harbours¹. The study of harbour dumps can be performed to fill the gaps that the study of wrecks does not allow on one hand. The «times capsules» represented by wrecks, offer a snapshot of material culture on board and on the other hand the harbour, as «open space», offers a diachronic vision of the ceramics used by the sailors. Our work is to identify the chronology and the origins of artefacts from different geographical areas, and their uses that could be collective or personal or for a commercial destination.

Actually on the French coast, fifty shipwrecks and eight harbour dumpsites have been identified and dated between the 12th century and the end of the 18th century. From full or partial archaeological search, twenty-seven shipwrecks have been discovered with ceramics as merchant product, and twenty-four with ceramics as on board furniture. In addition, eight important anchorages offer notable artefact assemblage: Girolata, Calvi and Ajaccio in Corsica, Villefranche-sur-Mer, Brégançon, Endoume and Pomègues in Provence.

¹ For their valuable assistance during our PhD research we wish to thank Le Département des recherches archéologiques subaquatiques et sous-marines (Drassm/MCC), le laboratoire d'archéologie médiévale et moderne en Méditerranée (LA3M/CNRS) and l'association «Anao L'aventure sous-marine».

However, the site of Villefranche-sur-Mer is the most important for these activities from Antiquity to 19th century, and mainly for the modern period between 16th and 18th century. The research shows that this harbour area is divided among civil and military areas. These two specialised port areas of Villefranche-sur-Mer, established since the 17th century, are associated with two anchorages where the studied ceramics come from. The first area is in the north part, at the bottom of a battery calls «les Deux-Rubens» and the second, in the south part of the Lazaretto for the quarantine (Fig. 1).

The ceramic discovered in Villefranche-sur-Mer harbour represents today the 68% of artefacts with 3585 fragments, and 1963 full archaeological form. The study of these artefacts required a precise method because it is not an enclosed space such as a wreck, but an open space used on a shorter or longer time. Thus, the study of furniture needs to implement systematic records and chrono-typology to obtain reliable dating. Indeed, there are many ceramic production areas in Post-Medieval period showing us the northern Mediterranean relationships. For instance, the productions of glazed, tin-glazed and earthenware come from Italy, Spain, France, come from England and Germany for sandstone, from China for porcelain and from Turkey for stone-paste. The ceramic study's from the harbour has shown us the prevailing workshops market production. However, it should be noted that the presence of ceramics from extra-local area do not necessarily represent the economic activity, but rather contacts and relations across the place of departure and the place of arrival.

In the artefacts batch analysed, many ceramics have engravings like *graffiti*. Performed after baking, the *graffiti* appears on different forms. Four major groups appear, Latin capital letters, representations of built object, symbolic and abstract shapes. For Latin capital letters it is usually, in Villefranche-sur-Mer area, initial as «J.P», «A.F», «GBP», «CA» or «AB». The representations of built object are represented by a needle, scissors, an arrow or hourglasses. Furthermore, we find a square sail, a Latin sail or banners. The symbolic and abstract shapes are ladders, tops, stars with three, four, five or six branches, crosses potent, Latine, etc.

These graffiti are generally performed on common pottery used by seafarers of the lowest classes like sailors. These graffiti do not constitute trading or customs marks, but marks of appropriation by a person or a group of individuals. To mark the possession of an object in a world community engraving, a geometric symbol or capital letters allows the individual to acquire property. Before changes in maritime practices and the industrialisation of production at the end of 18th century, this practice appears regular. For examples, our study finds graffiti on the on board furniture of *Novy Svet* shipwreck, 13th century, discovered in Crimea (Morozova, 2012: 153), *La Lomellina* shipwreck, 1516, in Villefranche-sur-Mer (Thirion, 1987: 241;156) and *L'Aimable Grenot*, 1749, in Saint-Malo (L'Hour/Veyrat, 2004: ill. 8) or, far away, from the *San Diego* shipwreck, 1600, in Philippines Fortune islands (Dupoizat, 1994: 249). To illustrate the material culture in French Mediterranean area we have selected significant ceramic artefacts.

Transport and storage

The forms mainly composed by glazed jars, are short and large and used for transportation and storage of foods and liquids. These artefacts are usually employed for water, olive oil and wine

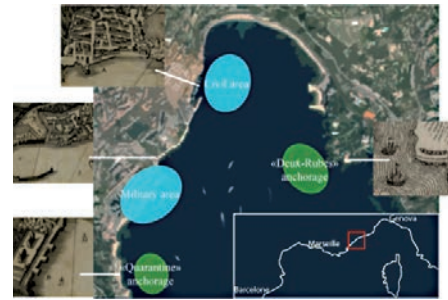


Figure 1. Bay of Villefranche-sur-Mer end of 17th and 18th century. Iconographic sources: AM 06 – 01FI0046 «Vue du port et des environs de Villefranche» by Nicolas de Fer and BNF-FOLQB201 (128) «Prise de la ville et du comté de Nice par les français» anonymous.

but also for wheat, salting and dried fruit transportation and storage. They are usually closed by a cork and embedded depending on the destination (commercial, usual) and needs. This forms comes from Spain for the 14th century and only from Liguria in northwest of Italy for the 15th century (Fig. 2. 1). For the next centuries we find jars from Spain, particularly from Catalonia (Fig. 2. 2) and Andalusia (Fig. 2. 4-5), also identified on board of the *Sainte-Dorothée* shipwreck, 1693, for example (Fig. 2. 5). However, we have found other jars from France in Provence with only internal glaze and two horizontal handles (Fig. 2. 3). Except for cargo, involving the transportation of goods in jars, these presences in small numbers refer to an acquisition in which, the contents of jars are more important than the object itself. However, jars disappear from the 17th century, in a period of a wide development of the wooden barrels.



Figure 2. Transport and storage forms. 1-Genova c. 15th, 2-Catalonia c. 16th, 3-Andalusia c. 17th, 4-Andalusia jars *Sainte-Dorothée* shipwreck 1693, 5-Provence c. 17th (picture LA3M-CNRS, Drassm-MCC and drawing by author).

Cookware

The cookware and tableware are more important between 16th and 18th century. The forms used to accommodate the food will depend on the method of cooking; the type of products prepared and must meet the constraints of board, space and importance of the team particularly. For the cookware the Iberian productions are predominant. Between the 17th and 18th centuries, they are declined on multiple glazed ceramic typologies unlike other productions. This use resonates with comments reported by the Dominican Father Labat (Labat, 1993: 354) during his trip aboard a Spanish ship in the 15th century: «All of the crew have their pignate² particularly». Finally, the

² «Pignate», is a French word, particularly in Provence, to designate a cooking pot or simple pot.



Figure 3. Cookware forms. 1-7-Catalonia stoves, pots, cassiolette and lids with graffiti c. 17th, 8-cargo of cookware Brescou 1 site, 9-Provence pots c. 17th, 10-Savona pot c. 17th-18th (picture Drassm/MCC and drawing by author).

cookware is diversified and included stoves, pots of different volumes with their lids, cassiolette and pans (Fig. 3. 1-7). For cooking pots, they will be rare on board from the 18th century because of the massive use of copper alloy cauldron for the needs of crew. Adding that frequent maritime trade between Genova and Barcelona and the significant presence of the Iberian marine certainly participated in the distribution of ceramics, as the cargo of Spanish cookware attests (Fig. 3. 8) *Brescou 1* site (Amouric/Richez/Vallauri, 1999: 109). Moreover, along with the use of Spanish products for kitchen, Provence and Liguria are also present, but in fewer quantity (Fig. 3. 9-10). Although, the Italian cookware productions never really dominate the trade, instead of the Provence's which has enforced her presence at the end of 18th century and commercialized these products beyond the Mediterranean area.

Beverages service and table dishes

For the liquids, as for wine, water or alcohol, the use of pitchers and bottles are frequent. The first-productions are Iberian and Italian with brown glazed ceramics (Fig. 4. 1) and earthenware, blue on blue «a berretino» and polychrome (Fig. 4. 2-3), for the 16th century. For the 17th and mid-18th century we found Iberian glazed forms of pitcher (Fig. 4. 4), «boat pitcher» and «dourgue» (Fig. 4. 5-6) but also a new production from France, particularly in Provence with «bouteille à passants» or «conscience» (Fig. 4. 7). We found both productions decorated with clear slip and metal oxides in anchorages and shipwrecks such as *La Lune*, 1664 (L'Hour, 2012) and *La Madone d'Hydra*, 1793 (Joncheray, 2012). In the Mediterranean the sandstone bottles from Collogne, are rare. Only two examples of «Bellarmine» were discovered on Villefranche-sur-Mer anchorage and *Sainte-Dorothée* shipwreck (Fig. 4. 8).

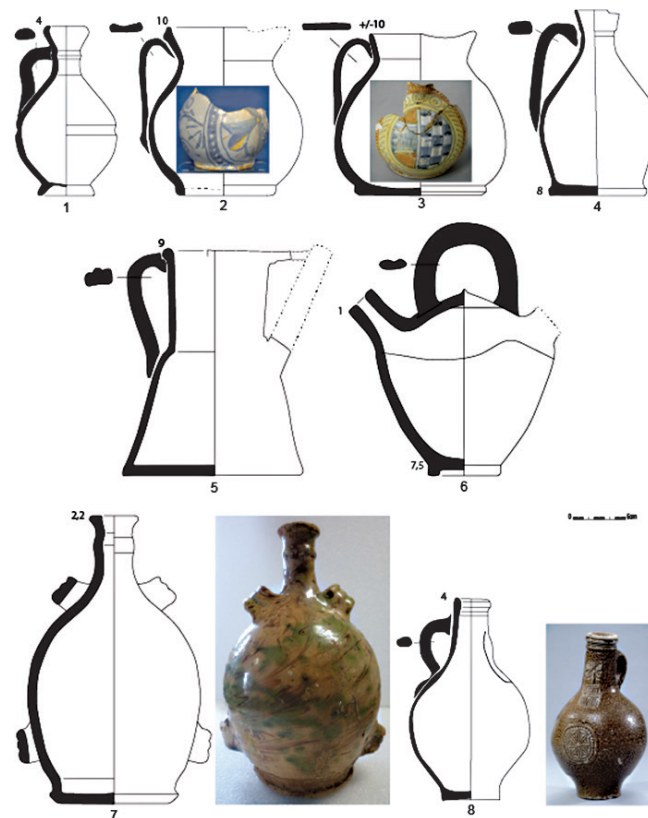


Figure 4. Beverages service forms. 1-Catalonia green glaze c. 16th, 2-3-Liguria earthenware c. 16th, 4-Pisa brown glaze c. 17th, 5-6-Catalonia brown glaze c. 17th, 7-Provence bottle with slipware *La Lune* shipwreck 1664, 8-Cologne sandstone bottle say «Bellarmine» *Sainte-Dorothée* shipwreck 1692 (picture Drassm/MCC and drawing by author).

For the tableware, numerous glazed, tin-glazed and earthenware have been identified and seems similar to the ceramic discovered in the North Mediterranean shipwrecks and anchorages. The composition seems homogenous and generally consists of cut, bowl and, for the end of modern time, plate. However these forms were declining in many production centers in Spain, Italy or France.

During the 16th century Fréjus, in the south of France, exports yellow glazed (Fig. 5. 1). In the northwest of Italy, Savona exports ceramics with graffito flower (and others decorative motifs) under a green or yellow glaze (Fig. 5. 2); Pisa exports the «a stecca» motif under green or brown glaze (Fig. 5. 4). Barcelona exports the earthenware with blue vegetable motif (Fig. 5. 3). At the beginning of the 17th century, Liguria exports «a berretino» blue on blue earthenware (Fig. 5. 5), and between the 17th and 18th century, the «taches noires» from Albisola (Fig. 5. 6). During the 17th century and after, France and particularly Provence, exports glazed ceramics with slipware decoration (Fig. 5. 7). The typology and the size of numerous bowls suggest a dual use, for drink and eat, while others seem too small for it. The last one, associated with soup plates, are an evolved form better adapted for lunch. Dishes or large cups are also used for the service. This practice may refer to galley slaves in the 15th century as specified by Felix Fabri brother in his «journey to the Holy Land» (Fabri, 2000: 177), which states that the crew take their lunch three by three. In the French navy, the practice is the same and was called «crew's dish». Furthermore, «crew's dish» is relative to a specific ceramics production during the 17th century of Huveaune workshops in Provence (Fig. 5. 8).

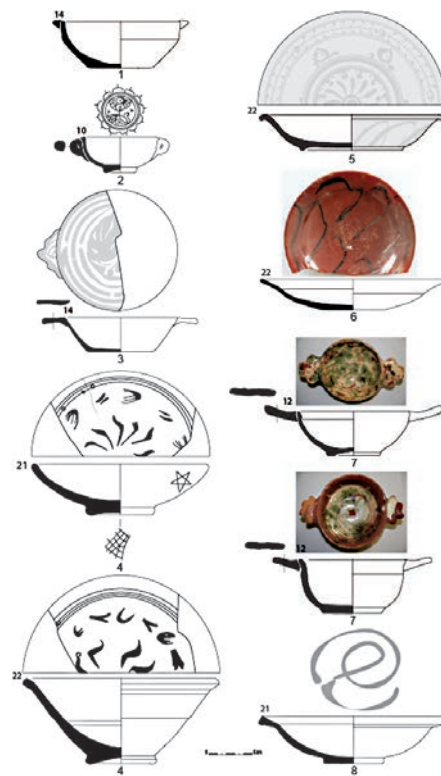


Figure 5. Table dishes. 1-Fréjus yellow glaze, 2-Savona green glaze, 3-Barcelona earthenware with blue, 4-Pisa «a stecca» green and brown glaze c. 16th, 5-Liguria «a berretino» blue earthenware c. 16th-17th, 6-Albisola «taches noires» brown glaze c. 17th-18th, 7-Huveaune slipware decoration and brown glaze c. 17th, 8-Huveaune «crew's dish» glazed c. 17th (picture and drawing by author).

Other artefacts: lighting, apotropaic practices, recreation and writing

There are also lighting artefacts as well as glazed oil lamp and candlestick from late medieval and modern period. They are mainly from Spain and France (Fig. 6. 1-2). From Spain, only oil lamp with one small cove and pinched nose are observed in our research for a long period from the 13th century to the 15th century. From Provence, feet of candlesticks glazed and decorated with clear slip during the 17th century are present but in few proportion. It is the same case for the apotropaic practices. Only the discovery of Liguria earthenware baptismal font (Fig. 6. 3) and some bowls decorated with Roman Catholic invocation like «IHS» (*Iesus Hominum Salvator*), illustrate these practices (Fig. 6. 4-5). Their presence materializes current piety during navigation. Indeed, we know that facing to wrecks and death, humans have increased appeals to religion. This tradition primary leads to a regular presence of a chaplain on large ships or to individual practices by mariners.

Moreover, a lot of clay pipes are frequently revealed on anchoring places or shipwrecks. For the 17th century the clay pipes come from Spain (Fig. 6. 6). For the 18th century, they come from of eastern Mediterranean area (Fig. 6. 7) and from Italy such as «choggia» (Fig. 6. 8). The kaolin clay pipes come from northern Europe, Holland (Fig. 6. 9), England and France. Because of the cheapness of clay pipes and because of their fragility, they are thrown overboard. Thus, we found them in quantity. The presence of pipe bowls called «makeshift» is singular (Fig. 6. 10). Discovered only in the anchorage of Villefranche-sur-Mer it is a simple brick trimmed and equipped with a stove and a hole to insert a stem. The mystery of their origin remains unsolved today. They are maybe related to the transport of bricks by boat for the construction of the citadel nearby and of the development of port dependencies.



Figure 6. Ceramics artefacts for other uses. Lighting artefacts: 1-Spanish oil lamps c. 13th-15th, 2-Huveaune candlestick c. 17th. Apotropaic practices c. 16th: 3-Genova baptismal font, 4-Savona earthenware blue and yellow bowl, 5-Savona glazed bowls. Clay pipes selection c. 17th-18th: 6-Spain earthenware, 7-Eastern Mediterranean, 8-Italia «choggia», 9-Holland, 10-Other indeterminate. Writing: 11-Albisola «taches noires» pen-peack c. 17th (picture and drawing by author).

There is also another rarity in our maritime contexts only one ink «pen-peak» type with a flat base (Arminjon/Blondel, 1984: 532) was discovered, maybe this form was the most adapted for wide bearing movements during the navigation (Fig. 6-11). This glazed ceramic comes from workshops of Albisola in Italy, is currently assigned to the 17th century and «taches noires» productions.

In the maritime context of the northwestern Mediterranean, a break occurs at the end of 18th century in the material culture with some changes in maritime practices and the industrialisation of productions. Prior to that, the on board ceramic has not yet been really normalized. The material culture can be called «stream to sea» because it was acquired from port to port or from the starting point. The association per period allows determining a maritime material culture that appears in the various archaeological analysed sites. The facies are indeed similar and reflect the principal uses on board of ships. However, the same production centers dominate the market. The important presence of ceramics, from the north of Italy and the north of Spain, is not a co-

incidence in this Mediterranean context of the northwest. In fact, their presences are linked with the commercial route of olive oil, wheats and wine in direction to the Kingdom of France and the Duchy of Savoy. These merchant ships, or those intended for the protection of the commercial route, left in their wake a set of products acquired since the harbour of departure or during a stopover necessary to their daily life. Thus, ceramics discovered in the maritime context come from important production centers that export mostly by sea. The harbour keeps rich information and their archaeological studies for the medieval and post-medieval periods have begun in France. Their analysis allows to determine the history evolution of harbour activities and finally allow to obtain significant evidence on seafarer's life and condition on board.

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The architecture of a great 16th century warship: results from the initial surveys of *Mars* (1564)

La arquitectura de un gran barco de guerra del siglo XVI: resultados de las prospecciones iniciales del *Mars* (1564)

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Abstract: During the 16th century the naval ships were developed with increased size and a larger quantity of guns. When the Swedish ship *Mars* exploded and sank during action in 1564, she was one of the largest ships in the world. In 2011 the wreck was relocated outside the island of Öland in the Baltic Sea. Thanks to the favorable conditions about two thirds of the hull are preserved which includes the stern with the large stern castle. The site thus offers a unique opportunity to study a state of the art warship from this period. The site has been surveyed during three seasons. This paper is based on these initial surveys and aims to present the kind of insights regarding 16th century naval architecture that *Mars* has revealed so far.

Key words: Naval architecture, artillery, sixteenth century, war ship, Baltic Sea.

Resumen: durante el siglo XVI, las naves se desarrollaron incrementando su tamaño y una gran cantidad de armas. Cuando el navío sueco *Mars* explotó y se hundió durante la acción de 1564, era una de las naves más grandes del mundo. En 2011, los restos fueron reubicados fuera de la isla de Öland en el mar Báltico. Gracias a las condiciones favorables, dos partes del total se han conservado, incluyendo la popa y el gran castillo de popa. De este modo, el sitio ofrece una oportunidad única de estudiar los buques de guerra de este periodo. Este yacimiento fue prospectado durante tres temporadas. Este artículo está basado en estas prospecciones iniciales y tiene como objetivo presentar el tipo de conocimientos sobre arquitectura naval del siglo XVI que el *Mars* ha revelado hasta ahora.

Palabras clave: arquitectura naval, artillería, siglo XVI, buque de guerra, mar Báltico.

Introduction

A medieval navy consisted of large merchant ships converted for war-use in conjunction with a specific conflict. In the early modern national states, which were ruled by powerful monarchs and administrated by bureaucrats, the navy, to a greater extent, was an institution. Medieval naval warfare may be described as field-battles that had gone to sea. The intention was to sail up close to the enemy ships, to board and to fight face to face. For strategic reasons, the first specialized fighting ships were built with high fore- and stern-castles which offered the opportunity to aim down onto the enemy decks and shoot with longbows, crossbows and light artillery. The high castles were also intended to deter an enemy from embarking.

These ships are relatively frequently depicted on preserved paintings, sketches and engravings. These are often fairly reliable and detailed, especially when we are entering the sixteenth century. But besides the images, the sources that reveal the architecture of these ships with any detail, are scarce and the information that reveal how these ships were built, how they were used, their internal spatial arrangements and so forth, are thus limited. Besides the *Mary Rose* in England (Marsden, 2009), and also the *Lomellina* in the south of France (Guérout/Rieth, 1998; Rieth, 1991), the number of archaeologically surveyed ships from the sixteenth century that reveal any substantial hull-structure are few.

In 2011 the remains of the Swedish warship *Mars*, a ship that sank in 1564, was discovered in the Baltic Sea. As a consequence of the low salinity and absence of the shipworm, the hull is remarkable well preserved. Thus we are suddenly faced with a largely complete ship from the period of transition, one that may shed new light of previously unlit aspects of the first generation of specialized fighting ships, carrying heavy artillery.

Since the discovery, three seasons of fieldwork has been carried out at the site. The aim of this paper is to present some of the results won so far. Of course the ship may be highlighted through a variety of aspects, but the prime objective here is to focus on the hull and the particularities of the ship's architecture. Before doing so, however, it is appropriate to recapitulate something about the historical background of this legendary ship.

Historical background

The Nordic Seven Years War lasted between 1563 and 1570. It was fought between Sweden under the reign of Erik XIV and Denmark who was allied with Lübeck. The conflict was sprung out of the aim to control the trade on the Baltic Sea. It has been called the «First Great war» (cf. Smirnov, 2009) as it was the first of a number of conflicts that followed during the centuries to come. It was a war that was fought both on land and at sea. In 1564 the Swedish navy consisted of 38 ships of different sizes. The largest ship was the brand new *Mars* –also referred to as *Makalös* (Matchless)– which was built at Björkenäs shipyard in Kalmar. The ship was completed and armed with a large number of newly cast bronze cannons in the spring that year.

By the end of May, the Swedish navy met the allied Danish-Lybeckian navy outside Öland. The battle lasted for two days. On the first day *Mars* managed to sink the Lybeckian ship *Långe Barken* using heavy artillery (Ekman/Unger, 1942: 177). The following day the ships were dispersed due to bad weather. *Mars* was then attacked and surrounded by enemy vessels. In these events a fire broke loose aboard *Mars*. In the heavy smoke the Swedish Admiral struck the colours and surrendered. About 100 Swedes were taken on board the enemy ships at the same time as the burning *Mars* was boarded by 300 lybeckians. When the fire reached the gun-powder magazine the *Mars* blew up and sank. The ship was a renowned vessel already when it was still

afloat and its foundering was a celebrated triumph for the allied. They were not slow to use the event for propaganda purposes and pamphlets describing the victory over the giant Swedish ship were soon in print (Ekman/Unger, 1942: 177).

However, no contemporary documents reveal clear indication of how large *Mars* really was. Over the past 400 years there has been much speculation regarding the ship's impressive dimensions. According to a Lübeck source the ship was «10 ft longer than the church of St Peter in that city» (Ekman, 1939: 5-10; Anderson, 1939: 296-299). The same goes for the number of guns aboard this gigantic ship. Some say she carried 125 guns (Bechstadius, 1734: 134) but several mention 173 (Kuylenstierna, 1908: 40; Tornqvist, 1788: 34), while others indicate as many as 200 (Dalin, 1760: 583). Most agree that she had 107 guns (Glete, 2010: 534).

The Wreck

Needless to say, people have been searching for the wreck for years. But as the battle took place far out at sea, it was not until 2011 that the company Ocean Discovery located the wreck outside Öland using side scan sonar. Divers went down to confirm and discovered a wreck with a lot of cast bronze cannons, together with some occasional wrought iron pieces. A first brief survey of the site were made using ROVs already in the fall of 2011 (Rönnby, 2012). The aim was to confirm that it was the right ship and to learn how much was left of it in order to plan future fieldwork. The gathered film-material was processed into a preliminary sketched plan of the site (Fig. 1).

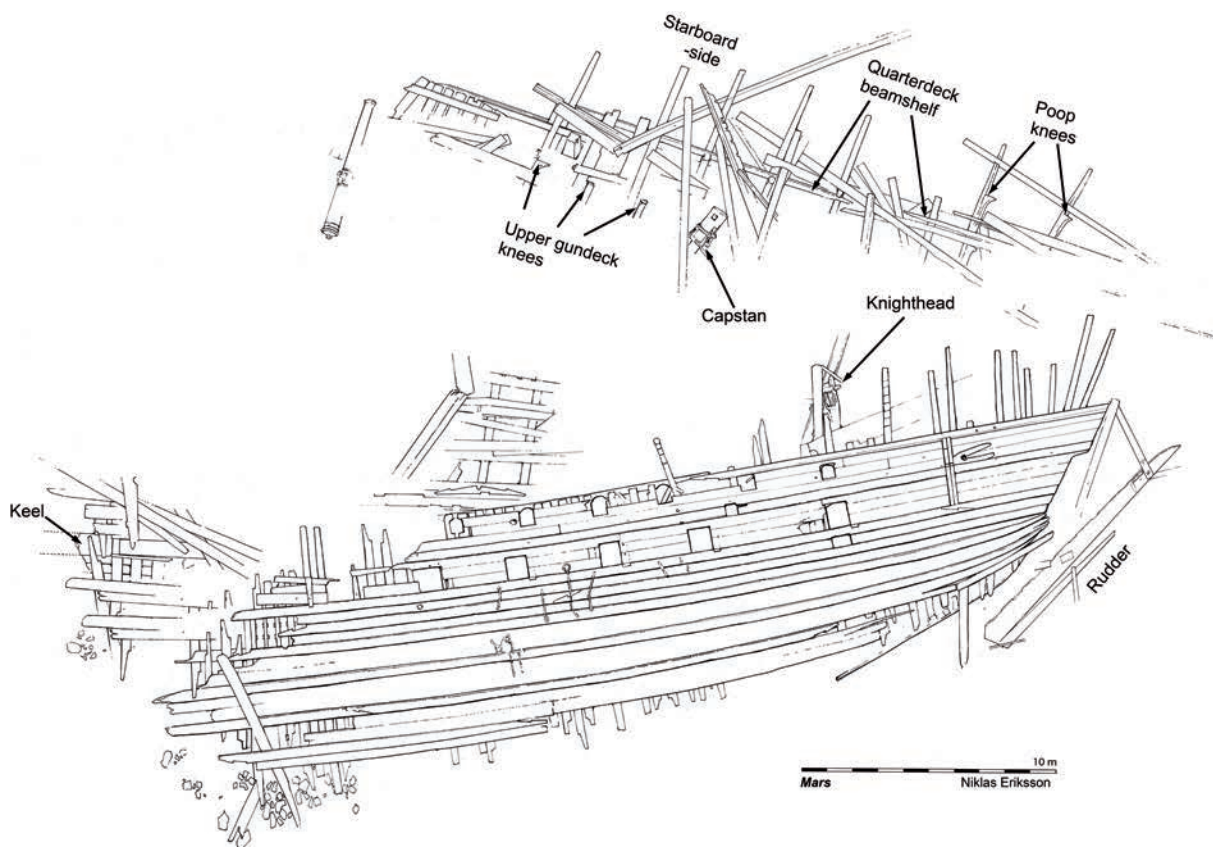


Figure 1. Preliminary plan of the Wreck-site. The stern is to the right, with the rudder resting loose on the seabed. Note the double rows along the port-side and the standards from the sterncastle on the starboard-side (Niklas Eriksson).

According to witnesses from the battle in 1564, *Mars* foremast flew straight up in the air like a crossbow bolt when the powder store exploded (Ekman/Unger, 1942: 178). The remains of the ship at the seabed further underscores this violent events as the forward portion of the hull is nearly annihilated. What remains of the heavily-framed ship is broken up into three more or less coherent parts, consisting of the lower hull, a coherent starboard side and a coherent port-side. Survey results suggest that the hull broke into these three pieces while it was still on the surface. When the hull made contact with the seabed it listed to starboard (for more details regarding the hull of *Mars*, see Eriksson, 2012a; 2012b; 2013; 2014b; see also Adams, 2014: 90-91).

From a Scandinavian horizon *Mars* is an early example of carvel construction (cf. Adams, 2003; 2014), and the ship reveals some constructional features which are unusual in later ships. A peculiarity are the laths which are placed in between the seams of the planking. The purpose of these laths was to hold the caulking in place. Archival material mentions that *Mars* was *fullattat* («fully lathed») (Ekman, 1942: 96). A parallel to this constructional feature is from the ship *Elefanten*, a Swedish naval ship built in between 1554 and 1559 and which sank on shallow water, the same year as *Mars*. *Elefanten* was archaeologically surveyed in the 1930s (Ibid. 89-99). As with *Elefanten* the majority of the frames on *Mars* are made out of compass timbers, which are scarf-jointed together.

Mars have three wales just above the water-line. The planking is butt jointed, whereas the wales are scarf jointed. In the same way as on the hull of *Elefanten*, every third strake in *Mars* bottom planking is thicker. Another feature that *Mars* shares with *Elefanten* is the round stern where the planking ends towards a transom beam. The beam is decorated with an ornament which reminds the cordage that runs along the outline of the timber. The transom beam is shaped after the two gun-ports which used to house the stern-chasers placed on the orlop-deck. Above the transom beam is the counter and the flat transom. An illustration in a Danish manuscript on artillery, signed Rudolf van Deventer and dated to 1585 depicts a Swedish ship in action with a Danish. It reveals a stern which is identical to both *Mars* and *Elefanten* (*Det Kongelige Bibliotek, Köpenham/ Royal Library Copenhagen*) (Fig. 2).

Mars was the largest vessel yet built for the Swedish navy. It is tempting to see both *Mars* and *Elefanten* as a kind of prototypes for the fighting ships that were built in the following centuries. The techniques employed were still under test and evaluation and the Swedish shipbuilders of the 1500s were in the process of learning how to build really large ships.

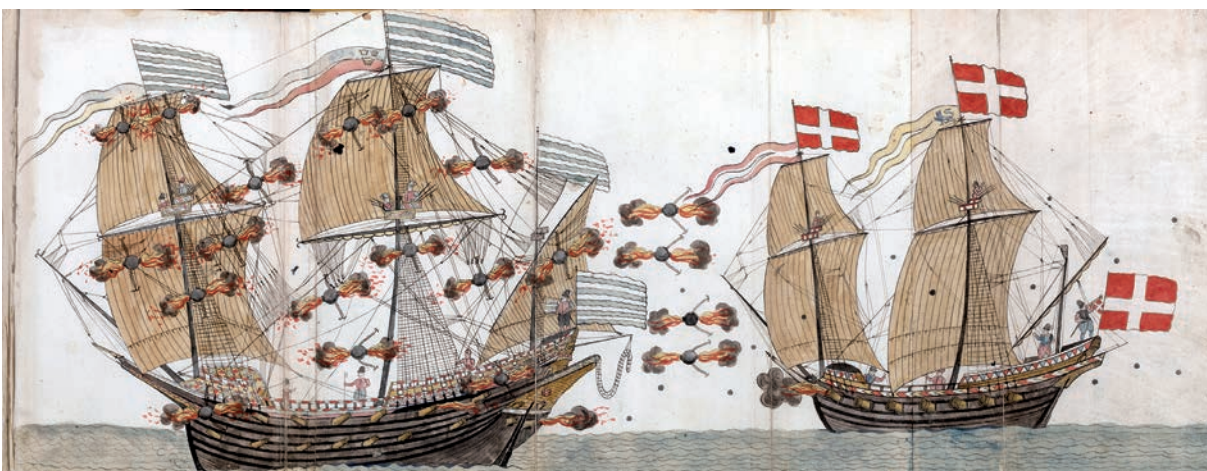


Figure 2. Illustration from a Danish manuscript, signed Rudolf van Deventer 1585, showing a Swedish ship in action with a Danish. Note the round stern, where the planking ends towards a the transom beam (*Det Kongelige Bibliotek, Köpenham/ Royal Library Copenhagen*).

Already the initial survey of the wreck, made using remotely operated vehicles (ROV), gave some results regarding the general layout of the hull. When looking at the siteplan (Fig.1) the perhaps most conspicuous part is the still coherent portion of the ships port-side. Two rows of gun-ports reveal that *Mars* had two nearly complete gun-decks running from stem to stern. Six gun-ports of the lower gun-deck are preserved in the respective port-side. They have the usual square shape that we find on any fighting ship during the age of sail, but are relatively small, 0.7-0.75 m. They are irregularly placed on the hull-side and the distance differs between 1.85 to 3.4 m. The lower gun-deck is where *Mars* carried the heavy artillery. Two stern-chasers were placed on the orlop-deck, underneath the lower gun-deck.

The ports of the upper gun-deck are much smaller, only 0.44 to 0.55 m wide. The upper edge of the ports are rounded, which indicate that they were not equipped with the conventional gun-port, with hinges on their upper edge. Similar ports are visible on several late medieval pictures. Just as with the ports on the lower gun-deck, these ports are irregularly distributed along the hull-side. These ports are generally placed at a smaller distance, between 1.45 and 2.55 m. The irregularity means that some of the ports of the upper gun-deck are placed just above the ports of the lower gun-deck, something that naval architects often try to avoid as it weakens the hull-structure. The absence of ports towards the stern is noticeable and might have to do with the fact that there were an officer's cabin or similar located here. But the absence of ports may also have to do with the type of gun-carriages used aboard *Mars*. As described with more detail below, the gun-carriages are two-wheeled and thus require more deck-space than the conventional four-wheeled version.

Underneath the two gun-decks there was an *orlop*-deck, which served as a dry storage area. The aftermost portion of the hold is very well-preserved and reveals undisturbed contexts with supplies of rolls of lead used to repair leaks in the hull. The galley was located amidships, down in the hold. The galley has disintegrated but the scattered remains suggest that it was located before the main-mast.

Deck-knees and beam shelf, preserved *in situ* along the starboard side, reveal that the stern-castle had a quarterdeck running from the main-mast to the stern. In the aftermost part of the stern-castle, *Mars* also had a poop-deck.

Written sources do not explicitly mention how many masts *Mars* had, but they do reveal that the ship had 5 fighting tops and also describe the sails. Thus *Mars* had «a Main sail, with its bonett, a main topsail, and a main topgallant sail. A Foresail with its bonnet, fore topsail and topgallant sail. A mizzen with its bonnet and topsail, and a spritsail with its bonnet» (*Storskönwalen, med dess Bonett. Stormärsseglet, och Öfver-Märsseglet. Focke Schönwalen med dess Bonett, Förmärsseglet och dess Öfvermärssegel Mezan med dess Bonett och märssegel, och Blindan med dess Bonett*» quotation in Tornqvist, 1788: 34, authors translation). The remains of the masts themselves have not been relocated but there are several constructional features which reveal their original dimensions and locations in the hull. For instance the main-mast partner has been found loose, which reveals that the mainmast had a diameter of c. 1.2 m at deck level. On the starboard side the channel is preserved in its original position. The channel ran from the mainmast and all the way to the stern, which is revealed by a bracket preserved in its original position on the port side.

Fieldwork 2012-2014

Even if a significant portion of the hull and a vast quantity of archaeological information still survives at the seabed. To piece the wreck together into a ship is quite a challenge. The condition in which the wreck rests at a depth of 75 m does not make things easier. Fieldwork has been

carried as a collaborative effort between MARIS (The Maritime Archaeological Research Institute at Södertörn University), the marine survey company MMT, the company Ocean Discovery, who found the wreck, and Deep Sea Productions who are filming a documentary about *Mars* (Holmlund/Rönnby, in press).

The fieldwork thus has both archaeological and commercial objectives. The TV team has carried out a lot of diving, but as the wreck rests at 75 meters, with a bottom time of 20 minutes, will yield a decompression time of nearly two hours. The divers have made some extensive photography and also very promising tests with photogrammetry; a technique which appears very suitable for exhibition purposes.

Drawing on experiences from the survey of the so called «Ghost Ship» (Eriksson/Rönnby, 2012) the archaeological fieldwork has been carried out using ROVs. The methods used for recording under water are mainly acoustic. We have used Multibeam, but also BlueView technique (see Holmlund, 2014: 4-9, Holmlund/Rönnby, in press) operated using ROVs (for a discussion on the use of film for ship-documentation see Eriksson, 2014a: 37-52).

The great benefit with the Blueview technique is that it collects a lot of information concerning the shape and dimensions of individual timbers and coherent structures. It thus provides an opportunity to measure different features and carry out a lot of analyzing and measuring after the fieldwork has ended. It is thus possible to go back to the material and extract information as queries pop up, while analyzing or writing about the wreck.

Fieldwork has focused on collecting information to enable a reconstruction of the hull. Not necessary the construction sequence of the hull, but rather the space that the hull-sides, deck-levels and so forth encapsulated. Drawing on studies of buildings and landscape, such a reconstruction may be used as a departure point for a phenomenologically inspired analysis (see Eriksson, 2014a). As *Mars* sank during a fierce battle an underlying motif has been to reconstruct the chaotic environment during a fierce naval action in the sixteenth century.

Sterncastle

The wreck-site largely consists of loose, highly deformed timbers of which we will never be able to establish the original purpose, function or position of. But even if the site appears disordered and confusing at a first glimpse, there is in fact a certain logic in the pile of frames, beams, planks, guns, loose artefacts and human remains. The deck-levels for instance, are piled on top of each other, which mean that there is a certain stratigraphy among the constructional parts. The dimensions of the different parts reveal which deck-level they derive from. The deck-beams of the gun-deck are thicker than the ones in the quarter-deck, and thicker than the beams from the poop-deck. It is thus possible to establish the original location of the loose timbers even if they are found somewhat out of context.

But also other loose timbers can be very informative and a few of such items were brought to the surface for more detailed observation. The timbers were selected as they were considered informative of the cross-sectional shape and construction of the hull. After the recovery the items were brought to Västerviks museum and placed in a pool in the middle of their *Mars*-exhibition. They were thus put on display immediately after salvaging and the archaeological recording has been carried out in front of the museum's visitors.

Mars stern-castle is of particular interest as the ship was built, used and sunk, during a period of transition of naval warfare, a shift from boarding tactics to artillery (cf. Glete, 2000: 17-

39; Rodger, 1996: 301-324). *Mars* thus both carried heavy artillery on her lower gun-deck, but was also equipped with a high, carrack-type stern-castle of a kind associated with medieval boarding tactics. Much of the stern-castle is preserved. Along the starboard side the standards that have supported the sides of the stern-castle are preserved in situ, while their counterparts from the port-side are found loose (Fig. 1, a).

One of the loose standards that originally were placed along the port-side was salvaged, together with a top rider. The still attached deck-knee, notches for shelf-clamps, nail-holes and so on from these constructional features provides several clues as to the height between decks, dimensions of the individual timbers and cross-sectional hull shape. Whereas *Mars* lower hull –as described above– is carvel built and heavily framed with compass timbers, the stern-castle is of a much more lightweight construction. It was built during a second phase of the ships construction and forms almost a building on its own, standing on top of the carvel built hull.

The raised standard reveals some clues regarding the sequence of the stern-castles construction. After the carvel built hull was completed up to the upper gun-deck, seven or eight standards were erected and attached to the hull on each side. They were attached to the hull using thick iron bolts. These standards are clearly identifiable among the other timbers as they are not shaped after the clinker-laid planking of the stern-castles sides. The standards formed the framework onto which the clinker-laid planking was attached using iron nails. When the planking was completed, top-timbers, shaped after the clinker-planking, were inserted in between the standards. The procedure thus has several similarities with the construction of a shell-first clinker hull (Hasslöf, 1988).

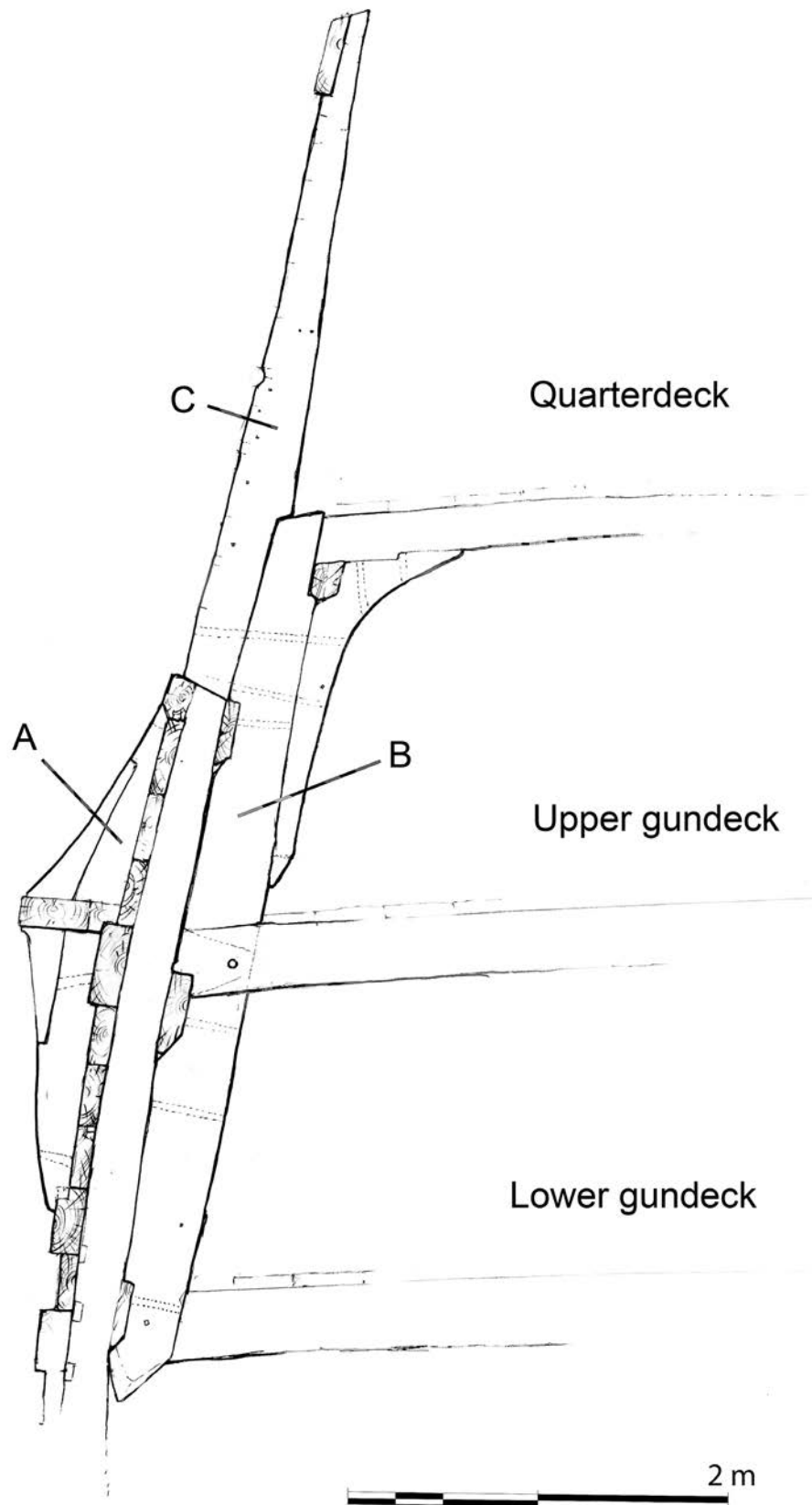
The situation with a lightly built sterncastle on top of a heavily carvel built hull corresponds well with witness from the Spanish Armada that attacked England in 1588, who observed that «the upper work (...) was of a thickness and strength sufficient to bear off musket shot. The lower work and the timbers thereof were out of measure strong, being framed to planks and ribs four or five foot in thickness, insomuch that no bullets could pierce them» (quotation in Hough, 1969: 94).

The shrouds for the masts were fastened to the hull through chains which were anchored to the hull with iron bolts. As mentioned above the channel on *Mars* had a shelf which ran from the mainmast all the way to the stern. The purpose of the shelf is to give a greater spread to the shrouds. As shown on several images of ships from the sixteenth century and earlier, the channel were attached to the hull using through a vertically oriented timber which I simply refer to as a bracket. On *Mars* this vertically oriented timbers are placed just abaft of each lower deck gun-port. This is not a coincidence as the timber has provided additional strength to the hull in connection to the gun-port.

One of these vertically oriented brackets for the channels was salvaged as it contributes with the information of the curvature of the hull amidships, but also the dimension of the wales. Together the raised ship-timbers provide a good idea of the ships cross-sectional construction and hull-shape (Fig. 3).

Cannons

During the sixteenth century the medieval wrought iron breech-loaded guns were gradually replaced by muzzle-loaded cast bronze guns. *Mars* was armed with more than one hundred bronze guns and a few wrought iron pieces (see above). Arming an early modern warship was almost as expensive as building the ship. A large number of bronze guns are scattered all over the wreck-site. What is most striking is perhaps the varying size of these barrels, from the largest weighting around 4.1 tons to the small ones weighting under 100 kilos (Sjöblom, 2012: 16-18; 2013: 26-34).



Niklas Eriksson

Figure 3. Cross section of showing the construction of *Mars* hull and sterncastle. A=bracket for the channel, B=top rider, C=standard onto which the clinker laid planks of the sterncastle were attached (Niklas Eriksson).

Two guns have been salvaged from the wreck one small and one large. Large guns could be used for centuries. For instance the Swedish ship HMS *Kronan*, wrecked in 1676, was armed with a large number of trophy cannons. Several of these were over 100 years old when she sank (Einarsson, 1997: 215). Smaller cannons however, which became obsolete in the seventeenth century, were recast into guns of more operational calibers (cf Törnqvist, 2006: 167-175). The really unique guns from *Mars* are thus the small ones, as they would not have survived to our time if the ship had returned to the naval base (Fig. 4).

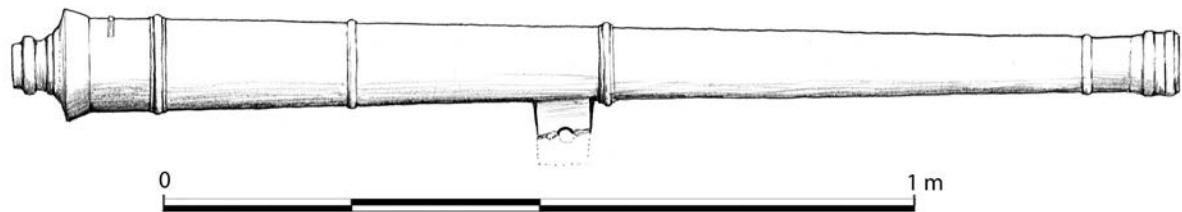


Figure 4. The small bronze gun salvaged from the wreck. Note the small bracket on the lower side of the barrel (Drawing: Niklas Eriksson).

Finds of small guns –falcones and similar– from wrecks reveal that breech loaded bronze versions were in use in the Mediterranean and elsewhere from the late medieval period onwards (cf. Beltrame/Ridella, 2011). The falcones observed on *Mars* however, are muzzle-loaded. It was one of these that was salvaged during fieldwork. The c. 1.55 m long barrel has a caliber of c. 30 millimeter and is equipped with the Swedish king Erik XIV coat-of-arms on the breech. The barrel is unusual in the sense that it lacks trunnions for it to rest in either a carriage or a swivel of the conventional type. The only feature that reveals something regarding its attachment is a small bracket on the lower side, which indicates that it originally rested in a stock.

The grape has a square hole in its end which is surrounded by incrustations and rust. It thus has contained a steel tiller used for aiming the gun. A small bracket, placed just aside of the touchhole most likely derives from a firing mechanism. Written sources describes the use of *tell-ehakar*, which were small cannons that could be aimed, which sometimes were equipped with a matchlock mechanism (Alm, 1934: 127; Lenk, 1943: 152).

The larger gun, which measures c. 3.6 m in length were also salvaged. It was found, broken in two and were brought to the surface mainly for exhibition purpose. The large barrels from *Mars* are generally very similar to the bronze cannons in use during the centuries to come. The gun-carriages however are of a different, more archaic design, and not of the kind we usually associate with sea-ordnance. It was quite a surprise to observe that all gun-carriages aboard *Mars* appear to be of a two-wheeled type, which is commonly associated with field artillery (Fig. 5). Aboard *Mary Rose*, for instance, which sank 19 years before *Mars*, the bronze guns are placed in four wheeled carriages, whereas the two-wheeled carry the elderly wrought iron guns (cf. Fontana/Hildred, 2011).

One gun-carriage, with one of its original wheels has been salvaged from *Mars* (Fig. 6). The gun-carriage is just above 2.5 m long and consists of two parallel oriented planks. Traces of the ironwork are visible as stains on the surface of the wood, which is charred due to the fire while the ship sank. Judging from its location on the wreck-site, the gun-carriage originally carried one of the stern-chasers, which were pointing aft through the ports underneath the wing transom. It was thus placed on the orlop deck. The barrel which originally was situated in this carriage has not been relocated. Hence we don't know the size of *Mars* stern-chasers. It is ap-

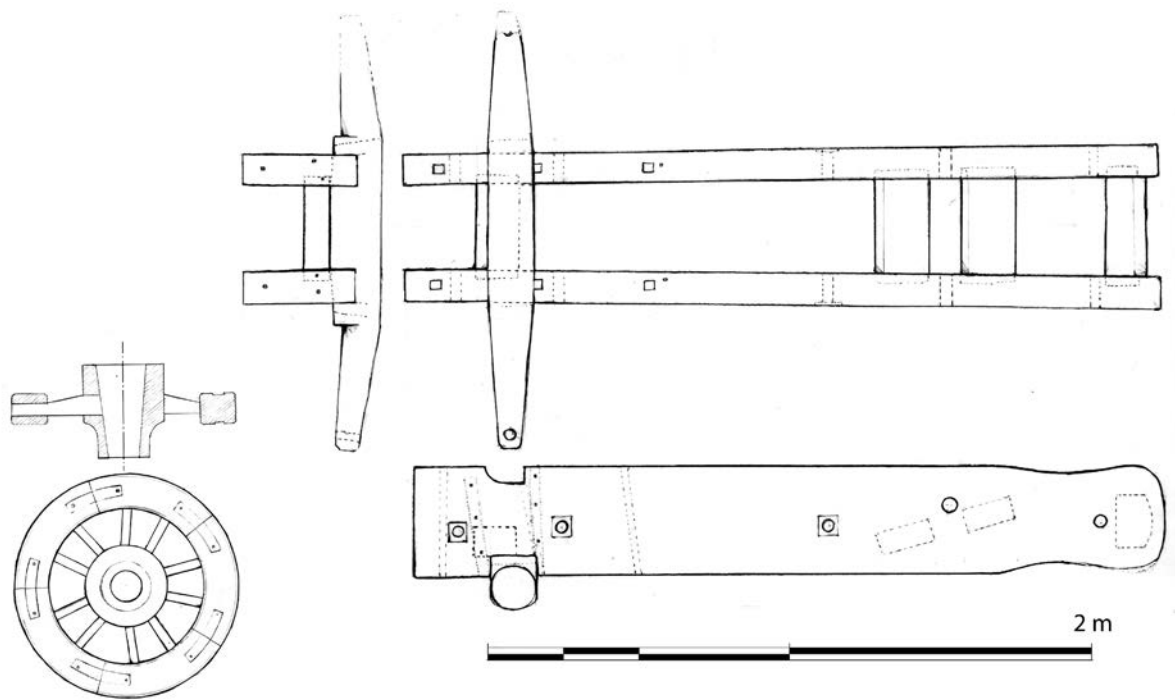


Figure 5. Preliminary drawing of the lifted two-wheeled gun-carriage and wheel (Drawing: Niklas Eriksson).



Figure 6. A gun together with a two-wheeled carriage resting upside down (Photo: Ingemar Lundgren).

parently though, that the above mentioned, over 3.6 meters long barrel that also has been salvaged, is too small for this carriage.

The great length of the gun-barrels, especially when placed in a two wheeled carriage, demands a lot of deck-space. The absence of gun-ports in the aftermost part of *Mars* hull sides, is likely due to the fact that the guns pointing aft, the stern-chasers, required a lot of deck-space, to recoil and in order to be reloaded. It is uncertain why the Swedish navy did use two-wheeled carriages during this period, when other navies obviously already were using four-wheeled.

Future

This paper has very briefly presented some of the naval architectonical insights won from the survey of *Mars* so far. There are of course a vast number of queries to discuss using this wreck as a departure point. *Mars* was built in the arms race around the Baltic Sea during the sixteenth century, which may be regarded as an experimental workshop for the construction of large fighting ships and naval warfare. One hundred years after *Mars* sank the sailing warship had reached its final form, with three masts and muzzle-loaded guns in ports along the sides of the hull – the basic design that the fighting ships would keep until the mid-nineteenth century and the innovation of steam, rotating gun-turrets and so on. *Mars* may thus be regarded as one of the prototypes for these ships.

To an extent it is when fieldwork ends that the real archaeology begins. The material collected from the field expeditions still requires a lot of further processing and analysis. Reviewing the material so far, things look promising, and eventually, in a not so very distant future, we will have a quite clear picture of what *Mars* used to look like. But still there is a lot of work to do before we get there. And then –after more than four hundred years– we will finally know just how huge the largest ship on the Baltic Sea really was.

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Ships and Space – the spatial arrangement of *Vasa* 1628

Naves y Espacio: la distribución espacial del *Vasa* 1628

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Abstract: Warships in the 17th century were extremely crowded. Even the officers lived in crowded, shared small spaces. The Swedish warship *Vasa's* (1628) overall spatial arrangement is very similar to contemporary English and especially Dutch ships. But is *Vasa* really representative for a warship in Europe in the 17th century? By using the ship itself, as well as other archaeological material, historical sources, paintings and ship models, we can get a better understanding of the interior of early-modern warships. How did people live on the ships – where did they sleep and eat, who were the «cabin-people» and did the admiral sleep alone?

Key words: *Vasa*, Seventeenth century, space, warship, nautical archaeology.

Resumen: los buques de guerra en el siglo xvii estaban extremadamente llenos de gente. Incluso los oficiales vivían en espacios pequeños compartidos con otros. La disposición espacial del buque de guerra sueco *Vasa* (1628), es muy similar a la de los barcos contemporáneos ingleses y especialmente holandeses. Pero ¿es *Vasa* realmente representativo como buque de guerra de la Europa del siglo xvii? Mediante el uso del propio navío, así como de otro material arqueológico, fuentes históricas, pinturas y maquetas de barcos, podemos conseguir una mejor comprensión del interior de los buques de guerra de la temprana Edad Moderna. ¿Cómo se vivía en los barcos? ¿Dónde dormían y comían? ¿Quiénes ocupaban los camarotes? ¿Dormía solo el almirante?

Palabras clave: *Vasa*, siglo xvii, espacio, buque de guerra, arqueología náutica.

In the 1620s Sweden was a rising power under the ambitious king Gustavus Adolphus. In 1621 Riga was captured from Poland and Sweden was soon to enter the Thirty Years War in Germany. Gustavus Adolphus reformed the state bureaucracy, to the purpose of supplying the army and the navy with men and money. In 1628, the warship *Vasa* sank on her maiden voyage in Stockholm harbor.

Power, space and social difference

The 17th century marks the heyday of the Swedish «four estates society». Everyone in society had their god given place – nobles, priests, burghers and peasants. The harmony of the four estates was not to be questioned. People's status was displayed in a very visible way, in clothing, housing and ways of living. The practices of social difference were strong (Englund, 1989: 28, 46). Splendid castles, statues and triumphal arches were important ways of displaying power for the princes and nobles of Europe (Burke, 1992; Stadin, 2009). A naval ship was a floating representation of power and its exterior displayed ideological messages. The ideas of the four estate society were visible even inside the ship. This paper discusses the social hierarchies and division of space onboard naval ships, with a starting point on the warship *Vasa* (1628).

Vasa – many people in a small space

Aboard large ships were representatives of both higher and lower social strata from different parts of the Swedish kingdom. But the people on board cannot be seen as a direct reflection of the surrounding community. The «ship-society» was a male-dominated world, which often required specific specializations. In 1628, the 47.5 meters long and 11.5 meters wide *Vasa*, was planned to house about 450 people. Of these, 300 were soldiers, divided into two companies, who had not yet boarded the ship at her departure (Skenbäck, 1983: 49). This was because *Vasa* was planned to be in readiness in the Stockholm archipelago. The soldiers could therefore be located on shore but also close at hand to save the ship's food supply and to avoid diseases. In the event of departure, they could quickly embark the ship. Throughout most of the 17th century, the crew slept directly on the gun decks. Hammocks were officially introduced into the fleet in 1676 (Spens, 1942: 360). The limited space on board and the fact that sleeping and working areas in most cases were the same meant that privacy, peace and tranquility were rare.

In the first half of the 1600s, before ship of the line battle tactics, the ultimate aim in battle was to board the enemy. For this purpose the ships carried many soldiers. On *Vasa* the «army»-soldiers were probably organized in the same way as on land. This meant that the total number of officers and non-commissioned officers on board were more or less the same as on a naval ship 100 years later. The difference is that on *Vasa*, the majority were tied to the army and not to the ship itself. The officers and the non-commissioned officers counted as «cabin-people» (Swedish: *kajutfolk*), men who had access to the after part of the ship and also ate better food (Glete, 2006: 609; SAOB spalt: K58 – kajut-person; TiS, 1836: 195). Normally, the senior officers came from the nobility (Glete, 2006: 609; Skenbäck, 1983: 59).

The people on board can be roughly divided into four groups according to their military status; officers, non-commissioned officers, petty officers and common men (seamen, gunners and soldiers) (Glete, 2006: 609; for alternative classifications see Hammar, 2014; Skenbäck, 1983). Below is a description of the planned crew for *Vasa*. I have given the officers and others from the two army-companies the prefix «army» to distinguish them from the sailors. «Specialists» are those who do not have direct military or ship-oriented positions, for example priests.

The planned crew of the *Vasa* 1628

- Officers: 1 vice-admiral, 1 captain, 2 lieutenants, 2 army-captains, 2 army-lieutenants and 2 army-second-lieutenants. A total of 10 officers.
- Non-commissioned officers and certain specialists: 1 master, 1 masters mate, 1 boatswain, 1 boatswains mate, 2 navigation officers, 1 master gunner, 1 ship's marshal, 1 priest, 1

barber-surgeon, 1 drummer and 30 army-non-commissioned officers and specialists. A total of 41 officers and specialists.

- Petty officers and certain specialists: Coxswains and their mates, quartermasters, cooks and carpenters. A total of 16 petty officers and specialists.
- Common men: Seamen, gunners and ship-boys: 114 men. Soldiers and others: 272 men. A total of 386 common men.

In total 453 men (Barkman, 1931: 91; Skenbäck, 1983: 39-43).

***Vasa* spaces**

Swedish shipwrights had a long tradition of building large warships, however, in the early 17th century many Dutch shipbuilders were hired and one of them, Henrik Hybertsson, built *Vasa*. In the second half of the century English builders brought their ideas to Sweden. But the Dutch and English shipwrights always had to deal with the Swedish admiralty and other influential people with opinions on the construction of ships (Höglund, 2013; Jacobsson, 1999: 24-25). The source-material concerning spaces on ships from the first half of the 1600s is very scarce. From the second half the situation is slightly better, but is it possible to draw any conclusions about *Vasa* from these sources? How similar were Swedish, Dutch and English ships?

Vasa is of course an important source concerning space on ships. The ship is almost completely preserved and the researcher can board the restored ship and take a look at the interior. However, there are some concerns – was the ship's interior completely finished when she sat sail on the 10th of August 1628? What has disappeared over the centuries on the seabed? We know that the upper deck and parts of the stern were destroyed during attempts to salvage the bronze guns. We also know that the ship was not fully equipped and that the soldiers were not yet onboard when *Vasa* sank (Cederlund, 2006: 310-400; Hocker, 2011: 190; Höglund, 2002; Wendel, 2006: 146-170).

Vasa has five main deck levels – the hold (not really a deck and used for storage of supply's), the orlop (mainly a storage deck), the lower gun deck, the upper gun deck and the upper deck. In the stern, there's also the poop – and topgallant poop decks (Fig. 1, 2).

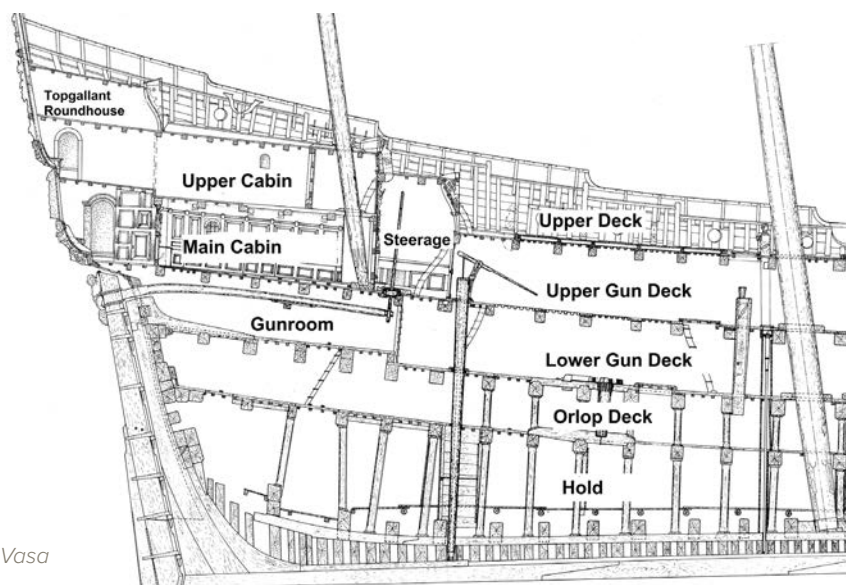


Figure 1. The spatial arrangement of *Vasa*
(Photo: Patrik Höglund).



Figure 2. The lower gun deck on *Vasa* (Photo: Patrik Höglund).

Aft of the upper gun deck is the main cabin, once richly decorated and fitted with foldable beds that could be pulled out. Today a lot of the *Vasa* interior is in museum stores due to conservation requirements. In front of the main cabin is the steerage with the whipstaff for steering the ship (Fig. 3). To the sides of the steerage there were two small cabins. Above the main cabin is the upper cabin, with traces of foldable beds on the ship sides. Forward of this cabin is a small room with a possibility for two small cabins at the sides, similar to those in the steerage. At the top of the stern is the topgallant roundhouse, which also might have contained foldable beds (Cederlund, 2006: 321; Hocker, 2011: 100; Landström, 1980: 137).

The gun decks are big open areas, except in the stern, where there are rooms separated with bulkheads. Under the main cabin, aft of the lower gun deck, the tiller runs in the ceiling in such a sealed area. The orlop is mainly an open store-room, except amidships where the galley box is located. In the stem and stern sections there are also rooms separated with bulkheads. The hold originally had several compartments, all of them probably meant for supplies and other stores. The brick galley for cooking is situated just ahead of the mainmast and reaches up from the hold through the orlop deck.



Figure 3. The steerage on *Vasa* (Photo: Patrik Höglund).

Other sources

Because of the scarcity, I have used varied source material, both by type and time period. The existing literature and the known sources available about Swedish conditions have been compiled and analyzed. When it comes to other sources and literature I have used those that are relevant to, and in some cases can be directly linked to Sweden. The majority of the source material used concerns the 17th century. This has been divided into before and after 1650. The reason for this is to show how limited the source-material is before 1650 and thus *Vasa's* unique position as a source for this period. Another reason is that the ship of the line tactics in the latter half of the century changed the way war was fought at sea, and therefore affected the spatial layout and the manning of ships (Turnstall, 1990: 16-47). There is also much more literature and research concerning this latter period, and traditionally especially English research on sailing warships has often taken 1650 as its starting point (see e.g. Gardiner/Lavery 2004; Glete, 2000; Harding, 1999).

Before 1650

The English King Henry VIII's ship *Mary Rose* (wrecked 1545 and salvaged 1982) has on the preserved side of the main deck cabins that appears to have, based on the finds in them, been occupied by the navigation officer, the barber and the carpenter. This meant that the space for guns would have been limited, but it was apparently not considered important. Probably because at the time boarding tactics were the decisive part of battle. One simply did not have to fill every suitable space with guns. *Mary Rose* is a carrack – a ship suitable for boarding-tactics. The upper parts of the ship, where the officers lived, is not preserved (Allen/Gardiner, 2005: 653).

The Swedish ship *Mars* (sunk in battle in 1564, found 2011), is one step closer to the kind of ship that became dominant from the late 16th century – the galleon (later to develop into the ship of the line). The ongoing investigations of *Mars* shows that the ship, despite its character of «half carrack, half galleon» had deck arrangements much like later large warships, with a hold, orlop deck, two gun decks, quarter – and poop decks (more on the deck arrangements below). No detailed studies of the interior of the ship have yet been undertaken (Eriksson, in press).

There are a few sources available on the interior of English ships during the first half of the 17th century. John Smith's *A Sea Grammar* from 1627, tells us that the master's cabin (upper cabin) was aft on the poop deck. Below was the main cabin and forward of that was the steerage with a binnacle (a cabinet with compass, hourglass, etc.) and the whipstaff. Along the ship's sides, in the steerage, the main and the upper cabins, there were several small cabins, benches and cabinets. Below the main cabin, was «the Gunroome over the Ordnances», i.e. the storeroom for small arms and artillery equipment (Swedish: *arkli*). In this space there were also some guns and the tiller in the ceiling (Smith, 1970 [1627]: 7-15). The trumpeters place was on the poop deck (Smith, 1970 [1627]: 43). Smith also writes that two comrades should not go on the same watch, as there is more room in the cabin if they overlap (Smith, 1970 [1627]: 49).

In *A treatise on Shipbuilding* from the first half of the 1620s, the unknown author writes that the gunroom is aft on «the orlop». This in fact probably refers to the lower gun deck, because «the orlop» is described as a typical gun deck with rows of gunports. The author probably describes a ship *without* what we would call an orlop deck. On the deck above (the upper gun deck) is the captain's cabin, forward of this is «the dining room», the whipstaff and the binnacle. Over the captain's cabin is the master's cabin and aft of that «the round house» (poop cabin, later top-gallant roundhouse). The author also writes that on these decks in the stern, there are

several cabins «for the use and succor of men». Specifically mentioned are cabins for the masters and the navigation officers adjacent to «the dining room», under the quarterdeck (Salisbury/Anderson 1965: 12-13, 28). According to the British naval historian Brian Lavery, many of the common sailors in English ships in the early 17th century had access to a cabin. In 1642, there were at least 56 cabins for a crew of 260 men on board *Victory*. These were probably double-cabins (see Smith above, about cabin mates and watches) and maybe we should think of them more as bunks, like those in the steerage on *Vasa*. Over the course of the 17th century, the number of cabins in English ships became fewer. The navy started using hammocks for the crew. The cabins were considered unhealthy, they were in the way of the increasing number of guns on board, hampered inspection of the hull and could cause splinters if they were hit during combat (Lavery, 1995: 155).

Joseph Furtenbachs *Architectura navalis*, from 1629, depicts a ship very schematically in a longitudinal section. The aft sections are, from top to bottom; *Camera per il Pilotto* – cabin for the navigation officer (or the pilot), *Popp.* – «stern» (probably the main cabin), in front of this *Bussola* – «compass» (probably the steerage) and below *Armoria* – «armoury» (the gunroom) (Furtenbach, 1629: 94-98, print 12).

In 1634, the French diplomat Charles Ogier visited the Danish ship *Stora Sophia*. The ship was about the same size as *Vasa* and armed with some 50 guns. *Stora Sophia* was built in 1627 and sank in 1645 outside Gothenburg on the Swedish west-coast. Ogiers description of the ship's stern reveals many similarities to *Vasa*. There were four «chambers», of which the top one was for the master, the next one for the captain and the third for the king or admiral. The latter also contained six berths, three on each side. The bottom chamber served as gunroom and contained all sorts of weapons, for example swords, bombs and grenades (Ogier, 1914: 50).

After 1650

In The Swedish National Maritime Museum's collections there is a spectacular model that depicts a two-decked ship from the second half of the 1600s (Ship model Ö4, also erroneously called, Amaranth) (Glete, 1990). The model is furnished. Aft on the lower gun deck is the gunroom. It has the tiller in the ceiling and on each side are two guns in gunports. In the stern are two unused gunports. On the inside of the bulkhead are shelves fitted with powder cases (turned wooden containers with ready-made powder charges). Above the gunroom is the main cabin with furniture consisting of a table, two chairs and a sofa. All the furniture is ornamented with gilded details and fitted with leather upholstery. The bulkhead towards the gun deck has a shelf for chart rolls. The walls, ceiling and furniture are painted white and the beams in the ceiling are red. On the sides of the room are a large number of pistols in a shelving system. The cabin also has a gun on each side. Unfortunately it is not possible to see into the upper cabin. The entrances to both the upper and main cabin are sculpted. The model's division of space has many similarities to *Vasa*. The model was restored by the commander, naval historian and painter Jacob Hägg in the 1890s, and it is difficult to know whether Hägg has changed the original interior or not.

The division of space in the model of an unknown Dutch two-decked ship from about 1660/1670 is very similar to the model Ö4 and *Vasa* (Winter, 1967). The spaces are open with relatively few enclosed rooms. The gunroom is located aft on the lower gun deck, with powder cases on the bulkhead, the tiller in the ceiling and two guns on each side. Above is the main cabin that houses two guns, much like the Amaranth model (See also Rålamb and Lenox below). The entrance to the main cabin is provided with sculptures, as is the entrance to the upper cabin.

The French copper print-collection *Album de Colbert*, from 1670, describes the design of a French three-decker 80-gun ship. The gunroom is aft on the lower gun deck, in the space where the tiller is in the ceiling. In the room there are two gunports per side and two in the stern. Above is the volunteer's cabin, with muskets in rows on the sides. In front of this cabin is the steerage with the whipstaff. On the quarterdeck are cabins for the officers. It is worth noting that the commander's relatively small cabin, is located aft on this deck. No gunports are located in the officer's cabins. At the top is the topgallant roundhouse, which houses six separate cabins. In front of this, along the hull sides are two (possibly four) low «deck cabins» for the navigation officers. They are similar to those in the steerage on the *Vasa*, though here in the open (see also below about trumpeters cabins on English ships) (*Album de Colbert*, 1670: plates 43-50).

Nicolaes Witsens *Aeloude en Hedendaegse Scheeps-bouw en Bestier* from 1671, describes space mainly aboard a pinnace (a small armed vessel for trade or war), but also on bigger warships. On the pinnace, the gunroom is situated aft of the gun deck, above the orlop deck. Witsen writes that on the bulkhead between this room and the actual gun deck, there are often shelves for powder cases. Above the gunroom is the main cabin, which on large ships can be divided into two rooms. Occasionally there is a staircase to the upper cabin, which can also be divided into two rooms (Hoving, 2012: 114-116, 154-156). Above this there can be another cabin on big ships. In the main cabin there are sometimes bunks along the sides (Hoving, 2012: 138).

English warships after 1650

From the second half of the 17th century we have more detailed information about space on English ships. In a regulation from 1673 big ships were considered to need somewhere between 32 and 55 cabins, but those cabins were now only intended for officers. Sailors and soldiers slept in hammocks on the gun decks (Lavery, 1995: 156). For the two-decked 70-gun ship *Lenox*, built in 1677 and part of a shipbuilding program that standardized English ships for a long time, there is detailed information preserved. The ship had some 50 separate rooms on board. Of these, the majority were individual cabins, most of which were very small. Some were only 90 centimeters high (Endsor, 2009: 7, 65; Lavery, 2010: 82 about so-called 3/4 – cabins, which the holder had to crawl into).

The cabins on the gun decks were very lightly built, often of old canvas that could be easily removed before battle. These small cabins housed for example navigation officers and carpenters. The cabins were concentrated on the upper gun deck, underneath the quarterdeck. There were also some cabins aft on the lower gun deck, in the forecastle, and on the orlop deck. Cabins and bulkheads could also be removed when the ship was not in active service, to ventilate the interior and prevent mold and rot (Endsor, 2009: 64-65, 91).

The captain had his bed in a separate cabin adjacent to the main cabin at the stern on the upper gun deck. The cabin was the captain's office, but was also intended for meetings and representation. Ahead of the main cabin was the steerage. Below was the gunroom, which then partially served as a shared space for the non-commissioned officers. Adjacent to this were some small cabins, for the constable and the barber-surgeon among others. Under the gunroom, in the aft part of the orlop deck, there were a large number of storage rooms, but also three cabins. Up in the stern castle, on the quarter-deck, the senior officers –including the lieutenants– had their cabins (Endsor, 2009: 64-65). On some English ships there were fixed benches with small doors at the stern of the uppermost, open deck. A so-called «Navy Board» model of the *Royal James* (1671), as well as some paintings and prints (see below) show this (Winfield, 2010: 29). These

benches later grew and formed a cabin, the «topgallant roundhouse» (see model of the *Royal William* 1719 in Winfield 2010: 47) – a return to the design several ships such as the *Vasa* had during the first half of the 17th century. The benches were cabins for the ship trumpeters (Winfield, 2010: 35; Lavery, 1983: 134). There are a number of illustrations with sections (in the ship's longitudinal direction) of English three-deckers, so-called «first rates», from the last decades of the 17th century (see e.g. Lavery, 1983: 42, 134; Winfield, 2010: 122-123). On these a large number of cabins can be seen. Most were, as in the case of *Lenox*, of a lightweight construction, located between the guns and mounted against the ship's sides and they were possible to quickly dismount. For a viewer today they look like closets. In some cases there are similar small cabins drawn on the orlop deck. In the stern, there was more generous space than in two-decked vessels, especially for the admiral, the captain and other senior officers. There was even room for counsel and representation. These areas appear to be richly decorated with friezes and pilasters. Also the entrances are equipped with sculptures. On a longitudinal section from the National Maritime Museum in Greenwich, even paintings of ships on the panels in the cabins are visible (NMM BHC0872). In contrast, there were guns in almost every part of the ship above the waterline, even in the admiral's cabin.

Swedish warships after 1650

During the first half of the 17th century, the construction of large warships in Sweden were led by Dutch shipbuilders. However, in 1659 two English shipwrights were hired by Karl (Charles) X. The king had been inspired by English ships he had seen in the Sound (Börjeson, 1942: 262-263, 274; Lundgren, 1999: 7-8; 2000: 4-7). The Dutch influence nonetheless remained strong and the Swedish Admiralty, accustomed to ships built in the Dutch way, complained about the new English-built ships. They were considered too narrow, especially in the stern and stem areas. The main cabin and the gunroom became too small and cramped (Jakobsson, 1999: 233). The admiralty also complained that the gunpowder stores, which usually lay aft in the hold, became too small and must be moved forward.

Åke Rålambs *Skeps Byggerij eller Adelig Öfnings Tionde Tom* (advice about ship building for noblemen), published in 1691, depicts a two-decked ship in a longitudinal section (Fig. 4). Aft on the upper gun deck is the main cabin, with one gunport on each side and exits to the lower galleries. In front of the main cabin is the steerage with the whipstaff and the binnacle. Above is the upper cabin, with two gunports per side and exits to the upper galleries. The lower gun deck houses the gunroom in the stern, with two gunports per side (Rålamb, 1943 [1691]: 27-34, Plate H). Contemporary with Rålamb is Werner von Rosenfeldt's undated *Sjömansmemorial* (Sailors Memorial), with descriptions of officer's duties on a warship (Cavallie, 1976). There are also glimpses of information regarding space. Concerning the constable, von Rosenfeldt mentions he is in charge of the gunroom which is also considered as «his space» (Cavallie, 1976: 132-133). Before battle, the lieutenant must clear the gun decks from all items such as berths, chests and bulkheads, which can cause splinters (Cavallie, 1976: 139).

In Johan Dalmans sea-dictionary from 1765, there is information on space aboard naval ships in the mid-1700s. The gunroom appears to be located on the same place as on *Vasa* and constables and artillery officers have their cabins there. The carpenter and master's cabins are below the forecastle or forward on the orlop deck (Dalman, 2003 [1765]: 20, 84). Non-commissioned officers and surgeons stay aft on the same deck (Dalman, 2003 [1765]: 40, 84). On the upper gun deck, forward of the main cabin and below the quarterdeck, is the *skans* («coach») with what Dalman calls «cavotto cabins» under the stairs from the quarter-deck, and canvas cabins along the sides. Aft is the main cabin and smaller cabins (Dalman, 2003 [1765]: 40). On the quarterdeck, aft of the mizzen mast, there are more cabins (Dalman, 2003 [1765]: 42, 68).

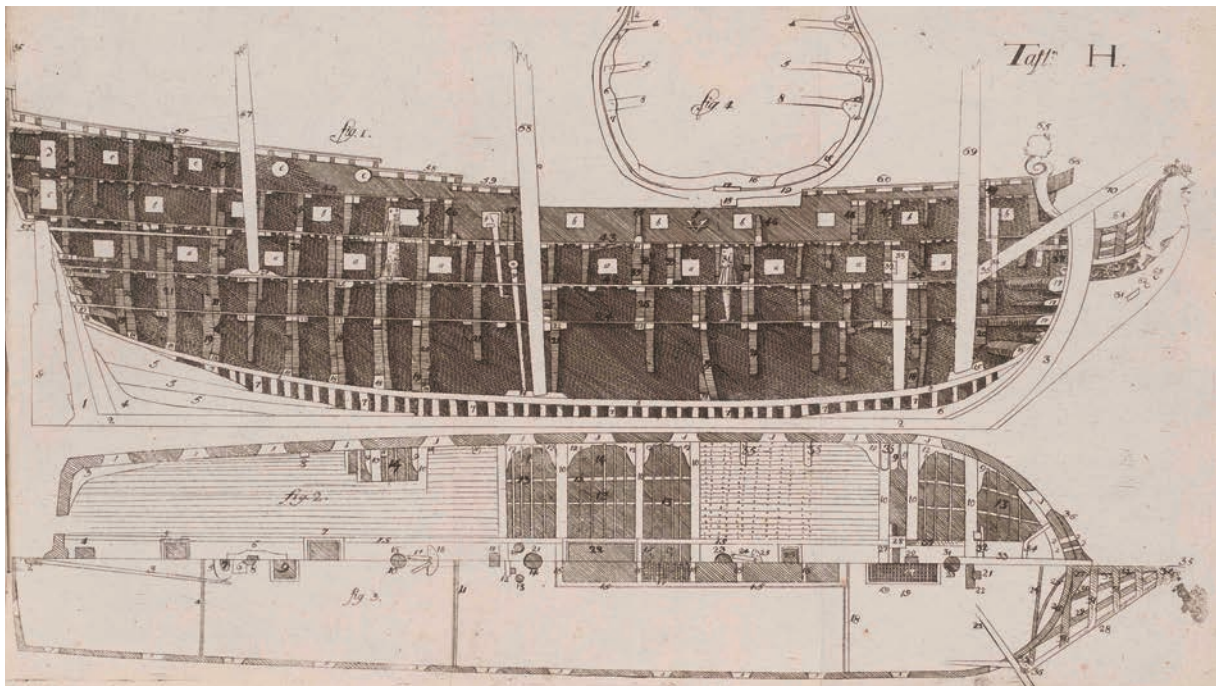


Figure 4. Longitudinal section of a two-decker (Ralamb, 1691).

Interiors of cabins in Swedish warships

As mentioned above, there are very few contemporary images showing the interior of ships in the 16th and 17th centuries. Sectional drawings show the larger layouts, but small rooms, furniture and details are largely absent. There are few known written records regarding the interior of Swedish ships. The sources tell us that in the officer's space and especially in the main cabin, high quality cloth such as satin was used for canopy beds and as table cloths. Panels, sculptures and gilt leather were used on the walls (Börjeson, 1943a: 44; Zettersten, 1890: 332; 1903: 309-310). Gilt leather and expensive cloth was also used for furniture. The scarce archaeological material confirms this (Einarsson, 1984: 11-13, Appendix vi, 1991: 10). The entrances to the spaces in the stern were also ornamented. *Carolus* (1650) had two meter tall sculptures on each side of the entrance to the main cabin and above the door there was also an ornamented piece. The entrance to the upper cabin was decorated in a similar manner (Börjeson, 1942: 272).

As shown above, exclusive fabrics for furniture, table linens and furnishings were highly appreciated on ships. This is also known from the homes of the nobles in the 17th century (Karlson, 1945: 22, 38). Gilt leather and panels for wall decorations, as well as sumptuous bed hangings are phenomena known from contemporary sources (Karlson, 1945: 53-55).

Vasa's spatial arrangements – a conclusion

The purpose of this article has been to collect sources regarding the spatial arrangement on naval ships and compare these with *Vasa*. The focus has been on how social differences were created and maintained by the means of spaces. The analysis has dealt specifically with the officers' spaces in the ship's stern. It appears that *Vasa* is fairly representative regarding space on a two-decked warship during the 1600s. If the comparison is narrowed to the first half of the century, this becomes even more apparent. The ship has an orlop deck and lower and upper gun decks. In the

stern there is also a poop – and topgallant poop deck. In the main cabin there were folding beds and cupboards. The steerage is forward of the main cabin. The gunroom is located aft on the lower gun deck, in the room with the tiller in the ceiling. The relative order of space is similar to many other ships. At this period, early in the 17th century, there were no guns in the cabins.

A deviation is *Vasa*'s upper gun deck, which on two-deckers normally was not covered amidships. On *Vasa* the quarterdeck and the forecastle is connected, forming a continuous *upper deck* (weather deck). This extended the common men's covered space considerably. Whether this occurred in other Swedish warships is not known. So far this solution has not been found in paintings of English or Dutch ships. But there are English sources and a few models that demonstrates similar solutions (Höglund, 2013; Lavery, 1983: 13, 61; SM model Ö3). Also in the stern there is an unusual solution in the design of the steerage, which, with its high ceiling, makes the entrance to the upper cabin a bit complicated (Fig. 1, 5). English ships were often delivered with unfinished interiors and this was not only due to haste, but was also partly intentional. The idea was to get air to circulate through the newly built ship and let the wood dry (Endsor, 2009: 64). It is possible that the *Vasa* was not completed in respect of the interior at the departure. For example, the gunroom is missing shelving for powder cases. Nevertheless, there are no indications of more separate rooms or cabins on board.

Vasa's cabins were decorated with sculptures and panels. The entrances were provided with sculptures in a similar manner as the ship *Carolus* (see above). No trace of ornamentation in the form of fabrics has been encountered, but it is likely that such were meant to be used on the ship. It seems common that the main cabins also housed some form of «regular» bed, sometimes apparently a canopy bed, since bed cloth and canopy's (ceilings) in precious materials is mentioned repeatedly in historical sources. This was probably designed for the highest commander on board. On *Vasa*, however, no such bed is known. An interesting aspect is whether certain furnishings and furniture was privately owned. It is known that officers, especially aristocratic ones, sometimes brought lots of possessions, including furniture, onboard (Einarsson, 1997: 212-215).

Most areas had several functions as both public and semi-private rooms. For example, the main cabin served as sleeping space, but also as a state – and council room. This has partly to do with the lack of space on a warship, but also because at this time it was common to socialize, eat and sleep in the same room. The system with benches along the walls which served as beds is also well known (Troels-Lund, 1939: 61, 177-181, 242). *Vasa*'s and contemporary ships' living space was allowed to precede on space over the placement of guns. On depictions of ships built before the ship of the line tactics were introduced in the mid-1600s, for example, the Danish *Tre Kroner* (1601), the English *Repulse* (1596/1609) and *Prince Royal* (1610), the French *Le Grand Saint Louis* (1626) (Landström, 1980: 16-17, 22-23, 36) and the Dutch *De Hollandse Tuyn* (1605-1640) (Rijksmuseum, Amsterdam), there appears to be no guns in the main cabins. Neither do written sources from the first half of the century speak of this. With the ship of the line tactics it became important to have as many guns as possible along the ships sides. It is possible that the models Ö4 (Amaranth) and «The Dutch two-decker» reflects this shift.

In principle, no private space existed aboard the *Vasa*, with the possible exception of the cabins/berths with sliding doors in the steerage. Gun decks were, in addition to their primary function as gun and work platforms, used as sleeping and recreation areas. As well as the storage decks, the gun decks were strictly functional with no decoration and with little natural light. The personal space for most people on board would have been very limited.

The positions mentioned in connection with spaces before the 1650's are: admiral (king), captain, master, navigation officer and trumpeter. After 1650 there is more detailed information on more positions and where they had their sleeping quarters and their equipment (see e.g. Endsor

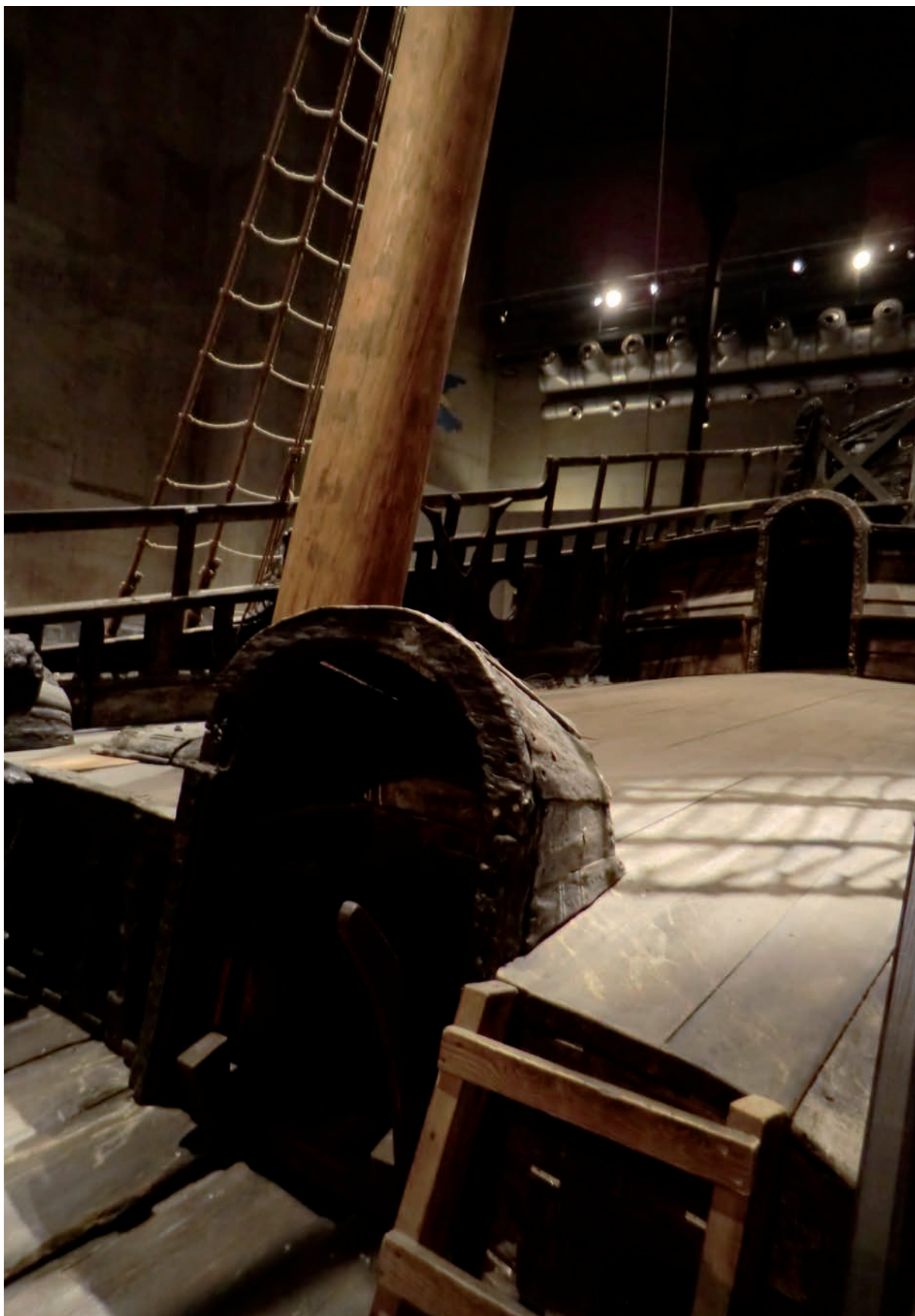


Figure 5. Entrances to the upper cabin and the topgallant roundhouse on *Vasa* (Photo: Patrik Höglund).

2009: 64-65). Space in the sources is often described as the «admiral's», «captain's», or «master's». This should not be taken too literally. Apparently several people have been sleeping in all these rooms. Instead, we might imagine that the admiral's cabin at this time simply was his state room, which was shared with other high-ranking officers, preferably nobles – and probably their servants. The fact that persons of the same sex, regardless of social position, shared room and bed was customary at this time (Fimmerstad/Triberg, 2000: 30; Venborg, 2009: 42, 73, 128).

The source material as used in this limited study suggests that Swedish, Danish, Dutch and English warships during the first half of the 17th century were similar in their spatial design, especially regarding the stern, which has been the focus of this article. However, in English ships, many had access to their own, albeit in most cases minimal, cabin. During the second half of the century this difference continued, although the number of individual cabins decreased in English ships (and the great mass of sailors slept in hammocks on the gun decks) and there are indications of more cabins on Swedish ships (e.g. Cavallie, 1976: 139). As late as 1736 it seems that Swedish ships have fewer cabins than in this case, French ships. The Swedish shipbuilder Gilbert Sheldon then had the opportunity to inspect the French admiral's ship *Bourbon* anchored outside Hanö in southern Sweden. He mentions specifically that the space under the quarterdeck was fitted with many rooms for the officers (Börjeson, 1943b: 226-227). An increasing number of cabins and the mentioning of canvas cabins for non-commissioned officers are mentioned first in Johan Dalmans sea-dictionary 1765. Fredrik Henrik af Chapmans drawings and models of ships of the line in the 1780s also show a growing number of cabins and small rooms, but not nearly as many as on English ships (SM Drawing SR 31 B4 / 5; MM model MM 2055).

The living quarters for the officers on *Vasa* can be divided into three types:

- The strictly separated, ornate and representative officers' rooms – The main and upper cabins. Reserved primarily for people with high status; admirals, captains, lieutenants and possibly masters. About 10 people may have lived here.
- The separated storage and non-commissioned officers' rooms – the topgallant round-house, the gunroom and the steerage. Reserved for people with a certain status; non-commissioned officers such as constables and navigation officers, and certain specialists such as barbers and priests. Approximately 15 people may have lived here.
- The separated storage and petty officers' rooms on the orlop deck. Reserved for people with foreman status; some (army) non-commissioned officers, petty officers and specialists. Approximately 30 people may have lived here. Possibly rooms adjacent to the galley in the hold can be included here.

Cabins and other areas where people with high status, such as officers and perhaps foreign dignitaries were staying, were beautifully decorated and reminded one of the upper-class environments on land. The most prestigious space on board was the main cabin and only *kajutfolk* («cabin-people») had access to it. It was also used when important visitors came onboard and represented then the king and the kingdom. But it could also represent the temporary holder of the cabin, such as the admiral, who perhaps had decorated it with his own exclusive furniture. The officers on Swedish ships in the first half of the 17th century appear to have shared space. It is likely that an admiral, or even the king, aboard a warship in Sweden at this time, shared room and maybe even bed with others. What we today would call *private space* thus appear to have been less important than *social space*. It was more important to obtain a place in the right environment, from what the position on board required, whether this meant that this was shared with others – the main thing was that the room was shared with equals. There was a big difference between the beautifully decorated rooms with windows in the ship's stern, and the bare, unadorned and dark gun decks, where the sailors and soldiers spent most of their time.

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— Model Ö4.

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El pecio de la *Mortella III* (Córcega, Francia): un aporte al conocimiento de la arquitectura naval del siglo XVI en el Mediterráneo

The shipwreck of Mortella III (Corsica, France): a contribution to the knowledge of the 16th century's naval architecture in the Mediterranean

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Resumen: los pecios de la *Mortella II* y *III* fueron descubiertos en la bahía de Saint Florent (Haute Corse) en el transcurso de una prospección arqueológica dirigida por el Centre d'Etudes en Archéologie Nautique –CEAN/SEAS– en 2005 y 2006. El interés científico de estos pecios del siglo XVI condujo, en 2010, a la organización de un programa de investigación sobre el yacimiento de la *Mortella III*. Desde esta fecha, se han realizado cuatro campañas de excavación, movilizándolo un equipo pluridisciplinar alrededor de un proyecto apoyado por el Ministerio francés de Cultura a través del Département des Recherches Archéologiques Subaquatiques et Sous-Marines (DRASSM) y la Colectividad Territorial de Córcega –CTC–. Esta comunicación tiene como objetivo presentar los resultados preliminares de los trabajos que se han realizado en este pecio, y en especial aquellos relativos a la construcción y arquitectura navales, ya que lo permite el buen estado de conservación de su carena.

Palabras clave: arquitectura naval del siglo XVI, construcción naval del siglo XVI, pecio del siglo XVI, pecios de la *Mortella*, pecios en Córcega.

Abstract: The *Mortella II* and *III* shipwrecks were discovered in Saint-Florent Bay (North Corsica, France) within an archaeological survey framework led by le *Centre d'Etudes en Archéologie Nautique* –CEAN/SEAS– in 2005 and 2006. The scientific interest of these wrecks dating from the 16th century led to the organization of a research program on the site of *Mortella III* from 2010. Since then, four excavations were conducted mobilizing a multidisciplinary team around a project supported by the French Ministry of Culture through its Department of Underwater Archae-

ological Research (DRASSM) and the Territorial Collective of Corsica (CTC). This communication aims to present the preliminary results of the works carried out on this shipwreck, and especially those related to shipbuilding and naval architecture allowed by the good condition of the hull.

Key words: 16th century shipbuilding, 16th century naval architecture, 16th century shipwrecks, Mortella shipwrecks, shipwrecks in Corsica.

El descubrimiento de los yacimientos de la Mortella y la génesis del proyecto de investigación del pecio de la *Mortella III*

El descubrimiento de los yacimientos

Los yacimientos de la *Mortella II* y *III*¹ fueron descubiertos durante el programa de prospección geofísica que se inscribía en el marco de elaboración de la carta arqueológica del patrimonio cultural marítimo de Córcega. Este proyecto fue dirigido por el Centre d'Etudes en Archéologie Nautique –CEAN/SEAS– en la bahía de Saint Florent entre los años 2005 y 2008, con una superficie prospectada total del orden de 20 km² entre la costa y 50 metros de profundidad, con aparatos de detección acústicos y magnetométricos.

Durante este programa se detectaron dos yacimientos arqueológicos que corresponden a pecios de navíos de alta borda que datan del siglo XVI y que fueron descubiertos a través del sónar de barrido lateral:

- El primero, bautizado *Mortella II*, fue localizado en el mes de octubre de 2005 a 48 metros de profundidad.
- El segundo yacimiento, a 700 metros al sureste del primero, fue descubierto en el mes de noviembre de 2006, a 38 metros de profundidad y bautizado *Mortella III*.

En el momento de su descubrimiento, estos yacimientos se caracterizaban por la presencia de un *tumulus* constituido de gravilla y piedras de lastre, recubriendo los vestigios de la carena de madera, así como también por la presencia de un mobiliario arqueológico esencialmente representado por piezas de artillería, bolas de cañón y anclas de hierro forjado.

Una asociación entre los dos yacimientos pudo establecerse rápidamente: en primer lugar, por la identidad tipológica de la artillería. Por otro lado, por la identidad de la naturaleza de la gravilla y las piedras de lastre, evidenciada por el análisis petrográfico realizado en el año 2007 (Gendron, 2009: 55-61). Ellas demostraron que los dos pecios estaban ligados al mismo suceso histórico.

Génesis del proyecto de investigación

El interés científico y arqueológico de estos yacimientos ha dado lugar a varias intervenciones desde el año 2005.

A partir de su descubrimiento y de las primeras observaciones realizadas entre 2005 y 2006, se organizó una inspección en 2007 por el Département des Recherches Subaquatiques et

¹ El origen del nombre de estos yacimientos está ligado a la torre de la Mortella, una construcción (s. XVI) que cierra la bahía de Saint-Florent al oeste y que constituye el punto de la costa más cercano a los pecios. El yacimiento de la *Mortella I* es un yacimiento arqueológico formado por una zona tradicional de fondeo situado a los pies de la torre.

Sous-Marines (DRASSM). El interés científico y el potencial arqueológico descubierto a través de esta operación, y en particular para la arquitectura naval, ha conducido en 2010 a la organización de una primera excavación arqueológica del yacimiento de la *Mortella III*. El análisis de las informaciones recogidas a lo largo de estas primeras operaciones ha permitido la puesta en marcha de un proyecto de investigación con un programa de excavación plurianual proyectado a tres años, entre 2012 y 2014.

Este programa conjuga en sinergia ocho estructuras de investigación pertenecientes a varios países europeos, movilizando a una treintena de arqueólogos, investigadores y técnicos. El objetivo es generar una dinámica de investigación susceptible de aportar una contribución significativa a nuestros conocimientos de arquitectura naval, de cultura técnica, de la guerra marítima y de la navegación en el contexto mediterráneo del Renacimiento. La riqueza del trabajo realizado se debe sobre todo a la interdisciplinariedad de los equipos colaboradores que permite abordar el tratamiento de los problemas sobre múltiples aspectos.

Los primeros trabajos realizados sobre el yacimiento de la *Mortella III* han identificado varios problemas que han permitido el desarrollo de los tres principales ejes de investigación que integran una evaluación técnica y analítica: el primero fue organizado alrededor de la arquitectura del navío, el segundo concierne a la cultura material ligada al estudio del mobiliario. Y por último, la importancia de la artillería presente en el yacimiento de la *Mortella III* nos exigió hacer de esta temática un eje de investigación único.

La importancia de los vestigios de la carena presente bajo el sedimento y el buen estado de conservación de la misma, nos hizo considerar como objetivo prioritario de este proyecto abordar y desarrollar el eje concerniente a la arquitectura naval y a las problemáticas asociadas a la misma. Así pues, la comunicación de hoy día se centrará en este tema. Pero antes de abordarlo, es necesario dar algunos apuntes sobre los vestigios mobiliarios del yacimiento, ya que fueron los primeros en aportar informaciones sobre la cronología y los orígenes del pecio.

Presentación del sitio de la *Mortella III*: el contexto arqueológico, los vestigios mobiliarios, la datación y la investigación histórica

La organización del yacimiento

El yacimiento de la *Mortella III* muestra una organización particular debido a la presencia de dos túmulos que materializan dos conjuntos arqueológicos bien diferenciados. Estos dos conjuntos, bautizados A y B, se distancian en más de 30 metros en la parte suroeste del yacimiento, juntándose en su parte noreste (Fig. 1). Esta organización doble ha planteado inicialmente la cuestión de saber si estábamos ante un pecio cuyas estructuras se habían separado, o por el contrario, si eran dos navíos que se habían hundido conjuntamente. Siendo con la excavación de una parte del *tumulus* B, durante la campaña de la excavación del año 2012, que fue posible dilucidar que estábamos ante la presencia de un único y mismo pecio: el cual se había roto en sentido longitudinal, a lo largo de la extremidad babor de las varengas. Los dos bordes se separaron antes de tocar el fondo, explicando de esta manera la presencia de los dos *tumulus*.

Los túmulos A y B tienen una extensión de 35 × 12 metros y 20 × 10 metros respectivamente. Estos se elevan poco más de un metro por encima del nivel general del fondo y están recubiertos de una espesa capa de gravilla de lastre y piedras de río que ocultan los vestigios de una carena. La observación de la extremidad calcinada de las cuadernas al nivel de una parte de los primeros ligazones, no dejan lugar a dudas sobre el violento incendio del que fue víctima el navío antes de su hundimiento. A su vez, cabe comentar que en el momento del descubrimiento



Figura 1. Sitio de la *Mortella III*.

del yacimiento, en la zona noreste, la parte trasera de la quilla emergía del *tumulus* A alrededor de 5 metros hasta su talón.

Para concluir este capítulo sobre la configuración del yacimiento, conviene mencionar que fue de gran ayuda para su comprensión, la realización de un fotomosaico compuesto de más de 300 fotografías. Este ha sido completado, año tras año, con el fin de obtener un documento de trabajo a escala, recibiendo un postratamiento destinado a la corrección de las deformaciones del objetivo y el ajuste de las imágenes a partir de nuestros levantamientos topográficos. Este documento de trabajo realizado por Christoph Gerigk, nos ha permitido mejorar considerablemente la calidad de nuestras observaciones (Fig. 2).

Los vestigios mobiliarios

El mobiliario es escaso en el yacimiento de la Mortella. Varios factores podrían participar en su explicación: el incendio que aparentemente destruyó el navío antes de su naufragio es probablemente una explicación importante, el pillaje del yacimiento antes de la intervención arqueológica ha podido tener también un rol importante igualmente. Pero estas explicaciones no nos parecen suficientes, dándonos la impresión de que el navío de la *Mortella III* pudo haber sido vaciado de su contenido antes de su hundimiento. Esta explicación queda sin embargo en con-

tradición con la presencia de cañones y balas de piedra, teniendo en cuenta que eran de gran valor en el siglo XVI. De hecho, lo esencial del mobiliario descubierto hasta el momento en el pecio de la *Mortella III* está representado por la artillería, seguido de algunos fragmentos de cerámica que fueron descubiertos mayoritariamente en la parte trasera del pecio y por último una gran cantidad de cordaje, hallado en la parte delantera. A continuación presentamos una síntesis del aporte de la artillería y de la cerámica al conocimiento del pecio.

La artillería

La artillería constituye la parte esencial del mobiliario arqueológico visible en el yacimiento. Esta ha sido el objeto de un estudio realizado por Max Guérout (GRAN) en 2010. Concentrada principalmente en la parte trasera del pecio, esta está representada por dos tubos asociados a culatas amovibles en hierro forjado. Su principio de construcción se acerca al de las barricas: los tubos están formados por duelas de sección trapezoidal reforzadas por manguitos cilíndricos colocados en caliente cuyas costuras están selladas por anillos que sobresalen alrededor del tubo.

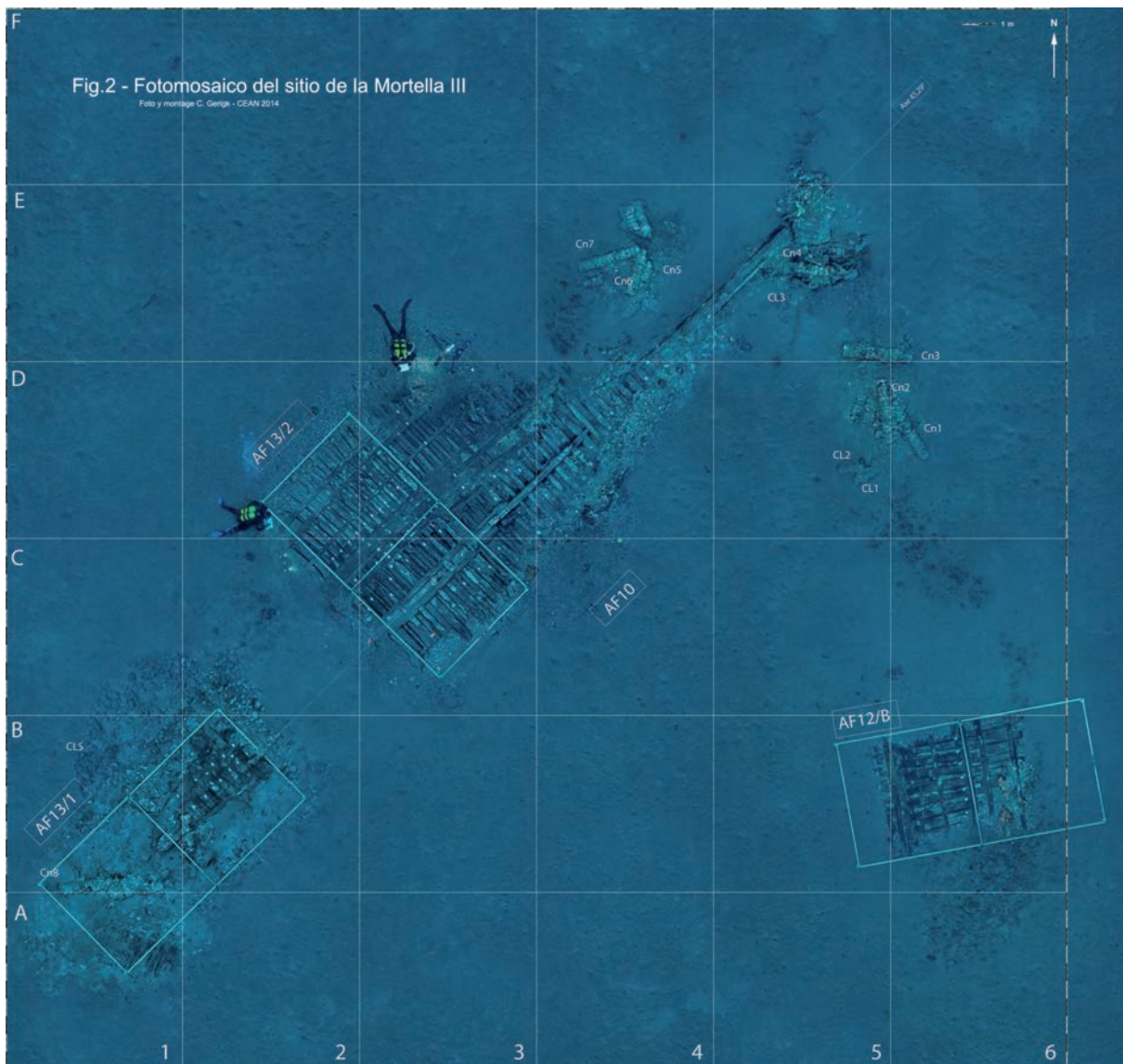


Figura 2. Fotomosaico del sitio de la *Mortella III* (©Christoph Gerigk).

En la actualidad se visualizan en el yacimiento de la *Mortella III* nueve tubos. Su longitud es de alrededor de 2 metros por un diámetro de 35 cm al nivel de los anillos y de 28 cm al nivel de los manguitos. Por otro lado, se identificaron ocho culatas con una longitud media de 70 cm.

Esta tipología de artillería es conocida bajo el nombre de *bombarde* por los franceses, *bombarda* por los genoveses. La encontramos en el Mediterráneo en varios pecios del siglo XVI, como en el de la *Lomellina* (1516) (Guérout *et alii*, 1989: 99-126). Ella nos ha proporcionado nuestras primeras referencias cronológicas, sabiendo que este tipo de artillería ha sido utilizada corrientemente entre el siglo XV y la primera mitad del siglo XVI, y que es solo a partir de la segunda mitad del siglo XVI cuando aparecerá la artillería en hierro fundido².

En el yacimiento de la *Mortella III*, la artillería está asociada a proyectiles de piedra, se han encontrado una treintena de bolas esencialmente de serpentina de 224 mm de diámetro por una masa del orden de 17 kg. Otros dos diámetros, de 125 y 158 mm están igualmente presentes con otros dos tipos de rocas más blandas. Los diferentes análisis petrográficos realizados durante cada campaña arqueológica muestran que, excepto la serpentina que es una roca de tipo metamórfico más bien originaria del norte de Italia, la naturaleza de las rocas utilizadas para la fabricación de bolas de cañón de pequeño calibre está frecuentemente asociada a rocas de origen volcánico del sur de Italia.

La cerámica

El estudio de la cerámica realizado por Frank Allegrini (Colectividad Territorial de Córcega – CTC), nos orienta de la misma manera, hacia un origen italiano. La cerámica está representada por un conjunto de fragmentos encontrados mayoritariamente sobre la parte trasera del pecio. Estos permiten identificar cuatro grupos ligados a la preparación de alimentos: copas, jarras, marmita y tinajas. Su origen está localizado en la región norte del Tirreno.

La morfología se acerca a las producciones de la vajilla llamada pisanoligur monocroma. En cuanto a las cerámicas que presentan decoraciones de incisión, evocan la producción *graffite monocrome ligure* producida en la región de Savona. Sin embargo, las jarras se acercan a los ejemplares recuperados del pecio de principios del siglo XVI, *Lardier 2* entre las islas Hyères y Saint-Raphaël (costa mediterránea francesa).

Aparte de la información que nos aporta la cerámica sobre el origen del navío, el estudio de la misma nos permite también precisar la datación, concluyendo que «la cronología del corpus evoca la primera mitad del siglo XVI».

La datación y las investigaciones históricas

La datación

Como ya lo hemos visto, las primeras referencias cronológicas han sido aportadas a través del estudio tipológico de la artillería y cerámica, inclinándose la datación relativa hacia la primera mitad del siglo XVI. El estudio dendrocronológico realizado por Fabien Langenegger (Office et Musée d'archéologie de Neuchâtel, Suiza) ha permitido precisar una datación absoluta del pecio,

² Max Guérout (GRAN), en su estudio de la artillería del pecio de la *Mortella III* informa de que la primera referencia conocida de un cañón de hierro fundido aparece en 1559 en los archivos de la Torre de Londres.

gracias a la determinación de la fecha de la tala de los árboles utilizados para la construcción del navío, situada entre 1517 y 1520.

Las investigaciones históricas

La asociación de los pecios de la Mortella a un evento histórico es aún algo incierto. El único episodio notable sobre el naufragio de unos navíos de alta borda que hemos podido localizar en los textos, concierne al de dos navíos a mitad del siglo xvi: un episodio relatado por el cronista corso Marc-Antoine Ceccaldi (Ceccaldi, 1888-1890: 213-214). En efecto, inicialmente nos ha conducido a establecer la hipótesis de la pertenencia de los navíos de la Mortella a la flota española de Alonso Pimentel cuyos dos navíos fueron hundidos en la bahía de Saint-Florent como resultado del combate que hubo contra la escuadra francesa del barón Paulain de la Garde en el mes de diciembre de 1555.

Esta hipótesis inicialmente formulada es compatible con los orígenes italianos que ha revelado el estudio del pecio, teniendo en cuenta además el contexto geopolítico del siglo xvi que consagra la alianza entre España y la República de Génova. Sin embargo, dicha hipótesis queda debilitada con los resultados del estudio dendrocronológico: en efecto, parece improbable que el navío pudiera naufragar después de 35 años de navegación o incluso 30 años si tenemos en cuenta algunos años necesarios entre el tiempo de secado de la madera y la construcción de la embarcación. Aunque esta duración de vida no es imposible, dobla la que habitualmente tiene de vida media un gran navío del siglo xvi en el Mediterráneo (Guérout/Liou, 2001: 262-263; Lane, 1965: 259)³. Por lo tanto, nuestro programa de investigación histórica se centra en los archivos franceses, italianos y españoles con el objetivo de encontrar alguna huella de evento histórico susceptible de ajustarse mejor a la cronología del pecio.

Los vestigios arquitecturales

El eje de investigación sobre la arquitectura naval comprende dos tipos de estudio, el de las técnicas y modos de construcción y el de las formas del navío. En nuestra excavación se ha impuesto este campo de investigación como el más rico y el más importante.

Organización y modos de construcción

Bajo el *tumulus* A se han evidenciado los vestigios de la carena de roble de la embarcación, construida con tracas a tope y orientada según un eje noreste / suroeste. El talón de la quilla está situado en la parte norte, la extremidad de la quilla en el sur. El eje longitudinal formado por la quilla y la sobrequilla está conservado en toda su longitud. Sobre la parte estribor se conservan las mediocuernas formadas por la secuencia varenga / genol / primer tercio de la primera ligazón, cuyas extremidades están carbonizadas, tal como ya lo mencionamos.

Las estructuras transversales

– Organización:

³ Max Guérout y Bernard Liou citan varios documentos extraídos de Génova que muestran que la vida útil de un navío en el siglo xvi era de 6 a 14 años. De forma convergente, Frédéric C. Lane escribe: «Toutes ces indications viennent confirmer l'opinion traditionnelle selon laquelle la durée moyenne de la vie d'un navire était de dix ans».

De forma clásica, partiendo de la parte trasera hacia la delantera, los genoles están fijados sobre las partes anteriores de las cuadernas y de las primeras ligazones hasta la cuaderna maestra que ha sido identificada como la 27ª partiendo desde atrás (M27). Después la secuencia se invierte con una fijación sobre las partes posteriores.

Las cuadernas están fracturas en dos niveles sobre toda la longitud del pecio:

- Del lado de estribor, al nivel de la unión genol/varengas, lo que tiene por efecto de provocar un hundimiento de 20° a 30° en la estructura.
- Del lado de babor donde solo las extremidades de las varengas, a veces fracturadas, han sido conservadas.

El conjunto estructural encontrado bajo el *tumulus* B es simétrico a aquel observado bajo el *tumulus* A. Los primeros vestigios están constituidos por los extremos rotos del lado de babor de las varengas, los cuales conservan una longitud que oscila entre 20 y 40 cm. Estas están unidas a las extremidades degradadas de sus genoles que están ellos mismos ligados a una parte de la primera ligazón. En la zona que hemos excavado (AF/12 B), los genoles están fijados sobre las partes posteriores de las primeras ligazones y de las varengas, por lo que los vestigios parecen claramente pertenecer a la zona delantera del pecio cuya parte correspondiente del *tumulus* A aún no ha sido excavada.

– Dimensiones:

Las principales dimensiones de la estructura transversal han sido tomadas sobre las 41 cuadernas descubiertas en el *tumulus* A. Para poder calcular cifras promedias significativas, estas cuadernas han sido divididas en tres grupos:

- El primero es el de los piques de delante, observados a lo largo de la campaña 2013.
- El segundo es el de las cuadernas de la parte central de la embarcación, observadas a lo largo de las campañas 2010 y 2012. Son 19 en total, de M16 a M34. Habiendo sido identificada la M27 como la cuaderna maestra. Este grupo cuenta pues con 7 cuadernas en la parte delantera de la maestra (marcando el límite de la zona de excavación) y 11 miembros atrás.
- El tercero está constituido por las cuadernas situadas detrás de M16, estando situado este límite en la zona que –considerando las proporciones de la nave– debía más o menos corresponder a la sección de los redeles.

Las principales medias de las medidas extraídas según el esquema planteado, están resumidas en las tablas presentadas en la Figura 3 que se comentan a continuación.

– Las claras:

En primer lugar, vemos que la clara y el relleno, materializado por la distancia entre el centro de cada varenga tiene una media de 33 cm en la zona central, un intervalo que tiende a aumentar hacia la popa (36 cm de media) y hacia la proa (34,3 cm de media). Remarcamos que los valores son bastante cercanos a los valores que fueron extraídos en el pecio de *Red Bay*, donde la clara y el relleno era de 36,8 cm en la parte central y donde el mismo fenómeno de aumento de la clara ha sido observado (aunque de forma más acentuada) y explicado en razón al espacio creciente necesario para la inclinación y el reviro de los genoles (Grenier, 2007: 62-64).

La clara calculada por el espacio entre las varengas era de una media de 17,7 cm para el grupo central, así pues tenemos ahí en promedio una parte llena por una clara. En esta parte,

el crecimiento entre las varengas y los genoles formaba un conjunto prácticamente continuo donde los espacios entre las piezas se hacían raros (espacios de 6 cm de media entre 7 cuadernas sobre las 19 del grupo). Para el grupo de delante, se constata de igual forma una casi ausencia de la clara entre las varengas y los genoles, aunque en la parte trasera las únicas medidas posibles entre las varengas V9 y V11 muestran un espacio del orden de 10 cm.

Tablero A – Resumen de las medidas de las estructuras transversales

Localización / piezas (medidas en metros)	Cuadernas		Varengas			Genoles			Primeras ligazones	
	Malla y lleno (1)	Malla (2)	Largo	Ancho	Altura	Largo	Ancho	Altura	Largo	Ancho
PARTE DELANTERA: promedios M1P à M8P	0,343	0,121		0,207	0,318		0,127			
PARTE CENTRAL: promedios M16 à M34	0,33	0,177	3,47	0,166	0,173	3,46	0,153	0,137	0,1466	
PARTE TRASERA: promedios M2 à M15	0,36	0,157		0,196			0,135			

Nota (1) : Malla y lleno: distancia medida entre el centro de cada varenga

Nota (2) : Malla: espacio medido entre cada cuaderna (al nivel de las varengas)

Tablero B – Resumen de las principales medidas de la cuaderna maestra M27

Medidas (m) / piezas de M27		V27	G27 A	G27 B	A27
Largo de la pieza		4,05	0,334	0,336	0,18
Sección	Altura promed.	0,18	0,132	0,148	0,155
	Ancho promed.	0,15	0,15	0,15	0,148

Tablero C – Resumen de las principales medidas de las estructuras longitudinales

Medidas en metros	Largo	Ancho	Altura o espesor	
Quilla 1 (sup.)	25	0,24	0,26	0,46
Quilla 2 (inf.)			0,20	
Carlinga		0,20 à 0,22	promed. 0,14	
Palmejares		promed. 0,16	promed. 0,14	
Forro exterior		0,6 à 0,29	0,80 à 0,90	
		promed. 0,139		

Nota : las medidas del foro exterior y de la quilla fueron recogidas en la parte central del pecio

Tablero D – Comparación de las medidas de las secciones de las varengas del pecio de la *Mortella III* con las de otros pecios

medidas en metros	Mortella III	Cattewater	Villefranche	Mary-Rose	Red Bay	Molasses Reef	Highborn cay
Anchos	0,166	0,20	0,20	0,25 - 0,49	0,20	0,16	0,16
Alturas	0,173	0,20	0,20	0,320	0,20	0,17	0,17

Figura 3. Recapitulativo de las principales medidas de las estructuras de la carena (Tumulus A).

– Las varengas:

El valor de la clara y del relleno toma su sentido una vez establecidas la sección media de las piezas de la cuaderna, y en particular la anchura de las varengas. Estas presentaban una sección más o menos cuadrada en la parte central del pecio donde su altura media era de 17,3 cm por un ancho de 16,7 cm, medidas tomadas al nivel de la parte estribor de la sobrequilla. Un hecho notable es el aumento de las medidas de las varengas de los grupos de delante y de detrás donde el ancho es prácticamente de 20 cm de media (20,6 y 19,7 cm respectivamente).

La varenga-maestra es aquella que ha mostrado el mayor tamaño, con 4,04 metros. Después hemos observado una disminución progresiva de las longitudes hasta 3 metros aproximadamente al nivel de la zona de cuadra. Para los grupos de delante y de detrás, las piezas estaban en muy mal estado para poder tomar medidas. En cuanto a los genoles, miden entre 3,20 y 3,70 metros en la zona central, las piezas de delante y de detrás no pueden de igual forma ser medidas con exactitud.

– Los genoles:

En la parte central presentan un ancho medio de 15,3 cm y una altura de 13,7 cm. El ancho de las piezas tiende a disminuir hacia delante (12,7 cm), hacia atrás el número de piezas visibles es demasiado bajo para poder extraer una conclusión.

– Las primeras ligazones:

Ellas miden 15,5 cm de ancho y de altura media.

Las dimensiones extraídas pasarán a formar parte de una reflexión que se basará en los datos comparativos extraídos de pecios del mismo periodo del Mediterráneo y del Atlántico.

La estructura longitudinal

– La quilla:

Ya en el momento del descubrimiento del yacimiento, emergía del sedimento el talón de la quilla. Pero no fue hasta el año 2013, con la excavación de la parte delantera del pecio que su extremidad posterior pudo ser localizada, permitiendo así medir su longitud total que es de 25 metros. Sin embargo, ningún rastro de la roda de proa ha podido encontrarse.

Fue enseguida, a lo largo de la campaña de la excavación de 2014, que se descubrió un escarpe simple marcando el ensamblaje de dos piezas de la quilla en la parte central del navío que ha podido evidenciar su morfología doble. Estas características inéditas –al menos arqueológicamente– merecen ser comentadas.

El escarpe de la quilla: el escarpe elegido para el ensamblaje de la quilla es simple. Consiste en la puesta a tope de las dos piezas de la quilla sin ninguna barbilla: estas son simplemente yuxtapuestas. A priori, este tipo de ensamblaje de las piezas de la quilla podría sorprender debido a su fragilidad, considerando la gran importancia de la función mecánica de la quilla. De hecho, sorprendió a los arqueólogos del pecio de Cais do Sodré (principios del siglo XVI, Lisboa), cuando descubrieron sobre este pecio un escarpe de la misma naturaleza. Escribieron entonces: «... ce système de jonction bout à bout, très rare, a été observé sur le caboteur de Cala Culip VI (fin du XIII^{ème}, début du XIV^{ème} siècle)...» (Rodrigues *et alii*, 1998).

Sin embargo, el estudio de los textos muestra que esta técnica de ensamblaje no fue una excepción en la historia de la construcción naval sino que incluso fue una regla, pudiendo ser originaria de la tradición mediterránea, extendida en el siglo xvi.

Un primer texto fue citado por los mismos arqueólogos de Cais do Sodré, se trata de un manuscrito francés de 1691 que describe este sistema de unión para la construcción de las galeas (Anónimo, 1691). En un estudio muy completo sobre este tema realizado por Cayetano Hormaechea (Hormaechea/Rivera/Derqui, 2012: 284), vemos sin embargo que este sistema ha sido preconizado desde principios del siglo xvii por las Ordenanzas españolas que generalizan su empleo para todos los navíos construidos en España. En efecto, en el artículo 20 se puede leer: «Puesta la quilla, que ha de llevar la unión a tope». (Real Ordenanza, 1618: art. 20). Así pues, se puede suponer que numerosos navíos han sido construidos en España con ensamblajes de quilla adoptando este principio. C. Hormaechea cita otros tres autores españoles del siglo xvii que preconizan este sistema: Juan de Amassa, en 1635, Díaz Pimienta en 1645 y Francisco Garrote que en 1691 da una explicación instructiva de la razón por la cual la junta a tope se prefiere a los otros (Garrote, 1691):

«la opinión que siguen los Españoles, que es el que dichas juntas deben ser de tope por haber hallado que aunque alquiebran mucho los bajeles, tienen la facilidad de atajar las aguas. [...] que es fuerza que lleve dos juntas, la una con el pie de roa de popa y la otra el de proa. [...] no apartándome en el todo de la opinión que siguen los españoles que dichas juntas deben ser a tope».

Así pues, tenemos aquí la razón esencial de esta elección: una mejor estanqueidad. Al estar la quilla en contacto con el agua, se puede comprender que una junta a tope permite generar el mismo sistema de estanqueidad que el obtenido por el sistema de construcción con tracas a tope.

La morfología doble de la quilla: esta aporta de forma evidente una respuesta al problema de la debilidad mecánica del ensamblaje que acabamos de describir: de hecho, la quilla no está compuesta de una pieza, sino de dos piezas macizas de dimensiones similares. La pieza superior, de una anchura de 24 cm x 26 cm de altura es aquella donde se sitúa el escarpe. Esta está reforzada por la pieza inferior de 24 cm de ancho por una altura de 20 cm.

La solución técnica adoptada sobre el navío de la *Mortella III* que asocia los escarpes simples a una quilla doble parece haber tenido una permanencia en el tiempo. Encontramos de todas formas, textos que la preconizan aún en el siglo xviii. Es el caso de los autores franceses Vial de Clairbois (Vial de Clairbois, 1787: 13) y Duhamel du Monceau que escribe: «les empatures ont ordinairement de longueur quatre fois l'épaisseur de la quille. Peut-être n'y aurait-il pas

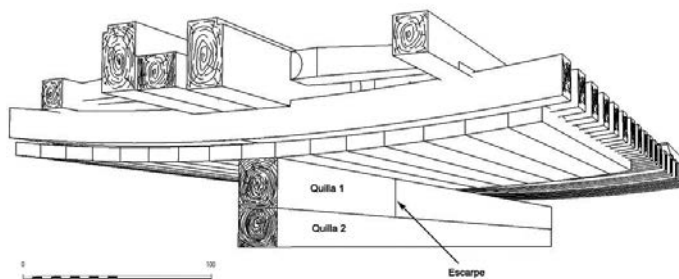


Figura 4. Esquema de la morfología de la quilla del pecio de la *Mortella III*. Dibujo de Jesús Guevara (CIAMAR).

d'inconvénient de supprimer les empatures et de faire correspondre les pièces de quille bout à bout, en doublant les escarpes par les pièces de contre-quille et de carlingue» (Duhamel du Monceau, 1752: cap. II, art. 9).

– Las piezas de refuerzo longitudinales:

Una serie de piezas longitudinales que aseguran una función de refuerzo de la estructura merecen ser mencionadas:

- *La sobrequilla*: se trata de una pieza de madera de una sección aproximada de 20 cm de ancho por 14 a 15 cm de altura. Está superpuesta a la quilla y puesta en el medio de las varengas endentada sobre su parte superior.
- *Los palmejares*: son piezas de madera de dimensiones cercanas a las de la sobrequilla endentadas sobre la parte superior de las cuadernas. Los vestigios visibles de la carena nos dejan ver 5 sobre la parte estribor y 6 sobre la parte babor: 4 de ellos (S1/S2 y S4/S5) son palmejares de ensambladura destinados a reforzar la unión entre las piezas de las cuadernas.

– El forro exterior:

En ausencia de su desmontaje, solo se ha podido observar de forma parcial. La longitud de las tracas, por ejemplo, no ha podido medirse. Las muestras extraídas de las tres tracas del fondo de la carena revelan un tablón exterior de roble. Sin embargo, la debilidad del muestreo no permite excluir la presencia de otras esencias, como es el caso del forro exterior de los pecios de *Villefranche* (Guérout *et alii*, 1989: 63-65) y de *Red Bay* (Loewen, 2007: III, 111).

Las dimensiones: el ancho del forro exterior varía de 8 a 29 cm, siendo el ancho medio de 17 cm. Su espesor oscila entre 8 y 9 cm en la parte central del pecio, pudiéndose comparar con el del casco de *Villefranche* cuyas 14 primeras tracas tienen un espesor de 12 cm y las siguientes de 10 cm hasta la 30ª traca.

El sistema de fijación: los forros exteriores estaban fijados a las cuadernas por medio de clavos de hierro de sección circular de 10 mm de diámetro, atravesando el forro exterior y la cuaderna. Dos clavos de una longitud de 27 cm aproximadamente eran clavados al nivel de cada cuaderna y su extremidad era remachada en su cara interior. Para cada clavo, se hizo un preorificio circular de 2 a 3 cm de diámetro en la cara exterior del forro exterior de manera que permitiera el hundimiento de su cabeza en la madera.

Este sistema de fijación a través de clavos de hierro atravesando la madera de lado a lado marca aquí una diferencia notable con la de los pecios de *Villefranche* o el de *Red Bay*, donde las puntas de los clavos de hierro no sobresalen de la madera. Dos textos del siglo XVI y XVII muestran que esta técnica de clavos remachados es corriente en la tradición de la construcción naval ibérica de la época moderna⁴. El primero fue escrito por Juan de Lasalde al rey de España en 1581 (Lasalde, 1581: f°299-301). El segundo es un tratado de construcción anónima publicada por Cesáreo Fernández Duro (Fernández, 1996: 243).

Finalmente, cabe señalar el estudio realizado por Carole Mathe sobre las materias de calafateo del casco (IMBE UMR 7263-CNRS, Universidad de Avignon), en el que menciona el

⁴ Estos dos textos nos han sido amablemente señalados por M. Cayetano Hormaechea, especialista español de la construcción naval ibérica.

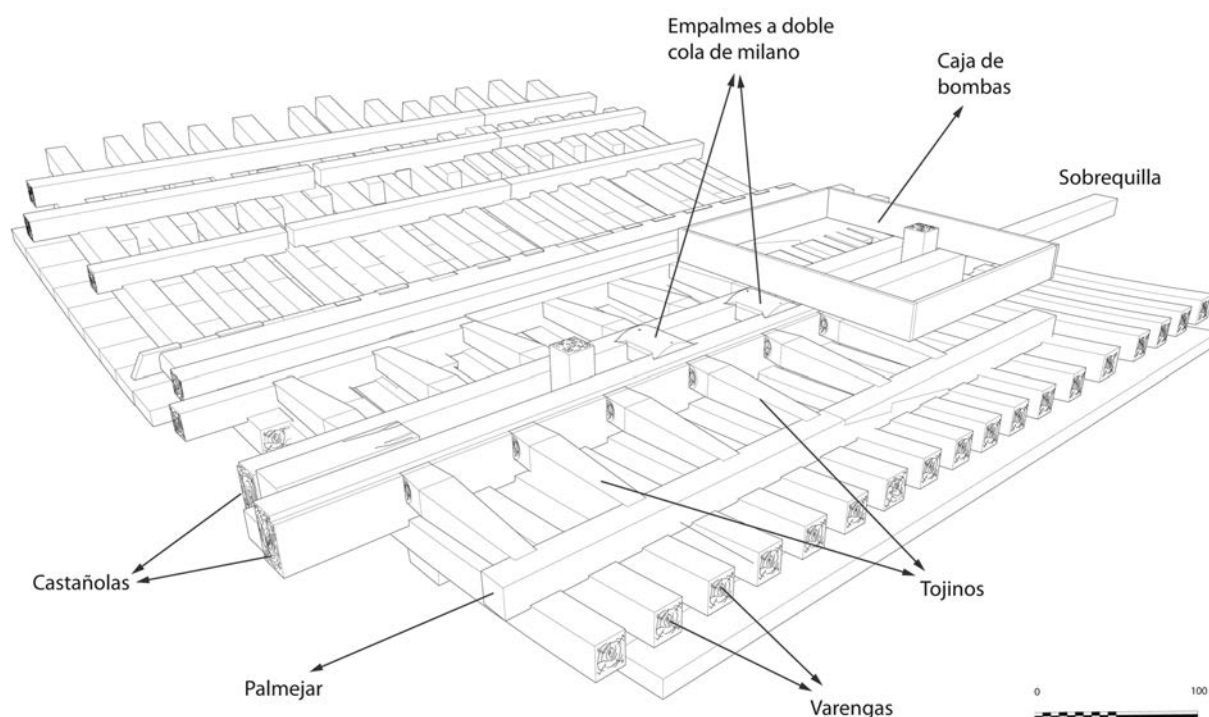


Figura 5. Esquema de la carlinga del palo mayor. Dibujo de Jesús Guevara (CIAMAR).

revestimiento del forro exterior con un betún compuesto por brea, resina de pino y grasa. Contrariamente al caso del pecio de *Villefranche-sur-Mer*, no se observa ningún revestimiento de plomo.

La carlinga del palo mayor (Fig. 5): para acabar este capítulo, conviene mencionar la carlinga del palo mayor que constituye uno de los conjuntos arquitecturales más remarcables que hayamos tenido ocasión de observar en el pecio de la *Mortella III*. Está formado por dos castañolas, piezas fuertes de roble de 5 metros de longitud y de 20 × 30 cm de sección que enmarcan la sobrequilla y descansan endentadas en la parte superior de las varengas. Estas dos castañolas están fijadas a la sobrequilla por medio de clavos de hierro de sección circular clavados en diagonal, y están unidas con empalmes a doble cola de milano. El espacio entre las dos llaves estaba destinado a recibir la mecha del pie del mástil. El conjunto estaba sólidamente mantenido de forma lateral por una serie de seis tojinos colocados en cada borde, apuntalados entre la cara exterior de las castañolas y los primeros palmejares de babor y estribor. Cabe señalar que la madera elegida para la confección de estos tojinos fue el enebro. En este caso, no parece ser una elección azarosa, ya que se trata de una especie mediterránea de una gran calidad mecánica, siendo su módulo de elasticidad una característica particularmente destacable.

Los modos de construcción

El origen mediterráneo de los vestigios arquitecturales

Este origen fue puesto en evidencia por una serie de indicios ligados a los modos de construcción, identificados a partir de la década de 1990 como pertenecientes a la cultura técnica originaria del espacio marítimo mediterráneo por oposición a los del Atlántico (Rieth, 1996: 69-81; Oertling, 1988: 233-240). Las principales «señales técnicas» identificadas son:

1. La naturaleza de la fijación del forro exterior a la cuaderna a través de dos clavos metálicos atravesando la madera de lado a lado y colocados cerca de los cantos y ausencia de cabillas por oposición a la tradición atlántica.
2. La morfología redonda de los clavos utilizados por oposición a los clavos de sección cuadrada que se encuentran en el espacio Atlántico. Esta diferencia está explicada en un tratado anónimo del siglo XVII, citado por Cesáreo Fernández Duro (Fernández, 1996: 243).
3. El tipo de ensamblaje denominado «ensambladura a barbilla» para la unión de las piezas de las cuadernas. Teniendo aquí un sistema de empalme cuya técnica de fijación es de tradición típicamente mediterránea por oposición a la técnica atlántica que mezcla los clavos cuadrados con cabillas de madera y cuyo escarpe es de tipo «cola de milano».
4. La morfología del sistema de carlinga del gran mástil a través de dos castaños enmarcando la sobrequilla unidos por medio de empalmes a doble cola de milano y reforzadas lateralmente por tojinos.

De hecho, nuestro estudio subraya que la trilogía «fijación del forro exterior / unión de las piezas de la cuaderna / carlinga del palo mayor», presenta las características de forma bastante precisa correspondientes a aquellas puestas en evidencia bajo el término «firmas arquitecturales» para el espacio marítimo mediterráneo (Rieth, 1996: 73).

Formas y proporciones del navío

No será hasta la campaña del año 2014, con la reconstitución en tierra de los vestigios de la media-cuaderna M27 que pudimos progresar significativamente en los problemas del estudio arquitectural ligado a la reconstitución de las formas del navío, a la comprensión de su geometría y a la evaluación de sus proporciones. Estas cuestiones figuran hoy día entre las más importantes de nuestro eje de investigación sobre la arquitectura naval del pecio de la *Mortella III*.

Siendo una etapa importante el descubrimiento en el año 2013 de la extremidad delantera de la quilla con la posibilidad de medir su longitud de 25 metros, la etapa siguiente era pues volver a reconstituir la forma de la sección maestra. Esta, sin embargo, se veía delicada debido a la ruptura de las cuadernas al nivel de las cabezas de las varengas que, como ya hemos evocado anteriormente, provocó el hundimiento de la estructura, complicándonos de este modo el trabajo.

Para superar esta dificultad, optamos por el desmontaje de la cuaderna maestra M27 y su estudio en tierra. Esta iniciativa no era sin embargo una garantía de éxito ya que debían cumplirse dos condiciones para que la forma que había que restituir fuera fiel: hacía falta asegurarse de que la madera no se había deformado durante el tiempo que permaneció en el agua y, por otro lado, de que los empalmes de los elementos de la cuaderna, varenga, genol y primera ligazón pudieran ser recolocados con toda seguridad en su posición original. Estas condiciones pudieron ser satisfechas⁵, disponiendo hoy día de una representación de la forma y de las dimensiones de la parte inferior de la sección maestra sobre la que podemos apoyarnos con un grado de confianza aceptable.

Sin embargo, nuestra restitución no es completa pues los vestigios se interrumpen al nivel de la primera ligazón. Así, la forma de la sección maestra en su parte superior queda sujeta a hi-

⁵ En primer lugar con un estudio de las células de la madera realizada por F. Langenegger (Office du Musée d'archéologie de Neuchâtel, Suisse) que ha demostrado que las cuadernas no habían sufrido ninguna deformación. En segundo lugar, el remontaje de las piezas respetando la coincidencia de los orificios de los clavos y las marcas de la madera ha permitido encontrar su lugar original.

pótesis. Por el momento, he aquí lo que nuestra restitución nos permite establecer con seguridad: Estamos ante un navío que presenta un cierto grado de astilla al nivel de su varenga maestra, lo que tiene por resultado un fondo de carena relativamente elevado que contrasta con los fondos planos del navío del *Red Bay*, por ejemplo, y atestigua un calado relativamente elevado.

La forma del fondo de la carena de la *Mortella III* es muy redonda: no se nota ninguna inflexión al nivel de los puntos de escoa en la varenga y, como consecuencia, el pantoque no está marcado. Sigue un arco de círculo de 5,65 metros de radio, prácticamente un círculo perfecto. Desde este punto de vista, la concepción del fondo de la carena se acerca al del pecio de *Villefranche-sur-Mer* que posee las mismas características, haciendo intervenir un solo arco de círculo hasta la zona de la línea de flotación. En el caso de la *Mortella III*, por encima ignoramos cómo evoluciona esta línea, por falta de vestigios, pero observamos que sigue una curva de un radio inferior a la mitad del primero en el caso de *Villefranche-sur-Mer*. Aquí se trata de un caso de figura que la arqueología ha documentado pero que, según nuestros conocimientos, no está evocado por parte de los autores del periodo.

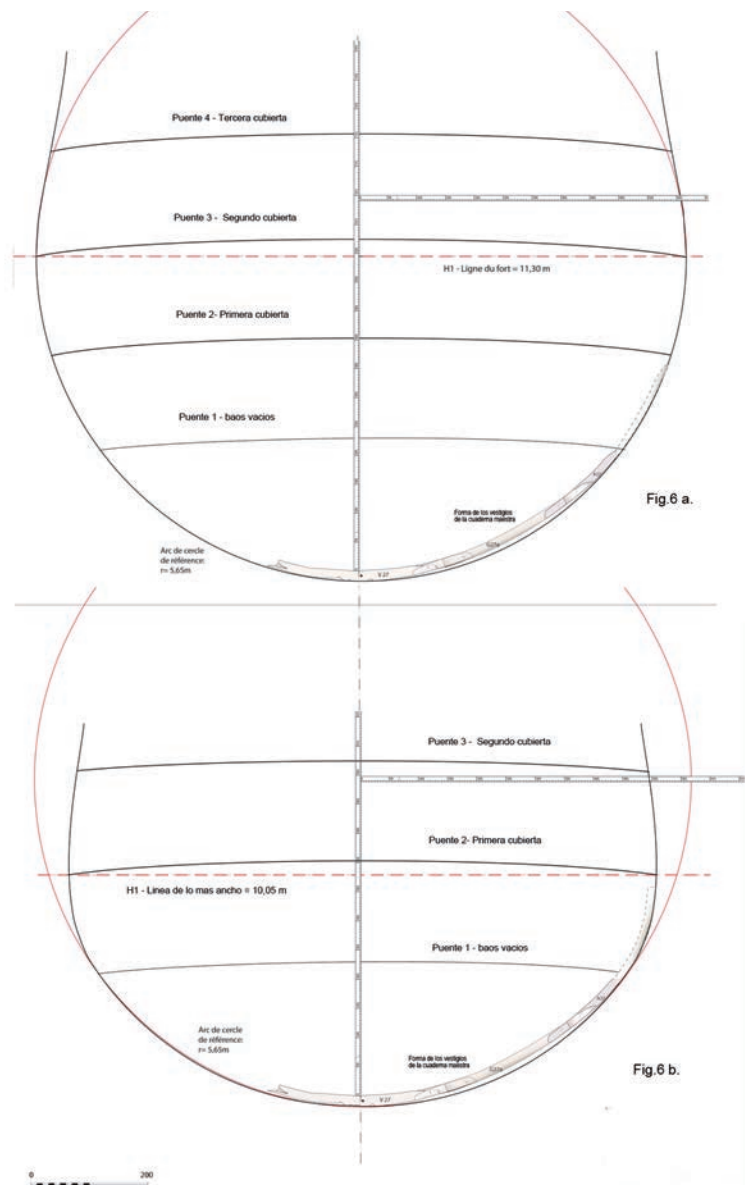


Figura 6. Restitución de la forma de los vestigios de la cuaderna M-27 e hipótesis de la figura de la sección maestra. Dibujo de A.C. de la Roche.

Según nosotros, se plantean dos posibilidades (Fig. 6): o la línea de la figura de la sección maestra del pecio de la *Mortella III* se redondea hacia el interior como el modelo del pecio de *Villefranche-sur-Mer*; o sigue su curso siguiendo el mismo arco de circunferencia. Esta hipótesis debe ser considerada puesto que este esquema de proyección es el que está preconizado por los autores de la península ibérica en el siglo xvi como Escalante de Mendoza en 1575 (Escalante de Mendoza, 1985), Diego García Palacios en 1580 (García Palacios, 1587) o Fernando Oliveira en 1570 (Oliveira, 1991): todos evocan en efecto una proyección de la cuaderna maestra por medio de un solo arco de circunferencia.

Conclusión

Las cuatro campañas de excavación que hemos realizado en el pecio de la *Mortella III* han aportado una cantidad de información de gran riqueza, sobre todo porque el periodo que trabajamos está aún mal documentado en el plano arqueológico, debido a los pocos pecios de esta época que han podido ser estudiados.

Como ya hemos visto, es el estudio de la arquitectura naval la contribución más importante a nuestro programa de investigaciones. Sin embargo, para atenuar esta constatación, hay que decir también que la artillería presente en el yacimiento así como el mobiliario lítico permiten igualmente desarrollar estudios que aportan una información muy importante al conocimiento del yacimiento. Respecto a la cerámica hallada, por pobre que sea nuestra colección de fragmentos, aporta igualmente información interesante.

Por otro lado, los últimos resultados de nuestro estudio arquitectural que conciernen a la reconstitución de la forma de la carena del pecio de la *Mortella III* son una aportación muy útil al problema actual que se interroga sobre el modo de proyección de la cuaderna maestra en la construcción naval del siglo xvi. *Mortella III* y *Villefranche-sur-Mer* podrían tener una línea transversal concebida según el mismo patrón, por oposición al del *Red Bay* cuya proyección por medio de cuatro arcos de círculos respondería, según Brad Loewen (Grenier, 2007: 87-88) a un modo de concepción preconizado por el constructor inglés Mathew Baker (Baker, 1580). Esta diferencia podría estar ligada a aquellas que separan las dos culturas técnicas mediterráneas y atlánticas y que están en el corazón de los problemas de la arqueología marítima náutica desde hace varios años.

En relación con lo que precede, las dos hipótesis que hemos propuesto sobre la restitución de la cuaderna maestra en su parte superior permiten percibir inmediatamente un ancho en la manga de entre 10 y 11 metros. Este orden de cifras define las proporciones de un navío cuyo ratio manga máxima / longitud de la quilla se establece entre 1:2,27 y 1:2,50. Se trata ahí de proporciones que, si bien son superiores a la regla *As-dos-tres* que preside en la construcción de los navíos de comercio durante este periodo (y a la que responde el navío *Red Bay*), queda conforme a los ejemplos que tenemos en el Mediterráneo. Esta relación de proporciones, que tenemos aún que afinar y confirmar, constituye un elemento suplementario que aproxima los pecios de la *Mortella III* y el de *Villefranche-sur-Mer*.

Para acabar, una cuestión importante queda aún pendiente: la del número de cubiertas, siendo la respuesta a esta pregunta la que nos desvelará una nueva orientación tipológica. Las dos hipótesis sobre la forma de la sección maestra que proponemos autorizan la opción de un navío con dos o tres cubiertas. De hecho, la manga máxima del navío de tres cubiertas alcanza normalmente 10 metros, pero la organización de las cuadernas y la posición de las cubiertas son aún poco conocidas. No disponemos todavía de elementos suficientes para abordar esta cuestión, pero seguramente se encontrarán respuestas para acabar con una visión clara de las características del navío.

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Proyecto Delta: pecios localizados y excavados durante las obras de construcción de una nueva terminal de contenedores en el puerto de Cádiz

Delta Project: located and excavated shipwrecks during the construction works of the new container terminal in the Port of Cadiz

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Resumen: en este artículo vamos a tratar de presentar un avance de la intervención arqueológica llevada a cabo durante los trabajos de construcción de la nueva terminal de contenedores (en adelante NTC) del puerto de Cádiz. En dicha actividad se han localizado dos pecios con un interesantísimo material arqueológico. Este es el resumen de la excavación de los dos pecios, uno del siglo XVI y otro del siglo XVII, y de los resultados preliminares de la investigación.

Palabras clave: pecio, Cádiz, arqueología subacuática, botijuelas, lingotes, cochinilla.

Abstract: In this article we will try to present a preview of the archaeological intervention carried out during the construction of the new container terminal (hereinafter NTC) of the Port of Cádiz. In this activity two wrecks have been located with an interesting archaeological material. This is the summary of the excavation of the two wrecks, one from the sixteenth and another from the seventeenth century and also of the preliminary research results.

Key words: Shipwreck, Cádiz, underwater archaeology, olive jars, ingots, cochineal.

La presente comunicación tratará de explicar de forma detallada la localización y excavación de los dos pecios excavados durante las obras de construcción de la nueva terminal de contenedores en el puerto de Cádiz. Dicho proyecto lo ha promovido la Autoridad Portuaria de la Bahía de Cádiz. Previo al inicio de las obras según lo establecido por la Consejería de Cultura de la Junta de Andalucía se llevaron a cabo prospecciones geofísicas, sondeos mecánicos y sondeos manuales en el área en la que se plantearía la obra. A pesar de los resultados negativos obtenidos en ambos casos se continuó el sistema de control arqueológico a bordo de las dragas. Como consecuencia de ello se localizaron dos pecios históricos en una primera fase y un tercer pecio, histórico también, en una segunda fase.

Resumimos aquí más de dos años y medio de intervención arqueológica, más de tres mil inmersiones y muchas más horas de labor sumergida en las que se han atravesado numerosas fases de trabajo subacuático combinado con controles en draga, amplias prospecciones y la excavación de estos dos pecios en unas condiciones de trabajo duras y difíciles. Sin embargo creemos que la gran diversidad de estudios que se han puesto en marcha: comercio, artillería, construcción naval, cerámicas, contenidos biológicos, dendrocronología, etc., van a aportar un volumen de información inestimable para la interpretación de los pecios, dadas las numerosas ramificaciones en cuanto a comercio, artillería, estudios de construcción naval, estudio de la cerámica, de contenidos biológicos, etc., que actualmente se nos presentan.

Comenzaremos dando una serie de nociones de las características de cada pecio, de su estructura naval, para a continuación resumir el material arqueológico extraído de ambos.

Delta I

Fue el primer barco localizado y se hallaba en una situación sumamente difícil de excavar debido a estar sustentado sobre un talud de fango arcilloso, en un principio bastante consistente pero que iba perdiendo firmeza con el paso de las semanas de trabajo en su entorno. A diecinueve metros de profundidad máxima y con unas condiciones de visibilidad prácticamente nulas en la mayoría de las ocasiones. Su situación impedía la construcción del muelle de atraque de la Nueva Terminal de Contenedores por lo que tras la presentación de un innovador proyecto de traslado y la aprobación del mismo por parte de la Consejería de Cultura se autorizó su reubicación y posterior excavación en un lugar menos profundo, más resguardado y en donde el pecio podría quedarse después de la excavación.

Una vez trasladado, se realizaron trabajos de excavación en su ubicación original, en el entorno del pecio y una excavación sistemática en el interior del mismo ya en su nueva ubicación.

Excavación

Con el traslado del pecio a una menor profundidad los tiempos de inmersión se alargaron con lo que se logró rentabilizar el trabajo subacuático y se pudieron cumplir los plazos estipulados para la excavación.

Debido a las malas condiciones de visibilidad se recurrió a la instalación de unos ejes cartesianos de PVC, en los que cada uno de los cuatro brazos tenía un color distinto; asimismo se emplearon dos colores diferentes para montar el cuadrículado de la excavación, utilizándose un color para las líneas longitudinales y otro para las transversales, quedando marcadas cada una de las intersecciones con etiquetas amarillas que facilitaban su visualización. La metodología



Figura 1. Etiquetado de clavazón del pecio *Delta I*.

empleada ha ido encaminada en todo momento a rentabilizar los tiempos de inmersión, al reducirse notablemente la profundidad, los tiempos de trabajo en fondo se multiplicaron con lo que fue posible realizar la excavación en los dos meses previstos. Para ello se instalaron ejes cartesianos de PVC cada uno de un color y un sistema de cuadrícula para facilitar el trabajo tanto de excavación como dibujo y registro gráfico.

La estructura conservada del pecio se correspondía con el plan del barco, por lo que nos encontramos con una gran cantidad de lastre (consistente en piedras de tamaño medio) que hubo que retirar para llegar al forro interno de la nave. A continuación se procedió al dibujo y registro de la estructura naval, para ello se marcaron mediante cable amarillo todos los elementos que conforman la estructura. Esta marcación también se utilizó para proceder a la realización de un fotomosaico, actualmente se está procediendo al tratamiento digital para elaborar un montaje definitivo.

El traslado de la gran cantidad de lastre que llevaba el barco fue el obstáculo más importante que había que superar además de la mala visibilidad reinante a la hora de obtener un registro gráfico adecuado de la estructura constructiva del pecio una vez retirado todo el lastre.

Se realiza una marcación de toda la clavazón del barco mediante el uso de cable eléctrico de color llamativo que facilite la identificación del tipo de clavos o cabillas utilizados en cada caso. Se realizan varios intentos de fotomosaico en paralelo al dibujo de la planta del barco, como apoyo a dicho registro, archivos que se encuentran actualmente en proceso de tratamiento digital para confirmar que es posible su montaje definitivo.

Finalmente el barco se vuelve a cubrir del sedimento original que lo preservaba, sobre el que se colocan lienzos de geotextil y piedras de su lastre original, comprobando en varios días que la propia dinámica de mareas y sedimentación lo van cubriendo y conservándolo en un estado similar al que tenía antes de la intervención.

Construcción naval

Se trata como decimos de una embarcación de madera que conserva unos 20 metros de su eslora y entre 7 y 8 metros de manga. La impresión más evidente que nos dio en las primeras inmersiones fue la robustez de su estructura, obtenida a través del uso de cuadernas de doble espesor. No conserva ni la proa ni la popa, desconocemos pues la eslora total del barco.

Se trata de una embarcación cuya técnica constructiva es propiamente ibero-atlántica. El sistema constructivo tradicional del siglo XVII evoluciona escasamente, caracterizándose por el uso de «ligazones superpuestas», también denominado varenga-genol.

Se detectan, como parte del fiador, una serie de conjuntos preensamblados de varenga-genol con pernería en hierro, principalmente en el cuerpo central del barco. El resto de la clavazón utilizada para la fijación del casco a la estructura transversal es de madera.

La clavazón de hierro en su totalidad era una característica propia de los españoles y que les diferenciaba de los ingleses y holandeses que usaban encabillado de madera.

Esta dualidad de clavazón de hierro y de madera plantea la necesidad de continuar con los estudios para profundizar en la nacionalidad del barco.



Figura 2. Proceso de excavación del pecio *Delta I*.

Quilla

Contamos con tres tramos de quilla con empalmes de unión del tipo media junta. Sus proporciones son constantes entre 27-28 cm por 31-33 cm de ancho.

Casco externo

Conserva hasta la hilera de traca 7 en el costado de izquierdo y otras 8 en el derecho, su grosor y anchura va variando en función de su posición no siendo simétricos.

El casco está protegido por una espesa capa de calafateado compuesta por fibras vegetales unidas con brea, pudiendo llegar hasta el medio centímetro de grosor.

El barco presenta un doble casco. El segundo casco es de una madera más clara que el casco al que protege, con un grosor constante de unos 5 cm. Bajo este casco de sacrificio encontramos a ambos lados de la quilla una hilera de madera a tope con la pared lateral de la quilla.

El casco interno está muy bien conservado se contabilizan seis hileras seguidas de tracas y a continuación dos palmejares, aunque se conoce la presencia de un tercero a tenor de la clavazón que se detecta sobre varengas y genoles.

Sobrequilla

Se conservan dos tramos de sobrequilla con un punto de empalme del tipo de media junta.

Cuadernas

Se conservan un total de 26 cuadernas de doble espesor formadas por juegos de varengas y genoles ensamblados entre sí por medio de dos hileras de clavazón de hierro. La retirada del casco interior en un sector concreto de la banda izquierda del barco permitió el acceso a la zona de unión de la varenga y su genol. Se realizó un corte para acceder a la zona y se pudo verificar que se trataba de pernos de hierro (que es un tipo de ensamblado propio de la construcción ibero-atlántica definida por la colocación de una estructura básica llamada fiador).

Clavazón

Podemos decir que el 90% de los elementos de clavazón utilizados para ensamblar las distintas piezas del barco son cabillas de madera. El resto pernos y clavos de hierro.

La estructura básica o fiador se constituye con pernos de hierro que unen lateralmente como decimos varengas con genoles. Las varengas a su vez se han fijado a la quilla por medio de pernos de hierro así como a la sobrequilla. En todo el eje de crujía predomina por tanto el uso de clavazón de gran tamaño de hierro. El casco externo se coloca a razón de dos cabillas de madera por tabla y miembro como regla general reforzando con varios clavos de hierro.

Material arqueológico

El material más representativo del pecio lo constituye un lote de 22 lingotes de plata de doble procedencia: Potosí (actual Bolivia) y México, un primer estudio los sitúa a mediados del siglo XVII. Con un peso que oscila entre los 7 kg del más pequeño hasta los 37 kg del más pesado suman en total casi media tonelada de plata. En cada una de las piezas se aprecian numerosas marcas: de propietario, números de serie, sellos fiscales, catas del ensayador, pureza de la plata, casa de la moneda a la que pertenecen, valor, etc. También se localizó alguna porción de plata con forma de plancha plana procedente bien de algún tipo de contrabando o bien podía llevarse a bordo para pagar reparaciones de urgencia.

Además se hallaron instrumentos de navegación como varios compases de bronce y un astrolabio también de bronce de la primera mitad del siglo XVII, principal herramienta de posicionamiento de la época antes de la invención del octante y posteriormente el sextante.

Numerosas piezas de motonería, vigotas, roldanas, motones, de una madera de gran resistencia y excelente estado de conservación.

Platos de peltre, pipas de caolín, botellas de vidrio, numerosos restos de cuero, principalmente de calzado. Un ponderal, una campana de bronce, etc.

Una variedad de tipos y series decorativas que enriquecen notablemente el catálogo de cerámicas de toda la intervención. Cerámica sevillana serie Blanca y Azul figurativa, observada en jarros con pico vertedor donde la decoración se concentra en la mitad superior de la pieza y con motivos vegetales de la primera mitad del siglo XVII. Cerámica lisboeta serie decorativa azul



Figura 3. Detalle de marca de propietario de uno de los lingotes hallados.

sobre blanco, caracterizada por vidrios intensos y brillantes y con motivos decorativos variados pero con inspiración clara de las porcelanas chinas. Junto con estas cerámicas y series propias de la vajilla de mesa se observan muchos más tipos de recipientes con otras funcionalidades relacionadas con el transporte, almacenamiento, cocina o ámbito doméstico en general, piezas de cocina como ollas y cazuelas, o recipientes de uso doméstico como lebrillos y bacines.

Un total de 825 piezas componen el inventario del *Delta I* al que hay que sumar dentro del apartado artillería y munición: 30 cañones de hierro de diversas medidas y calibres, así como abundante munición de hierro que se volvieron a sumergir en la zona de protección del pecio y que están pendientes de un estudio en profundidad.

Delta II

Segundo de los barcos localizados durante las obras de construcción de la terminal, conservaba casi la totalidad de su eslora y se encontraba cubierto por una gruesa capa de fango limoso bajo la que aparecía un sedimento arcilloso muy compacto, que al mismo tiempo que dificultaba enormemente las tareas de excavación ha permitido conservar en su interior gran parte del cargamento intacto.

Como características generales comenzaremos describiendo que conservaba una eslora de 18 metros y una manga máxima de 5 metros. La posición del barco en el fondo es prácticamente horizontal con una ligera escora a babor.

Metodológicamente se emplea el mismo sistema de cuadrícula del pecio *Delta I*. En cuanto a la visibilidad, las condiciones fueron aún peor que en el primer pecio, por lo que únicamente en días contados se pudo disfrutar de unas circunstancias que posibilitaban el registro gráfico de la excavación con aceptables resultados. El resto del tiempo ha estado poniéndonos continuamente en el límite de nuestras posibilidades de inventiva para conseguir obtener buenas imágenes.

Igual que en la excavación de *Delta I* se procedió a montar una cuadrícula de ejes de PVC y cabos de colores, tanto para el registro arqueológico como para que los colores facilitaran el trabajo y orientación de los arqueólogos.

Se trataba de una nave mercante, cargada de mercancía variada estibada entre mamparos entre los que se encontraba el lastre (formado por abundante grava de pequeño y mediano tamaño). El sistema constructivo es de tipo Mediterráneo, con una cronología próxima a la segunda mitad del siglo XVI, se puede encontrar un paralelo en el pecio de la *Lomellina* de 1516 excavado en Villefranche.

Construcción naval

En cuanto a la estructura naval, se trata de un navío de tres palos de los que únicamente es visible la carlinga del palo mayor. Este elemento es el mejor documentado y resulta muy definitivo de una construcción mediterránea del siglo XVI.

La carlinga está formada por un conjunto de dos zapatas de dos metros de longitud, 50 cm de altura y 20 cm de espesor dispuestas sobre las varengas y a ambos costados de la sobrequilla. Para evitar que las zapatas se separen existen cinco contrafuertes por banda colocados sobre las varengas y tres llaves entre ellas ensambladas con colas de milano.



Figura 4. Detalle de la carlinga del pecio *Delta II*.

Sobre la mitad de proa de este conjunto se empotraba el palo mayor y en la de popa iba colocado el poste de drizas y la bomba de achique. (No queda resto alguno del palo mayor).

El palo trinquete se apoyaría a unos 9 metros del mayor sobre un bao del falso puente y el de mesana 7 metros a popa. (Datos estimativos, ya que no se ha podido identificar ninguno de dichos elementos).

Quilla

En la zona de popa comenzando en el codaste está compuesta de dos maderos superpuestos, quilla y contraquilla, esta última con las aristas biseladas para apoyar la traca de aparadura. Ambos maderos son de roble al igual que el resto de estructura y forros. Sin embargo en los elementos verticales de los mamparos de estiba con aristas achaflanadas en su mayoría abundan las coníferas.

Sobrequilla

A lo largo de la eslora hay dos uniones de la sobrequilla en rayo de Júpiter sobrepuesto.

Roda

Los datos obtenidos al ser el último elemento que se identificó se encuentran aún en fase de estudio.

Estructura transversal

Las picas traseras estaban verticalmente unidas por medio de un perno vertical en el eje de crujía. Los elementos de hierro correspondientes a los ensamblajes han desaparecido.

El ensamblaje de la pica con cada uno de sus genoles se realiza por medio de un escarpe transversal perpendicular al brazo de la pica, en su cara hacia popa, fijándose ambos elementos con sendos clavos de hierro (desaparecidos).

Casco

- Forro externo: las tracas del forro externo son de roble con un espesor de 6 cm y 20 cm de anchura. La totalidad del barco se encuentra forrado de plomo.
- Forro interno o granel: habría que distinguir dos zonas en la disposición del granel de cada banda. Una queda determinada por el espacio comprendido entre la sobrequilla y el palmejar que discurre proa a popa. En esta zona el plan de varengas constituido por las propias varengas y sus claras correspondientes va cubierto de tablas de roble de unos 20 cm de anchura colocadas perpendicularmente al eje de crujía. En la sobrequilla se apoyan sobre un batiente tallado en las dos aristas superiores desde proa a popa.

La otra zona del granel se encuentra entre el palmejar y la escoperada colocada en cada banda a la altura de la línea de cabezas de varenga, y se trata de una superficie estrecha y curva a todo lo largo del barco que cubre con tres tracas y la escoperada.

Material arqueológico

Cargamento

Se trata de un navío mercante del que se conservaba la bodega con una importante cantidad y variedad de productos dispuestos a lo largo de su eslora en zonas muy definidas.

- Botijas: son el objeto más numeroso de todos los encontrados, han aparecido en gran número y en excelente estado de conservación la mayoría. En ocasiones conservan tanto el contenido como el tapón de corcho. En su interior encontramos aceitunas de distintas variedades con su aliño correspondiente. Se está estudiando la posibilidad de recuperar posibles bacterias aisladas en su interior y la forma óptima de intentar extraerlas de su entorno estanco. Llama poderosamente la atención los esfuerzos dedicados a que permanecieran intactas durante el viaje, ya que conservan en numerosas ocasiones tanto restos de trenzados vegetales dispuestos para su protección sobre el forro y entre las varengas del mismo, como elementos de tipo ramas, etc., como refuerzos.
- Barriles: durante el proceso de excavación comenzaron a aparecer tanto piezas circulares de madera como duelas pertenecientes a barriles, así como un sistema de trenzado vegetal a modo de zunchos de madera reforzados. En capas inferiores del estrato por excavar empezamos a advertir que la arcilla que cubría dichas maderas aparecía en numerosas ocasiones teñida de un rojo muy intenso y con posterioridad ya no es la arcilla teñida sino la propia sustancia densa y compacta la que tiñe de rojo el mar. Aparecen en total restos de diez barriles, algunos prácticamente intactos con su contenido en el interior recubierto de una tela que ayudaba a su estanqueidad. Se analizaron muestras de dicha sustancia extraída pensando que podía ser el tinte extraído de la cochinilla. Los análisis



Figura 5. Uno de los barriles que transportaban cochinilla *Delta II*.

llevados a cabo por el Departamento de Ingeniería Química de la Universidad de La Laguna confirmaron con total certeza que se correspondía con dicho producto.

- Cajas: situadas en zona adjunta a los barriles y dispuestas de manera alineada son de forma rectangular de gran tamaño y en su interior transportaban productos vegetales aún por determinar, junto con una sustancia granulada de gran densidad y consistencia. Los laterales de las cajas presentan marcas pirograbadas que detallarían los propietarios de dichas mercancías. La conclusión de estos estudios permitirá conocer datos sobre la procedencia y destino del cargamento.

Armamento

Se localizan en los primeros días de estudio del pecio dos pedreros de bronce, uno de ellos cargado, y situados en la zona de popa y a mitad del barco aproximadamente, por su ubicación podrían considerarse como de uso y el hecho de estar cargado indicaría que podría estar defendiéndose en el momento del hundimiento.

A mediados de la excavación se localiza una gran concreción que una vez extraída y tras proceder a su limpieza mecánica aporta cinco nuevos cañones también de bronce, dos anclas y dos fragmentos de bombardas; el hecho de ir estibados entre mamparos nos indicaría que estaban siendo transportados, puede que para su venta.

Los cañones de bronce pertenecen a una fundición genovesa, la de los Gioardi, parece que las iniciales que presentan varios de los cañones se corresponden con el nombre de fundi-

dores miembros de esta familia de la segunda mitad del siglo XVI (D = Dorino, G = Giovanni, B = Batista).

Cerámica variada

La colección de materiales cerámicos tanto de un pecio como en el otro se caracteriza fundamentalmente por la variedad de tipos y series decorativas, con destacada presencia en el *Delta II* de cerámica italiana.

- Serie «Berettina» de origen liguir caracterizada por la decoración de motivos vegetales en azul sobre azul más claro.
- Serie «Graffita» producción común en el valle del Arno y que cuenta con muchas variedades. Su principal característica se da en la decoración que introduce motivos incisos o excisos bajo cubierta vítrea. Esta serie está muy representada.
- Serie «Marmorizzate», serie «alla porcellana», serie «compendiario», etc.

También aparece cerámica sevillana: serie Blanca de platos cónicos y escudillas con cubierta estannífera blanca. Serie Blanca y Azul figurativa, observada en jarros con pico vertedor donde la decoración se concentra en la mitad superior de la pieza y con motivos vegetales.

En este caso contaríamos con un inventario de 950 piezas arqueológicas, que actualmente están finalizando el proceso de estabilización y tratamiento.



Figura 6. Última botijuela extraída posicionada sobre la sobrequilla.

Se trataría por tanto de una nave mercante posiblemente italiana (existe la hipótesis cada vez más certera de que sea genovesa) dedicada al comercio de redistribución y que podría haber sido hundida por Francis Drake en su ataque a Cádiz en 1587 y sobre lo que se han encontrado noticias y cuyo estudio continúa en la actualidad.

En definitiva un estudio integral del material obtenido en las excavaciones continúa abierto en numerosos campos, fuentes documentales, estudio de la cerámica, de la artillería, procedencia de los lingotes, material de navegación, análisis de la composición y procedencia del cargamento recuperado, dendrocronología, estudio de las posibles bacterias que puedan permanecer en los contenedores estancos, análisis del material óseo, etc., con el esfuerzo y dedicación de un numeroso equipo interdisciplinar deseoso de aportar información y datos de dicho trabajo.

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Aproximación al estudio de yacimientos subacuáticos dispersos: el pecio de época moderna del *Agujero* (Gáldar, Islas Canarias)

Approach to the study of scattered underwater sites: the modern age shipwreck of Agujero (Gáldar, Canary Islands)

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Resumen: en este artículo describimos los trabajos realizados en el pecio del *Agujero* (Gáldar, islas Canarias), dentro del proyecto denominado «Documentación, Prospección y Registro de Yacimientos Arqueológicos Subacuáticos con Artillería de Hierro» de la Dirección General de Cooperación y Patrimonio Cultural del Gobierno de Canarias. Estos consistieron en la aplicación de manera conjunta de técnicas procedentes de la arqueología y de la conservación, orientadas a recuperar la información histórica que pudieran ofrecernos unos yacimientos que, por las características de su emplazamiento, en un entorno marino muy hostil, muestran un deterioro acusado y conservan casi exclusivamente materiales inorgánicos.

Palabras clave: arqueología subacuática, Gran Canaria, islas Canarias.

Abstract: This paper presents the works realized in the wrecksite of El Agujero (Gáldar, Canary Islands), in the project called «Documentation, Exploration and Record of Underwater Archaeological Sites with iron guns» of the Dirección General de Cooperación y Patrimonio Cultural del Gobierno de Canarias. We have tried to apply archaeological and conservation methods to recover the historical information of scattered wrecksites, where the structural remains have disappeared and only inorganic remains have been preserved.

Key words: Underwater archaeology, Gran Canaria, Canary Islands.

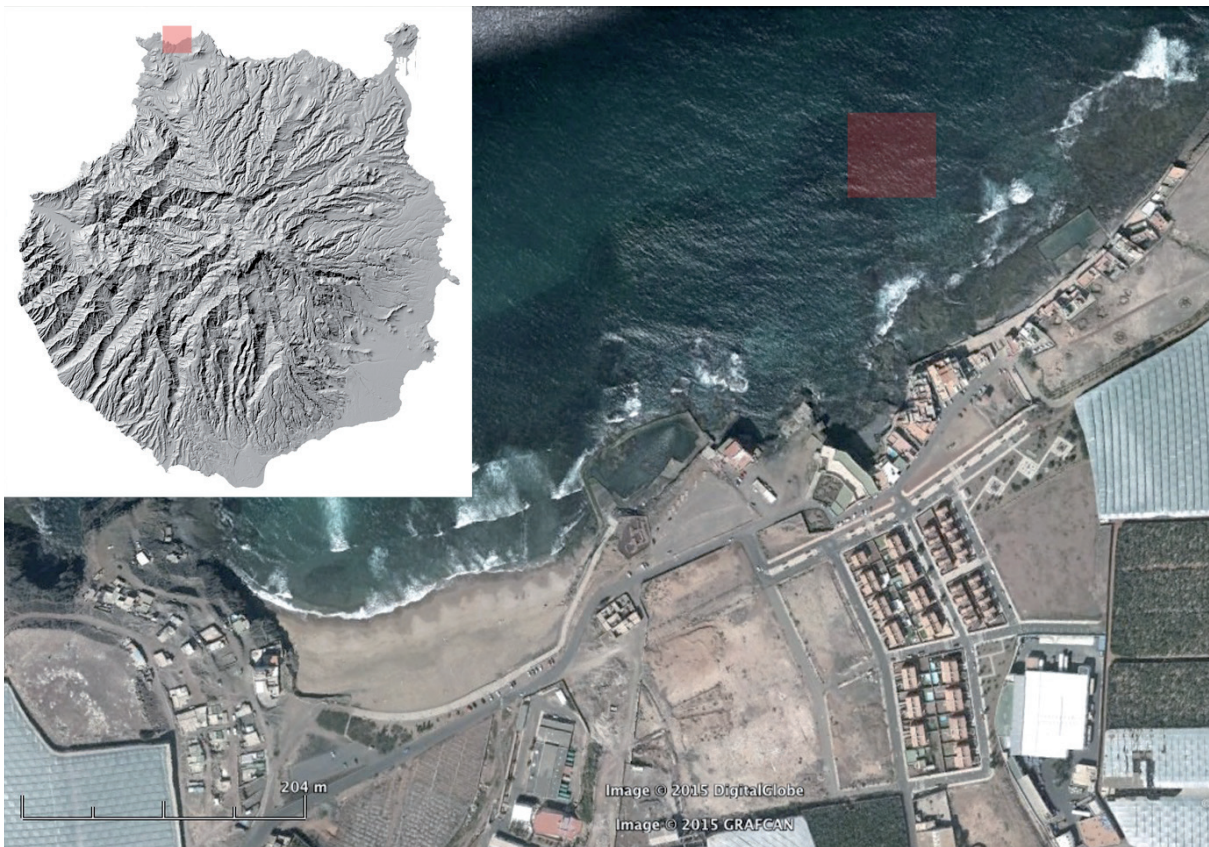


Figura 1. Emplazamiento del yacimiento arqueológico subacuático del *Agujero* (Gáldar, Islas Canarias).

Introducción

El pecio del *Agujero* se localiza en el municipio de Gáldar, al norte de Gran Canaria (islas Canarias, España). Esta isla, que ocupa el espacio central del archipiélago situado en las cercanías de las costas noroccidentales de África entre las coordenadas 27° 37' y 29° 25' de latitud norte y 13° 20' y 18° 10' de longitud oeste, posee una superficie de 1 532 km² y una altura de 1 949 msnm. El origen volcánico y el desarrollo geológico de la misma, sumado a su escaso tamaño y elevada altitud, le confieren una compleja y abrupta orografía; con una línea costera al oeste y norte, escarpada y acantilada, con muy pocas playas y ensenadas.

De este modo, la vertiente septentrional se abre hacia los vientos alisios, que soplan del noreste, y a la corriente fría que avanza en dirección suroeste, sufriendo el constante embate del denominado oleaje local y del mar de reboso o de fondo. El oleaje local, vinculado a régimen de alisios, se caracteriza por la persistencia de olas de no más de 3 m de altura, superados durante los temporales donde se han registrado olas de hasta 9 m. El mar de reboso o de fondo, generado por episodios tormentosos, lleva de manera intermitente hasta el litoral olas mayores de 3 m (VV.AA., 2012: 18).

La ausencia de refugios en las escarpadas costas del norte, las corrientes, el oleaje constante y los condicionantes climatológicos supusieron un peligro durante siglos para la navegación, tanto de altura como para las numerosas embarcaciones de cabotaje que se acercaban a los escasos puertos o a las pequeñas calas y radas que ejercían como tales.

El yacimiento arqueológico subacuático se ubica en la playa del Agujero, sobre una plataforma volcánica de escasa profundidad (entre 2 y 4 m), en uno de los puntos de mayor oleaje de Gran Canaria. La fuerza, constancia, regularidad y tamaño de las olas en este enclave, lo llevan a ser considerado uno de los mejores de lugares de España para la práctica del surf. Este hecho confiere al contexto arqueológico unas características muy especiales asimilables a los pecios del tipo 5 de la clasificación de Muckelroy (Muckelroy, 1978: 164), caracterizado por la inexistencia de restos de la estructura de la embarcación o de restos orgánicos y preservación de otro tipo de objetos con una distribución dispersa o desordenada en el fondo. Esas mismas particularidades hacen que las tareas arqueológicas solo puedan realizarse muy pocos días al año, cuando el mar está totalmente en calma y durante la pleamar. De otro modo es casi imposible realizar cualquier actividad subacuática, dadas las fuertes corrientes y la existencia de un rompiente.

El 18 de abril de 1899 el periódico *La Opinión* publica una noticia relacionada con el hallazgo y extracción de dos cañones en la playa del Agujero, próxima a la ciudad de Gáldar, en la costa norte de la isla de Gran Canaria. El descubrimiento al que se le suma otro cañón y una rueda de cureña que no pudieron ser recuperados, siempre siguiendo la narración periodística, fue realizado a instancias del párroco del pueblo por un buzo que trabajaba en la construcción del cercano puerto de Sardina (*La Opinión*, 1899: 3). Este tal vez sea uno de los primeros testimonios periodísticos relacionados con el hallazgo de restos arqueológicos subacuáticos en Gran Canaria y, quizás, la primera información que tenemos sobre el pecio del *Agujero*. Del destino de aquellos materiales nada se ha podido averiguar de momento.

Muy posteriormente, en 1968, el arqueólogo Celso Martín de Guzmán publica una nota sobre la localización, en el mismo lugar, de un recipiente metálico que interpreta como un «oinokhoe de época romana». En esta incipiente aproximación al patrimonio cultural subacuático de la isla, el autor sitúa una docena de culebrinas de época de Felipe II en los fondos del Agujero, cerca de las cuales se hallaban más «despojos de galeras hispanas» (Martín, 1969: 17).

Dos años después, durante el mes de septiembre de 1970 y según referencias orales recogidas de los vecinos de la zona, en las cercanías del punto donde se había localizado la jarrita se decide, con permiso municipal, proceder a la extracción de varios cañones, situados a unos 120 m de la costa y a una profundidad que rondaba los -3 m. En estas tareas participa el buceador Domingo China Santaña que, con la ayuda de varios vecinos¹, un tractor facilitado por el empresario inglés David Leacock y cables de acero, comienza los trabajos para arrancar, literalmente, del fondo un total de siete piezas de artillería. Estos cañones se distribuyeron por varios lugares del municipio conservándose actualmente cinco de ellos, en dos emplazamientos distintos, y en un avanzado estado de deterioro.

En 1998 se publica el primer estudio sobre el yacimiento subacuático de la playa del Agujero, donde se ofrece una descripción del mismo y se plantea una hipótesis sobre el tipo de embarcación, cronología y origen. En el mismo, se cita la presencia de restos de la «estructura de la embarcación» compuesta de madera y metal, así como catorce cañones distribuidos en dos grupos sobre un fondo rocoso entre 5 y 7 metros de profundidad. Según sus autores, la estructura «parece estar compuesta de madera y metal, ya que en ella se pueden distinguir tablas, listones y barras, en un avanzado estado de degradación»; por lo que concluyen que posiblemente se trate de «parte de las cubiertas o las cuadernas del bajel» que se conservarían «tal vez por ser de las secciones más duras del armazón» (Olmo/Sáenz, 1998: 630). Por el tipo de artillería y el número de piezas se sugiere que los restos podrían pertenecer a una fragata, corbeta o bergantín posiblemente inglés de la segunda mitad del siglo xvii (Olmo/Sáenz, 1998: 631).

¹ Información aportada por Domingo Cordero participante en la extracción de estos cañones.

En términos similares en relación a la cronología, tipo de embarcación y procedencia se exponen estas evidencias, diez años después, en la publicación de la «Primera fase del Inventario del Patrimonio Arqueológico Subacuático de Gran Canaria» de 2009 donde por primera vez se aporta una planimetría del yacimiento arqueológico (Olmo, 2010: 88). En este sentido se describe la estructura del navío, de 4 m de ancho por 6,5 m de largo, compuesta por madera y metal, donde «se pueden distinguir algunas tablas o baos» que se encuentran «totalmente recubiertos de concreciones y adherencias marinas», posiblemente «parte del casco o de los forros, e inclusive las cubiertas o cuadernas del bajel» (Olmo, 2010: 89).

Los trabajos arqueológicos realizados entre 2011 y 2012

Durante los años 2011-2012 y enmarcado en el proyecto de «Documentación, prospección y Registro de Yacimientos Arqueológicos Subacuáticos con Artillería de Hierro» de la Dirección General de Cooperación y Patrimonio Cultural del Gobierno de Canarias, pudimos realizar una serie actuaciones arqueológicas en el yacimiento del *Agujero* y una valoración inicial de alguno de los restos que habían sido recuperados del pecio en distintos momentos.

Los objetivos de este proyecto, en relación al enclave arqueológico subacuático del *Agujero*, se destinaron a conocer la potencialidad, extensión y elementos que conformaban el sitio arqueológico, si se conservaban o no partes de la embarcación y a realizar una planimetría básica geogeferenciada; además y dado que, en principio, el único material diagnóstico citado del yacimiento era su artillería, planteábamos el acceso a la información que pudieran contener. El método consistió en la desconcreción parcial de algunas piezas, siguiendo los planteamientos desarrollados para contextos arqueológicos similares en otros entornos geográficos (Zambrano/Bethencourt, 2001: 86). Se trataba de aplicar de manera conjunta técnicas procedentes de la arqueología y de la conservación, orientadas a recuperar la información histórica que pudieran ofrecernos yacimientos dispersos que, por las características de su emplazamiento, en un entorno marino muy hostil, muestran un deterioro acusado y conservan casi exclusivamente materiales inorgánicos.

Para ello procedimos en primer lugar al estudio y análisis de la documentación (cartografía, archivos y textos) que pudiera ofrecer detalles sobre los naufragios acaecidos en la costa de Gáldar. Paralelamente se hicieron entrevistas entre personas conocedoras del sitio (pescadores, buzos, vecinos, etc.) y/o que hubiesen participado en labores de extracción de materiales del mismo; así como entre historiadores y eruditos locales que ayudaran a aportar alguna referencia de interés para nuestros objetivos.

Durante esta primera etapa se recopilaron datos de fuentes históricas y documentales concernientes a varios naufragios en la costa del municipio de Gáldar desde el siglo XVII. Además de noticias sobre el hallazgo de materiales arqueológicos (cañones, anclas o cerámicas) en distintos puntos de la costa del municipio y de otros objetos, aparte de los cañones, extraídos presumiblemente del yacimiento del *Agujero* y que estaban en manos de algunos vecinos de la zona. Se trataba de una jarra metálica (Olmo, 2010: 44) y cinco lingotes de plomo², que nos iban ofreciendo un panorama mucho más complejo del yacimiento del que en un principio pensábamos. Así comenzamos a barajar la hipótesis de que todos esos materiales pudieran corresponderse a un mismo naufragio, dado que empezábamos a vislumbrar una coherencia histórica entre los mismos.

² Agradecemos a Celso Castellano el acceso a estos materiales extraídos del yacimiento hacía varios años.



Figura 2. Trabajos de registro arqueológico de las piezas de artillería 1970.

La siguiente fase consistió en el reconocimiento arqueológico mediante métodos de prospección directa, así como el registro gráfico (fotos de detalle, generales y fotomosaico) y planimétrico de las evidencias. Partíamos, a priori, de un yacimiento descrito y del que existía una planimetría, lo cual nos llevó a plantear como mejor opción la realización de prospecciones circulares a partir de elementos reconocidos. Los materiales detectados durante este proceso fueron posicionados, numerados, descritos y conservados *in situ*, dado que en esta fase no se planteaba la recuperación de evidencias sino su reconocimiento superficial y registro.

Durante estas tareas de prospección, realizadas en los pocos días del año en los que el oleaje daba tregua, pudimos acercarnos a un yacimiento arqueológico subacuático formado, a simple vista, por materiales inorgánicos entre los que destacan al menos quince cañones y una potente acumulación metálica (presumiblemente barras de hierro). No se identificaban en el lecho marino evidencias de naturaleza orgánica, como maderas, que pudieran pertenecer a la estructura del barco tal y como se planteaba en algunos trabajos publicados con anterioridad (Olmo/Sáenz, 1998: 630; Olmo, 2010: 89). De hecho, observamos que las condiciones físicas, químicas y biológicas del lugar eran las óptimas para el desarrollo de los principales agentes de deterioro de objetos orgánicos, que impiden o hacen extremadamente difícil su conservación (Sierra, 2003: 238.) Esto es así, al menos en el entorno más inmediato al lugar donde descansan los restos, dominado por una plataforma basáltica salpicada por cantos y rocas de tamaño variado a una profundidad entre 2-4 m, donde la cobertura sedimentaria mineral (arenas) se reduce a pequeñas zonas entre piedras o se encuentra en puntos a mayor profundidad.

Este primer acercamiento visual sirvió para tener una idea muy aproximada del contexto arqueológico, de su potencialidad y para evidenciar nuevos elementos de distinta naturaleza que se sumaban a los cañones y la barras de hierro: cerámicas, diversos objetos metálicos (en hierro,

plomo o aleaciones de cobre) y sílex, dispersos por una zona relativamente amplia y repartidos entre las rocas y bajo las piedras de tamaño variado que conforman el fondo marino del lugar. Aunque se trata de un espacio con un aporte de arena muy escaso, incapaz de mantener sepultado los restos del naufragio, la presencia de numerosas piedras ejerció como trampa para estos materiales, que aparecen entre y bajo las mismas. Cabe la posibilidad, por tanto, de que al menos una parte del registro arqueológico se conserve asociado, tal vez de manera fragmentada y dispersa en un entorno del que habrá que determinar la extensión, a las piezas de artillería y a la pila de barras metálicas (Fig. 2).

Los cañones de hierro se distribuyen en dos grupos que siguen un eje de unos 20 m de noroeste a sureste con una separación de unos 9 m. El conjunto situado más al norte está compuesto por al menos 12 cañones, muy agrupados pero sin un orden u orientación definida. Estos forman una importante concreción metálica junto con otros elementos que no hemos podido aún identificar y bajo los cuales podrían existir más piezas de artillería, de hecho se localizó un cañón que no había sido contabilizado. Al oeste de estos se observa un potente apilamiento metálico orientado de este a oeste y con unas medidas aproximadas de 6 por 4 m. Se trata con toda probabilidad de barras de hierro amontonadas que se han concretado, tal vez por ir estibadas en el mismo lugar. Sobre la plataforma que genera esta carga metálica se apoyan varias piezas de artillería.

Relacionados con este grupo se pudieron documentar numerosos restos de sílex de color melado, muy rodados y de tamaño pequeño así como algún fragmento cerámico. Además, formando parte de la concreción asociada a los cañones se intuyen otros elementos metálicos muy difíciles de diferenciar, dada la capa de corrosión y colonización biológica.

El segundo conjunto de cañones se halla a unos 9 m al sur del principal. Está compuesto por tres piezas, más separadas entre sí que las del grupo norte y a menor profundidad, dado que están más cerca de la costa. El material arqueológico asociado al armamento es más abundante, a primera vista, y está compuesto por fragmentos de cerámicas de pasta blanca y decoradas en azul cobalto, algunos objetos metálicos como un vaso de pequeñas dimensiones y otros restos dispersos atrapados entre las abundantes rocas y piedras distribuidas por el lecho marino. Es bastante probable que, ocultas entre las piedras, bajo las mismas o cubiertas por la fina capa de arena que se acumula entre ellas, se hallen más evidencias arqueológicas. La retirada de las piedras y la leve cobertura sedimentaria se salía de nuestro objetivo, dado que se trataba de una intervención esencialmente de prospección visual y de labores de desconcreción sobre los cañones. La mayor profusión de restos arqueológicos hacia el sur, podría estar relacionada con cierta lógica, con la dirección dominante de las olas (Fig. 3).

El espacio existente entre los grupos norte y sur libre de la presencia de cañones, tal vez pueda deberse a que las dos piezas sacadas en 1899 y las siete de 1970, estuviesen localizadas en esta zona. Su retirada dejó, presumiblemente, este vacío o discontinuidad entre un conjunto de cañones y otro, dividiendo en dos lo que fue quizás una unidad.

En la última fase del trabajo se abordó el registro y desconcreción de la artillería de hierro, metodología que permite acceder a la información histórica a través de las marcas de fundición que pudieran existir en los cañones, ocultas bajo gruesas capas de concreción, sin poner en peligro su integridad y garantizando la conservación *in situ*. Estas tareas consistieron en la selección, eliminación de la capa de corrosión y colonización orgánica y aislamiento posterior de la zona desconcrecionada de las piezas de artillería seleccionadas, posterior a la realización de la planimetría y georeferenciación de las mismas. En relación al número de cañones, tratamos de seleccionar un porcentaje representativo en función de su distribución en el fondo. Partiendo de la base de que las condiciones del medio solo permiten el acceso al yacimiento de

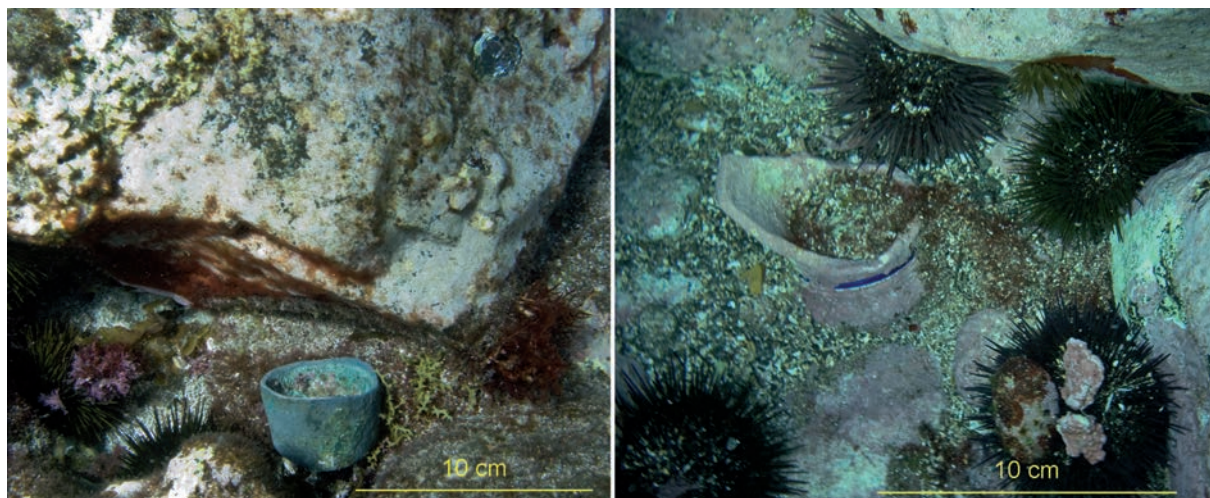


Figura 3. Cerámica y recipiente metálico de aleación de cobre localizados entre las piedras.

manera muy puntual, se decidió realizar un muestreo aleatorio simple de las piezas sobre las que intervendríamos. Dado que siempre existe la posibilidad de que un barco portara cañones de un lugar que no coincidiese con su pabellón y que no contábamos con la posibilidad de intervenir sobre todas las piezas, entendíamos que este era el método más acertado para una valoración inicial probabilística.

Entendíamos que para esta aproximación inicial, la elección de cinco piezas de artillería de manera aleatoria entre los dos grupos, podría ofrecer datos precisos, de hallar marcas, para



Figura 4. Desconcreción de uno de los cañones del pecio del Agujero, donde se observa uno de los muñones.

tratar de conocer el origen del buque naufragado, siempre contrastándolos con la información aportada por el resto del registro arqueológico. De los cañones se eliminó la capa exterior sobre los muñones donde, junto al espacio que va desde la faja de la culata al centro de la pieza, se solían realizar las marcas o inscripciones. Posteriormente se registró mediante fotografía digital cada una de las zonas desconcrecionadas. Finalmente procedimos a: en primer lugar, aislar del medio las zonas en las que se eliminó la concreción, con una resina de dos componentes que fragua en medios acuáticos y que ya había sido testada sobre cañones de hierro; en segundo lugar, se llevó a cabo un proceso de monitorización del sellado.

En este sentido, aunque la muestra fue representativa a nivel cuantitativo (se seleccionaron cuatro cañones de doce del grupo norte y un cañón de tres del grupo sur), pensamos que tiene carencias a nivel cualitativo, dado que solo se eliminó la concreción de los muñones y elegimos solo uno de cada pieza, salvo en un caso en el que se intervino en los dos. Por otro lado, el espacio superior entre la faja de la culata y el centro de los cañones, lugar muy utilizado para la realización de inscripciones o marcas, no fue analizado en ninguna pieza. Esto se debió al poco tiempo con el que contamos en cada inmersión para la realización de estas tareas, dado que el trabajo solo se podía desarrollar durante el repunte o reparo de marea, debido a la poca profundidad y a la existencia de un rompiente. Los resultados de estos análisis fueron negativos en relación a la localización de marcas o inscripciones, pero puso de manifiesto una regularidad en la medida de los muñones, que eran todos de 10 cm de diámetro.

Los materiales arqueológicos

En relación al estudio de los materiales hemos de advertir que nos encontramos en una fase muy inicial, por lo que estos análisis han de entenderse como parciales hasta su estudio en profundidad, dado que no entraba en los objetivos del trabajo su recuperación, estabilización y análisis. Básicamente, se procedió a la elaboración de un inventario y una valoración preliminar, tanto de los objetos arqueológicos que fueron extraídos por procedimientos no arqueológicos en el pasado, como de los localizados *in situ*. De todas modos, aportaremos aquí algunas valoraciones que tendremos que contrastar en futuras campañas que aborden un estudio exhaustivo del contexto arqueológico y de los materiales registrados.

Como se ha comentado, los restos presentes en el yacimiento arqueológico del *Agujero* y los que presumiblemente fueron sacados de su contexto, corresponden fundamentalmente a elementos inorgánicos: cañones, barras de hierro, recipientes metálicos, cerámicas, lingotes de plomo y otros restos metálicos sin identificar.

De la artillería solo podemos ofrecer datos parciales derivados de la observación de cinco piezas retiradas del yacimiento en 1970, en un estado de deterioro muy avanzado, y de la aproximación al estudio de cinco de las que se hallan *in situ*, cubiertas por una potente capa de concreción. Por ello, tanto el deterioro como la capa de concreción impiden un estudio riguroso de las piezas; unas por la pérdida de núcleo metálico y otras, por la imposibilidad de acceder al mismo sin eliminar la capa mineral y orgánica que las cubre.

En cuanto a las piezas localizadas *in situ*, sus medidas se sitúan entre los 135 cm de la más pequeña y los 259 cm de la más grande, siempre entendiendo que son medidas tomadas sin eliminar la gruesa capa de concreción. Siete de ellas tiene medidas entre los 135 y 160 cm, seis se sitúan entre los 225 y 259 cm y una mide 190 cm; la número quince está en una posición que impide medirla y la doce, 155 cm, está fracturada. No existe una distribución por tamaños, ni una orientación concreta, salvo la disposición norte sur que podrá estar vinculada a fenómenos posdeposicionales derivados de la dirección dominante de las olas.

Si bien los resultados de los trabajos de desconcreción fueron negativos en cuanto a la aparición de marcas o inscripciones, pudimos comprobar que la medida de todos los muñones era exactamente la misma (10 cm), independientemente de su tamaño. Desconocemos si estas piezas formaban parte de la artillería de la embarcación o si se trataba de una parte más del cargamento metálico que parece transportaba la nave. Desconocemos si la rotura de algunas de las piezas, como la 12 y alguna de las que están fuera del yacimiento puede interpretarse en ese sentido. Si dichas fracturas son debidas a factores posdeposicionales relacionados con el naufragio o a su método de extracción, o ya la nave las transportaba rotas.

Los cinco cañones que se encuentran fuera del agua tienen unas medidas más o menos homogéneas y están entre los 180-190 cm de largo con la boca y los muñones sobre los 8 cm.

De manera preliminar estos cañones, analizando las fotos de los que se encuentran fuera del pecio, se han interpretado como *sakers* ingleses de 6 libras y fechados a mediados del siglo xvii (Olmo, 2010: 92). Hemos de matizar que la medición de piezas de calibre pequeño plantea algunos problemas, dado que las diferencias entre un calibre y otro son muy sutiles (algunos milímetros); a ello hay que añadir la inexactitud de la toma de medidas sobre piezas muy deterioradas (Brown, 2012). Por ello, de momento, no estamos en condiciones de aportar datos concluyentes en cuanto al origen y fecha de la artillería. No obstante, teniendo en cuenta las medidas del largo de los cañones y del diámetro de los muñones desconcrecionados y analizando la morfología que se intuye en las piezas extraídas, encontramos ciertas similitudes con piezas de 6 y 4 libras estudiadas de la Compañía Holandesa de las Indias Orientales del siglo xvii. Los barcos mercantes de la VOC se nutrían en aquellos momentos de fundiciones inglesas y suecas que fabricaban cañones de esos calibres, cuyas medidas eran para los de 4 libras entre 124 y 200 cm y para los de 8 entre 160 y 240 cm (Brown, 2012). Tal vez los dos grupos de cañones del *Agujero*, que establecimos en función del largo de las piezas, se podrían corresponder a la división en esos dos calibres cuya morfología es muy semejante a dicho armamento inglés y sueco del xvii. En este sentido esperamos que en futuras campañas podamos aportar nuevos datos recogidos de la desconcreción de los cañones existentes en el yacimiento y ofrecer datos más precisos.

Las cerámicas registradas son hasta el momento fragmentos de lozas blancas decoradas en azul cobalto que en varios casos presentan medallones ornamentados (caras o ramos de flores). Se trata de restos presumiblemente de las denominadas *westerwald stoneware*, fabricadas en Alemania y que aparecen representadas en el registro material de los asentamientos coloniales ingleses de finales del siglo xvi y siglo xvii en América (Hume, 1995: 280). Los fragmentos localizados, bases, paredes y bordes pertenecen a varios recipientes, entre los que se registraron varios motivos ornamentales diferentes (como medallones con ramos de flores y caras). Las mismas podrían corresponder a tipos de estas cerámicas germanas frecuentemente asociadas al comercio marítimo inglés y holandés del siglo xvii (Wilcoxon, 1887: 74) y que encontramos representadas en obras pictóricas de artistas de mediados del xvii como Nicolas Maes, Pieter Claesz o Johannes Vermeer (Fig. 5).

Los restos arqueológicos metálicos del pecio del *Agujero* podemos dividirlos en dos grupos: las evidencias localizadas *in situ* y los objetos que se encuentran en manos privadas y que fueron extraídos hace años del yacimiento. Entre los recipientes localizados durante las tareas de prospección tenemos, en primer lugar, un pequeño vaso de tendencia troncocónica fabricado en aleación de cobre y localizado junto a los cañones del conjunto sur. Pudiera tratarse de un medidor como los recuperados en algunas excavaciones arqueológicas inglesas y que fueron usados entre los siglos xvii-xix (Biggs, 1992: 16). El otro recipiente pertenece a la base de una jarra en aleación de estaño, que localizamos en el sector occidental del sitio. A falta de ahondar en su análisis, la tipología de este objeto recuerda mucho a las jarras de medir abalaustradas inglesas fabricadas en peltre en época posmedieval exportadas durante el siglo xvii al continente africano (Weinstein, 2011: 197). En ese mismo sentido podríamos interpretar la «jarrita» metá-



Figura 5. Fragmento de cerámica tipo Westerwald localizada durante las tareas de prospección.

lica retirada del fondo durante el pasado siglo y definida como *oinokhoe* de época romana (Martín, 1968: 17) que se conserva casi entera, con el asa y el engarce de la tapa. Con la cautela que exige el hecho de haberla observado solo en fotografías, de las que deducimos además que se ha perdido la parte superior (Olmo, 2010: 44).

Los lingotes de plomo extraídos del sitio fueron al parecer cinco, de morfología trapezoidal y tamaño relativamente homogéneo. De momento y hasta que no se lleven a cabo estudios más precisos de las piezas: existencia de marcas, peso, medidas y composición, no podemos aportar más datos (Fig. 6).

Lo mismo podemos decir de las barras de hierro emplazadas en el yacimiento, que han de ser sometidas a un análisis más preciso. La existencia de la capa de concreción impide ver la morfología de las mismas y datos referentes a sus medidas. Los detalles que podemos aportar se refieren al conjunto, emplazado al oeste del grupo principal de cañones, y son sobre todo descriptivos. Se trata de un apilamiento, se observa claramente la superposición de elementos, orientado casi de este a oeste, de unos 6-6,50 m de longitud por 4 m de ancho y un espesor de alrededor de 1 m.

Conclusiones

Las particularidades de la costa norte de Gran Canaria y en general de la vertiente septentrional de todas las islas del archipiélago canario; abruptas, de fondos rocosos y con un litoral abierto a la presencia de olas de manera casi constante, han incidido de manera notable, junto a otros factores de tipo natural y cultural, en la formación de yacimientos arqueológicos subacuáticos con unas características muy especiales. Éstas se pueden resumir, como hemos visto anteriormente, en la existencia de restos de naufragios dispersos, donde los materiales se distribuyen, por lo general, de manera fragmentada por una superficie amplia del fondo marino.

En ese sentido nuestro trabajo trata de ofrecer una propuesta o aproximación metodológica, que esperamos se enriquezca con la discusión, capaz de acercarnos de manera interdisciplinar al análisis de estos sitios dispersos o de clase 5 (Muckelroy, 1978: 164), con el fin de conocer la compleja casuística que interviene en su configuración, además de las implicaciones



Figura 6. Lingotes de plomo del yacimiento en una colección privada.

históricas derivadas del hecho arqueológico. Para ello partíamos de la prospección arqueológica como herramienta de análisis arqueológico combinada con técnicas de la conservación, entendida como disciplina válida para general conocimiento histórico a partir de determinados procedimientos como la desconcreción (Zambrano/Bethencourt, 2001: 84).

Los resultados del análisis arqueológico inicial del pecio del *Agujero* apuntan, por el tipo de materiales localizados en el yacimiento y los que se extrajeron del mismo, a una embarcación que portaba al menos veintiséis cañones y un cargamento de barras de hierro. Es posible que transportara también lingotes de plomo dado que, si bien hemos podido acceder a cinco de estos lingotes sacados del pecio, aún no hemos localizado en el yacimiento más elementos que señalen su lugar de procedencia. La presencia de la potente carga de hierros, lingotes de plomo nos llevan a pensar en un mercante de origen europeo, cuestión que refuerza las de cerámicas alemanas registradas, los cañones (tal vez ingleses o suecos) y los recipientes metálicos, posiblemente ingleses. Desconocemos si los cañones, eran parte de la materia prima transportada o se trataba de armamento propio de la nave, dado que uno de los localizados en el yacimiento y tres de los retirados en 1970 tienen algún tipo de fractura, aunque no podemos conocer la causa de las mismas y si estaban rotos antes del naufragio. Tampoco podemos descartar que pertenecieran algunos a la carga y otros a la dotación armamentística. Curiosamente no hemos localizado aún balas, aunque pudieran estar ocultas en la potente concreción metálica del conjunto norte. En relación a la fecha, algunos de estos materiales arqueológicos, fundamentalmente las cerámicas y tal vez los cañones, apuntan al siglo xvii como hipótesis más probable.

Los datos obtenidos del registro arqueológico, contrastados con la información extraída de los protocolos notariales, nos llevan a plantear como hipótesis más plausible que los restos arqueológicos subacuáticos de la playa del Agujero pudieran pertenecer al navío inglés *Edgar* de Londres que, proveniente de la capital inglesa, naufragó en la costa de Gáldar en 1649. El agente inglés Enrique Brid solicita un año después poder recuperar la carga aprehendida por los jueces de la Inquisición y consistía fundamentalmente en barras de hierro, quinquillería, manufacturas textiles, herramientas, pescado, carne salada, etc. Además solicita permiso para poder sacar parte de la carga de hierro que aún se conserva en la orilla y cerca de la costa (Santana, 2014: 170-171). De la lectura del documento podemos extraer ciertas similitudes entre la carga que transportaba el *Edgar* y el registro arqueológico analizado. Sobre todo en relación al transporte de hierro y a la quinquillería, presentes ambas en el yacimiento.

Finalmente, pensamos que el estudio del yacimiento disperso del *Agujero* del que presentamos aquí un avance, plantea muchas más preguntas que las conclusiones que pueda aportar. A las mismas solo podremos contestar profundizando en el conocimiento no solo del contexto arqueológico, para tratar de registrar el mayor número de evidencias posibles que nos permitan confirmar o desmentir la hipótesis planteada, sino en el estudio y análisis de los materiales en un sentido amplio, que nos ayuden a contrastar los datos obtenidos con las referencias históricas.

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ForSEAdiscovery. Forest resources for Iberian Empires: Ecology and Globalization in the Age of Discovery (16th-18th centuries)

ForSEAdiscovery. Los recursos forestales para los Imperios ibéricos: ecología y globalización en la era de los descubrimientos (siglos XVI al XVIII)

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Abstract: In the Early Modern Age (16th-18th centuries) the construction of ocean-going ships was paramount to the development of cultural encounters during European expansion. In the case of the Iberian Empires, the establishment of new trade routes brought the need for armed merchantmen, galleons and smaller vessels, placing unprecedented demands on Iberian forests for the supply of construction timber. Forestry and sea power became inextricably linked, creating new geopolitical tensions, alliances and forest regulations. This paper outlines the methodologies and objectives of a major multidisciplinary project funded through a Marie Curie Actions grant (2014-18) which will see collaboration between universities, state research centres, and maritime archaeology companies.

Key words: Nautical archaeology, dendrochronology, historical GIS, Iberian Empires, ship-building.

Resumen: durante la Edad Moderna (siglos XVI al XVIII) la construcción naval fue la base principal para el desarrollo de la expansión europea. Para los Imperios ibéricos el establecimiento de nuevas rutas marítimas implicó la necesidad de construir y armar barcos mercantes, galeones y

pequeños navíos imponiendo una demanda sin precedentes sobre los recursos forestales en la península ibérica con el objeto de surtir de madera a las necesidades navales. Bosques y poder naval se convirtieron así en dos caras cuestiones relacionadas que crearon nuevas tensiones geopolíticas, alianzas y regulaciones sobre los recursos forestales. Este artículo describe metodologías y objetivos del más importante proyecto multidisciplinar financiado por el Programa Marie Curie Actions (2014-2018) que cuenta con una amplia colaboración entre universidades, centros de investigación y empresas de arqueología marítima.

Palabras clave: Arqueología náutica, dendrocronología, SIG histórico, Imperios ibéricos, construcción naval.

The ForSEAdiscovery Project, a historiographical framework

Historical studies have been looking into so-called «Environmental History» only for the last few decades. It can be said that social sciences has created a paradigm about the relation between human societies and nature throughout the centuries in which social, economic and political cooperation and competition have been employed for the exploitation of natural resources. However, one of the most relevant aspects of the first global age has not attracted the attention of the environmental social scientist, the evolution of maritime empires and its impacts in shipbuilding and forest resources. The primary assumption is that the history of deforestation in Europe is linked to economic development and military expansion (Williams, 2006). However, few authors make reference to the relationship between deforestation, how timber resources were used and traded, the monopoly held by contemporary financial lobbies, and shipbuilding. John Richards mentions an activity that could well be related to timber (Richards, 2006: 36).

«A prevailing sense of scarcity and doubt about sustaining local resources that leads organized groups to push commercial and political activities into new frontiers».

Richards sets out in this work to correct what he sees as a prevailing notion in environmental history that such organized human activities in the early modern era resulted in:

«an unrelieved tragedy of remorseless ecological degradation and accelerating damage.»

Wood was the first and most important natural resource for building and arming navies for the expansion and conquest of new territories, as well as for subsequent merchant operations. In this respect, the use and exploitation of forest resources over the modern period is comparable to the use of oil since the Industrial Revolution in terms of its strategic importance. This paradigm is especially important in the naval history of Spain and Portugal during the Early Modern Ages (Urteaga, 1987).

It is this historiographical framework which delineates the ForSEAdiscovery project, a Marie Curie Initial Training Network (ITN) funded by the European Commission with a consortium of fourteen participating institutions from eight different countries. This interdisciplinary project utilises history, underwater archaeology and dendrochronology to examine shipbuilding industries and timber use in the Early Modern Iberian Empires (16th to 18th centuries)¹. It is set in the Atlantic history during the first global age and has a dual objective: to collect bibliographic and documentary information as well as other literature on naval construction

¹ ForSEAdiscovery (Marie Curie Programme, FP7-People, 2013, ITN, Multipartner). This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement n.º PITN-GA-2013-607545.

and the use of timber within the political, administrative and economic framework in which the trade, distribution and utilization of forest resources was conducted in the Iberian empires; and to complement this with analysis of the archaeological evidence collected from Iberian shipwrecks, timber and other artefacts. Dendroarchaeology, complemented by a range of analytical techniques, will be applied to samples from selected shipwrecks that are thought to have been built in Iberia. Dendrochronology has the potential to determine the year in which the trees used for ship timber production were cut, and also to determine the geographical origins of these parent trees (Nayling, 2009). This adds value to historical knowledge of these shipwrecks and to validate the information from historical sources. It will be important to know how timber trade networks were organized to deliver forest resources to shipbuilding locations. Given the wealth of information available in historical databases on how wood was transported from Northern and Eastern Europe to the Iberian Peninsula between the sixteenth to eighteenth centuries, it would be reasonable to suppose that we should identify at least a proportion of the timber found in shipwrecks as being of non-Iberian origin (through dendro-provenancing).

The interplay between innovation and technological change in shipbuilding from the end of the medieval period through the Early Modern Era and scarcity of raw materials (in particular timber, whether this scarcity was perceived or real) has been the subject of both historical and archaeological discourse (Adams, 2013; Albion, 1926; Bamford, 1956; Wing, 2015). There is no doubt that the sixteenth century saw significant technological changes in shipbuilding on the Atlantic Iberian coast. To what extent the challenges of timber supply played a part in encouraging innovation remains less clear. Equally, the question of whether the shipbuilding demands for timber resulted in sustainable change of forestry practices in the Iberian Peninsula or deforestation and increasing dependence on timber imports cannot be readily resolved. It has been argued that by the eighteenth century conservation policies and resource organization, at least in the Spanish case, had developed sustainable levels of forest exploitation (Martínez González, 2013). We should not be surprised however to find both national and regional variation in woodland management, forestry practice, modes of resource control and delivery in support of shipbuilding industries for state navies and more localised private enterprise. Such complexity is best investigated through a multi-disciplinary approach drawing on the complementary approaches of history, archaeology and wood science.

Therefore, this research project is divided into three research work packages: historical wood supply and dynamic trade networks (history, GIS); nautical archaeology and shipbuilding (history and archaeology); and wood provenance (dendrochronology, wood anatomy, and wood chemistry). ForSEAdiscovery is an example of a cooperative effort to be made by the members of the Consortium headed by the Consejo Superior de Investigaciones Científicas (CSIC) in Madrid (Spain), seven laboratories from prestigious academic institutions (Universidade Nova de Lisboa; Universidad de Santiago de Compostela, University Wales Trinity Saint David, Universiteit Wageningen, Universiteit Leiden, Rijksuniversiteit Groningen and University of Lorraine) and one private company (Maritime Archaeology Ltd.) in five European countries (Spain, Portugal, France, United Kingdom and The Netherlands). This network of full participants is supported by another five associated partners: two key academic institutions (Nicolas Copernicus University in Poland and Texas A & M University in USA). Three small-sized companies also form part of the Consortium: Archeonauta S.L., specialised in the archaeological survey of shipwrecks, DendroDK, a sole-trader company specialised in dendroprovenancing of shipwrecks; and Dixit International, specialised in documentaries and audio-visual research².

² See web page of the Project: <http://forseadiscovery.eu/>.

The Consortium is supervising and developing fifteen individual subprojects with specific research objectives:

1. To create an inventory based on archival information of the sources of oak and pine used for shipbuilding in the Iberian Peninsula.
2. To collate historical and archaeological information regarding construction features of specific Iberian ships.
3. To investigate how the supply of timber and its dynamic trade network were organized
4. To synthesize results and to develop a Historical GIS based model combining information from the different disciplines involved in the project.

The research team aims to provide answers to a range of pertinent questions. Did Iberian forestry resources suffice to cover the high demand for shipbuilding during the centuries of European expansion? What was the nature and extent of trade that supplied timber from Northern Europe, mainly from the Baltic and Scandinavian areas? How did trade networks organise themselves around this timber trade? Was there a relation at all amongst the various monopolies of these networks? How was the exploitation of domestic timber resources arranged? How were these administered and employed by the lobbies that operated around the governments of these empires? This project tries to relate the history of naval construction and the progress of Atlantic maritime trade with deforestation and the value of timber resources, and to find out if all this had an impact on shipbuilding between the 16th to the 18th centuries.

Merchant networks and high speculation over wartime control of timber resources

In the Early Modern Era, 16th-18th centuries, shipbuilding fuelled the building of the empires. Building techniques evolved to make ships capable of oceanic explorations. Also, in a very short period of time, the design and the way merchant ships and warships were rigged evolved, and naval organisation itself underwent major changes. This investigation cannot be conducted without a truly interdisciplinary approach. Portugal and Spain pioneered the design and building of ocean-going ships, and these advances made possible the transition from Mediterranean-style vessels to a totally new approach to shipbuilding. The Iberian empires became a unique model in terms of political, cultural, economic and social interaction in the Atlantic first, and then at a global scale. The Iberian expansion was a dynamic spatial model evolving into self-sustaining locational structures. This spatial structure affected the logistics developed by other powers as they settled on the borders with a view to furthering their own expansions (Crespo, 2014: 71-91). For a few years Spain and Portugal became the Iberian Union from 1580 to 1640. During that time a combination of cooperation and competition took place. Both commerce and naval technology were part of a mutually beneficial exchange between both nations.

It was a time of great expansion for Hispano-Portuguese networks when new trade routes were explored and opened, and also for the development of an «integrated seagoing artillery» to be built into newly designed prototypes of heavily armed vessels, galleons and other smaller ships. This state-of-the-art technology at the time affected not only the way these maritime societies developed but also the way natural resources were managed. These new processes took place in port cities which somehow became the cradle of new financial and commercial activities from the 16th century. Docks and other facilities for rigging and repairing ships were integrated in the maritime cities, many of which became institutionally-appointed shipyards.

Forestry resources were regarded as the prime raw material for building navies and the foundations for the expansion of the empires. Forestry issues and maritime strength became two inextricably linked questions which led to geopolitical alliances and animosities that were reflected in the treaties signed at the time, in laws, forestry-related regulations, and in the emergence of new attitudes toward forestry management. In the 18th century Spain we saw an increase in forestry-related policies and in the interest shown by the State in safeguarding forests, as proven by the existing documentation (Martínez González, 2013). Also, at least hypothetically, a rise in the import of timber from Northern Europe was seen. The utilisation of wood from the Baltic and other distant areas was an ongoing practice in the whole of the Early Modern Era, and trading networks from Flanders and the Netherlands brought it to Spain and Portugal. Despite much research conducted into these commercial networks, the true nature of the relationship between this timber trade and the naval ventures of these two empires has not yet been elucidated. Another related question is the timber trade and the networks responsible for cutting down the trees and transporting them to the nodal points or ports for export. The new technological, economic and social scenes led to an all-time high in the demand for timber suitable for naval construction from the Iberian forests and from other areas. Oak (*Quercus spp.*) and pine (*Pinus spp.*) were the most sought-after types of wood, and traders were put under much pressure to keep up supply and develop new networks to ensure continuity.

Nautical Archaeology and Shipbuilding

A key source material in any study of timber usage in Iberian shipbuilding is hull remains that have been subjected to archaeological investigation. The project aims to expand and update existing databases on Iberian shipwreck sites with surviving hull remains. Many suspected Iberian shipwrecks do not include surviving timbers as a result of site formation processes. In other cases, sites known as a result of treasure hunting or looting where the focus was on recovery of artefacts without appropriate study of any surviving structures, and little or nothing is known about ship timbers. Nonetheless, numerous sites have been subjected to systematic archaeological investigation and less frequently detailed study of the scantling, morphology, mode and method of conversion, wood species and tree ring structure of timbers forming the ship's structure and fittings.

A number of *in situ* shipwreck sites will be selected for recording of hull structure, including details of exposed timber elements, and the recovery of samples for a range of analytical studies. A key focus for this aspect of the project will be suspected Iberian ships located off the Galician coast which have been under investigation by network partners for some years. Possible sites include the suspected 16th century galleon in Ribadeo, vessels associated with the AD 1596 Armada in Finisterre, then the 18th century frigate *La Santa María Magdalena* in Viveiro. As part of developing an effective diving team of young researchers capable of operating in a wide range of environments (including differing diving regulations for archaeological purposes), suspected Iberian sites lying off the coast of the United Kingdom will also be considered. A prime candidate is the protected Yarmouth Roads wreck which was subjected to selective excavation, provisional recording of surviving hull and the recovery of a substantial ceramic assemblage in the 1980s (Watson/Gale, 1990).

A further source of ship timber assemblages suitable for recording and analysis, with a focus on determining the nature of wood selection and usage, are collections held in storage or on display in museums and exhibitions. Examples range from the conserved Western Ledge material held in store in Bermuda (Bojakowski, 2011), the conserved and displayed Urbieta ship (Rieth, 2006), and the substantial collection of ship timbers held in Lisbon from underwater and urban excavations undertaken over decades. A demonstration project completed on the Arade

1 ship from this collection in Lisbon showed that the timbers came from mature oak trees felled in western France (Domínguez-Delmás *et alii*, 2013). This does not resolve whether the ship itself was French built or constructed in Iberia from imported timber. It is to be hoped that, where underwater archaeologists outside of the network are undertaking investigation of suspected Iberian shipwrecks, during the life cycle of the ForSEAdiscovery project, that we can collaborate to maximise the potential of such sites and recover selected samples for appropriate analysis.

Prime objectives of the project include the development of protocols for best practice in the recording, sampling and analysis of timbers from Iberian ships, whether *in situ* or following excavation and recovery. In recent years there has been widespread uptake of digital methods of recording including digital photogrammetry of *in situ* structures, and 3D contact digitising and laser scanning of collected timbers. The Newport mediaeval ship, arguably the first Iberian ship to have been dated by dendrochronology, provides a useful case study on the potential of the development of approaches to achieve the full potential of Iberian ship structures (Nayling/Jones, 2014). In this instance, following *in situ* recording of this clinker-built 15th-century ship, found in Wales, United Kingdom, the hull was dismantled and recovered for detailed recording. Three-dimensional contact digitising of individual timbers included recording of timber grain, knots and other morphological features of the wood were complemented by collection of data on annual ring counts and average ring widths. How such 3D records of characteristics of the parent trees used in timber production can best be utilised to produce digital 3D reconstructions of the parent trees will form one aspect of the ForSEAdiscovery project. Substantial numbers of samples were taken from those timbers with the best potential for dendrochronological dating (mostly radially split oak hull planks, and hewn oak framing timbers). Mean ring-width series derived from the hull planks were eventually cross-matched against tree ring series derived from historic buildings located in the hinterland of the northern Spanish (Basque) coast. The results not only confirmed and refined the 15th century construction date for the ship, but also by inference suggested a northern Iberian origin for the ship (Nayling/Susperregi, 2014).

Wood Provenance

The establishment of a dense network of tree-ring chronologies covering much of Europe has enabled dendrochronology to become the primary method of determining both the date of construction of excavated ships, and also the geographical origins of the timber used in their construction (Daly, 2007). This methodology has also provided direct evidence for timber trade such as the importation of Baltic timber for use in ship construction (Wazny, 2005). In contrast, the development of such chronologies in the Iberian Peninsula is less well developed, and the use of dendrochronology to characterise archaeological and historical material such as shipwrecks and buildings has been sporadic. Combining recent reviews of the present status of tree-ring chronologies in the Iberian Peninsula (Domínguez-Delmás *et alii*, 2015), with historical documentary evidence for the geographical sources of timber used in Iberian shipbuilding, the project aims to create or improve tree-ring chronologies in selected regions to encourage application of dendro-archaeological approaches in nautical archaeology. The construction of multi-century oak and pine tree-ring chronologies derived from living trees and historical buildings in regions known to have supplied timber to shipyards will provide a much needed reference dataset for Iberian Peninsula. It should be appreciated however that the development of such long chronologies in Europe has taken decades of research effort on the part of numerous dendrochronology laboratories. Hence, the strategy is to be very targeted in development of new ring-width chronologies in Iberia and to complement this approach with a range of additional analytical techniques.

A significant challenge in characterising the nature of archaeologically recovered ship timbers are the limitations of microscopic wood anatomy in the discrimination of the range of deciduous oak and pine species often used in Iberian shipbuilding in the Early Modern Era. Mechanisms for attempting discrimination of pine or oak species with known Iberian distributions (e.g. *Quercus faginea*, *Q. pyrenaica*) from those with more widespread distributions (e.g. *Quercus petraea/robur*) on anatomical grounds will be explored. Similarly, the potential of variation in geochemical composition of archaeologically recovered wood, as a reflection of variations in the physical environment (local soils, lithological materials, rainfall water) where the wood was formed will be examined through a range of analytical techniques (e.g. Pyrolysis-GC/MS, FTIR-ATR, Strontium isotopes). The application of such techniques has proved effective in determining the origin of timber including ship timber in other regions where dendrochronology is still in the development phase (English *et alii*, 2001; Rich, 2013).

Conclusions

This brief paper has summarised the main aims and objectives of this multi-disciplinary research project and considered the main lines of enquiry which are envisaged over a four year period. From an archaeological perspective, how might we judge the success of this project? In line with the intentions of the Marie Curie Actions programme, the development of a cohort of early stage researchers with core specialist skills complemented by an ability to excel within an interdisciplinary research environment will be seen as a priority. A highly desirable impact on the practise of underwater and nautical archaeology in Iberia would be a change in the perceived value of wood studies. In his masterful publication of the Pepper Wreck, Castro in describing the hull of this early-seventeenth century Portuguese Indiaman, noted that beyond selective species identification «Since there is no dendrochronological series for Portugal, no further analysis was conducted on the wood from this vessel» (Castro, 2005). By the end of this decade, if those working on Iberian shipwrecks are routinely undertaking scientific analysis of the timbers forming the hull assemblages being studied, the ForSEADiscovery project could be seen to have played its part in a significant development in the practice of nautical archaeology.

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«Si preguntaren por el capitan Calauaça...» Unas instrucciones para la exploración del Pacífico en el siglo XVI

«Si preguntaren por el capitan Calauaça...» Instructions for the exploration of the Pacific in the sixteenth century

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Resumen: a mediados del siglo XVI, los exploradores castellanos tenían un conocimiento sorprendente del océano Pacífico, sus islas y sus gentes. Las sucesivas armadas a la Especiería, sus diversas vicisitudes, otras expediciones y el espionaje a Portugal, habían conseguido este propósito. A pesar del Tratado de Zaragoza (1529), en Castilla y en sus tierras americanas no se olvidó nunca la riqueza y el potencial del Maluco. Hacia 1550 se tenía muy claro que la ruta más acertada para llegar a las codiciadas islas era la que partía de los puertos occidentales novohispanos. Esta circunstancia permitió la instalación de los castellanos en el extremo oriente tras el descubrimiento del tornaviaje. La documentación generada durante los preparativos de estas armadas permite conocer diversos y variados aspectos. Son piezas documentales que facilitan un acercamiento amplio sobre la comprensión castellana del mar del Sur momentos previos al asentamiento definitivo en Filipinas.

Palabras clave: Edad Moderna, Corona de Castilla, océano Pacífico, barcos, tornaviaje.

Abstract: In the mid-sixteenth century, Castilian explorers had a surprising knowledge of the Pacific Ocean, its islands and its peoples. Navies sent to the Spice Islands, its various vicissitudes, other expeditions and spying Portugal, had achieved this purpose. Despite the Treaty of Zaragoza (1529), Castile and its American lands never forgot the richness and potential of Maluco. By 1550 it was clear that the most appropriate route to the coveted islands was the one it started in the western ports of New Spain. This circumstance allowed the installation of the Castilians in the Far East after the discovery of *Tornaviaje* (maritime return path from Asian Islands to Mexican ports). The historical documentation generated during the preparations of such navies allows to know many and varied aspects. They are documentary pieces that facilitate now a broad approach to understand the Castilian colonization of the South Sea and the Philippine Islands.

Key words: Modern Age, Kingdom of Castile, Pacific Ocean, ships, eastward maritime return path.

Es bien sabido que la búsqueda de una ruta hacia Oriente y hacia las tierras e islas productoras de especias, constituyó una auténtica obsesión para los europeos de finales del siglo xv. El estrangulamiento de las rutas comerciales por parte de los turcos otomanos y la maduración de una sociedad renacentista, que veía en las especias una manera de completar un modo de vida más antropocéntrico (que cubría unas necesidades básicas en su salud y en su alimentación), explican tradicionalmente, a rasgos muy generales, las exploraciones hacia el continente asiático y sus islas.

Pero el asunto no queda ahí. Lo cierto es que la demanda de especias no se producía solo en Europa. Los documentos de la época exponen claramente que en el Viejo Continente se conocía el progresivo y gigantesco consumo que de clavo se venía produciendo, al menos desde comienzos del siglo xvi, en China, Turquía, Persia o Camboya. Así lo expone abiertamente el documento que expongo en este trabajo: «... gastan más en vn anno que antes en veynte...» (Archivo Histórico Nacional, Diversos-Colecciones, 34, 2: apéndice documental). Es decir, habría que matizar la relación que existe entre los viajes y asentamientos ibéricos en el sureste asiático y la búsqueda de las especias. Habrá que poner entonces de relieve, en resumen, la expansión del comercio y los comerciantes europeos, que se vieron en la necesidad de expandir sus capitales y sus productos, y tomar las riendas, o al menos participar, de unas redes comerciales que ya eran mundiales. Sabemos a través de la documentación, y es solo otro ejemplo, que fueron finalmente los propios comerciantes lusos los que transportaban el clavo hasta Malaca para allí venderlo a los comerciantes chinos.

Portugueses y castellanos estaban, en aquellas fechas, en las condiciones óptimas para realizar arriesgadas y costosas expediciones marítimas y abrir rutas y mercados. Sus barcos eran, también, el máximo exponente de la tecnología de la época. Así que este asunto cobró brío en la última década del siglo xv. Los navegantes castellanos se toparon con un nuevo continente en 1492. Los portugueses llegaban a la India en 1498; en 1510 se establecían en Goa y, finalmente, en 1512, Alfonso de Albuquerque llegaba a las Molucas: las codiciadas Islas de la Especiería.

Sin duda no es este el lugar donde resumir asuntos ya muy tratados, como es el de las expediciones dirigidas por ambas Coronas hacia los confines de Asia (véase la selección bibliográfica). Sí me interesa enfatizar el profundo conocimiento que se tenía, poco más de medio siglo más tarde del descubrimiento de América, del conjunto geográfico del globo. Todo ello gracias a la labor de los marinos que surcaron aquellas y otras aguas, que confeccionaban cuidadosas relaciones y memorias con las detenidas singularidades geográficas, económicas, biológicas, antropológicas, etc., de todo aquello que veían en aquellos remotos lugares. Testimonios todos mucho más cuidadosamente compilados, estudiados y sistematizados por los cosmógrafos y pilotos de la Casa de Contratación.

Y llegados a este punto, de buques, jarcias, velas y mares desconocidos, me gustaría dedicar este modesto trabajo a la memoria de José Luis Casado Soto, exdirector del Museo Marítimo del Cantábrico, y quien tanto hizo por la investigación y la difusión del conocimiento sobre los barcos castellanos que surcaron todos los océanos desde finales del siglo xv.

El contexto de los preparativos

El título que da nombre a esta comunicación es el comienzo de una frase extractada de la pieza documental que he referido poco más arriba. Corresponde con un detallado informe acerca de por qué, cómo, cuáles y dónde habían de ser los preparativos para enviar dos naos desde las costas pacíficas de Nueva España hacia las Filipinas, establecerse allí, contactar con los aboríge-

nes de las islas de los Malucos (ya empeñadas por Carlos V al rey de Portugal) y, desde allí, hallar el viaje de regreso. Por su interés y minuciosidad va transcrita completamente en el apéndice documental.

Lo cierto es que la búsqueda del tornaviaje era una imperiosa necesidad. Los marinos castellanos intuían en el Pacífico un régimen de vientos semejante al del Atlántico. Recordemos que ya Gonzalo Gómez de Espinosa intentó la vuelta desde los Malucos a las costas novohispanas en 1522, mandado por Juan Sebastián Elcano. Y lo hizo buscando latitudes altas. Así lo buscó también Hernando de Grijalva en su casi increíble y trágico viaje en 1537. Y también escrutó estos vientos Bernardo de la Torre, el Capitán Calabaza de los aborígenes filipinos, durante la expedición de Villalobos en 1545. También se marearon otras vías de vuelta por debajo de la línea equinoccial: Álvaro de Saavedra, en 1528 y 1529, y Ortiz de Retes en 1545. Expediciones que dieron lugar, por ejemplo, al descubrimiento de Nueva Guinea.

Habría que esperar a 1565 para que el patache *San Lucas*, seguido dos meses más tarde por la nao *San Pedro*, consiguiese hallar la vuelta a puertos mexicanos. En la nao viajó Andrés de Urdaneta a quien hasta ahora se le ha atribuido en la práctica todo el mérito del viaje. Sin embargo, no parece que sea del todo así. Así se afirma en el reciente trabajo del profesor Juan Gil: que tal ruta de regreso sería ya pública para la expedición de Legazpi, y su principal impulsor habría sido el experimentado marino Juan Pablo de Carrión, que precisamente no participó en esta armada por sus disputas con el agustino. Así lo afirmaba el veterano capitán de la mar del Sur en su informe a la Corona sobre la conveniencia de instalarse en las Filipinas: «... están en mejor paraxe para la buelta por estar en altura y arrimadas a la vanda del Norte, por donde se a de venir a descubrir la vuelta». Es decir, que la ruta del tornaviaje estaba ya fijada antes de que la armada de conquista de las Filipinas saliese de las costas mexicanas (en Bernabéu, 2013: 25-64).

Y es aquí donde hay que contextualizar la pieza documental que presento. Es esta un documento que yo sepa inédito, pero que, como digo, se puede contextualizar en los años previos a 1565 y a la expedición de conquista de las Filipinas dirigida por Legazpi. No parece, por su contenido, que el informe fuese escrito por Urdaneta. Determinados datos apuntan a esta circunstancia. Principalmente un «que pasó con *nosotros* el año de quarenta y dos», en clara referencia a la armada de Villalobos (1542), donde sabemos que el de Ordicia no participó. Además, el objetivo claro de esta armada era el clavo y las especias de los Malucos, Ambán, Bandán Jaba, Mindanao, Timor y las Célebes, así como el comercio con la China. Y sabemos que la intención de Urdaneta era la colonización de Nueva Guinea, y no el asentamiento en unas islas (incluidas las Filipinas), que él consideraba entraban en el antimeridiano portugués de Tordesillas.

Los buques

En primer lugar, el documento trata sobre los barcos. Determina la instrucción que habrían de comprarse dos navíos nuevos: uno de 150 toneles y otro de 120 en puertos nicaragüenses o panameños. Es decir, dos buques de porte mediano para la época pero que, sin embargo, constituyeron la espina dorsal de las armadas y los descubrimientos de la época. Refiere la necesidad de calafatearlos bien y, después, emplomarlos una braza a partir de la quilla. El resto de la obra viva, hasta la línea de agua, se emplomaría entre las costuras. Había de ser también una construcción recia («con que los estoperoles se alcance la cabeça el uno al otro»). También previene con que los buques estén bien enjarcados y con sus jaretas desde la mayor hasta el trinquete. De igual manera indica que han de llevar dos bombas.

Respecto a las anclas, habían de llevarlas duplicadas, y sobre cables y aparejos, velas y lonas para hacerlas, deberían de llevarlo todo triplicado. También advierte que si no hubiese

buena jarcia de España, Nicaragua o Panamá (entiendo que de cáñamo), habría de confeccionarse de pita en Guatemala. Cada buque llevaría un timón de repuesto.

Sobre la artillería, se indica que había de ser de bronce. Más específicamente, lo preferible si se pudiese hacer era artillar los buques con una docena de falcones de dicho metal, muy posiblemente de retrocámara. Se complementaría esta con cañones menores: dos docenas de versos dobles también de bronce pero con las recámaras triplicadas.

Las tripulaciones

Tras detenerse en las máquinas, pasa a los hombres. Lo primero que advierte es que los pilotos y gentes de mar fuesen buenos profesionales, y que si fuese posible, dejaran prendas en Castilla o en Indias (muy posiblemente para evitar deserciones y altercados serios, que los hubo). También previene de no contar entre ellos con gallegos y portugueses, quizá por cuestiones de espionaje.

Sobre los oficiales de carpintería y calafates, apunta la conveniencia de que ejerzan también de marineros. Era necesario también embarcar un herrero con su fragua y aparejos.

Para la salud de los cuerpos, embarcaría un cirujano y barbero con sus medicinas. Para la de las almas, un sacerdote en cada navío.

Y embarcados todos, los bastimentos, municiones y rescates y puesto todo a punto, el general de la flota ordenaría que se confiesen y comulguen todos los que fuesen en la armada, y que todos hiciesen testamento junto a su nombre y naturaleza. Toda esa documentación se enviaría a la Casa de Contratación de Sevilla.

Los bastimentos

Así pues, una vez surtos en el puerto de Acapulco, los buques embarcarían los bastimentos correspondientes. Sin duda era el puerto que ya se vislumbraba más apropiado, en especial por la cercanía a numerosas poblaciones y, sobre todo, por la proximidad a la Ciudad de México. En toda la comarca alrededor se podrían encontrar los productos convenientes y, además, según el relatante, tanto puerto como tierra eran muy sanos. En la rada acapulqueña se habrían de acopiar bastimentos y rescates antes de que llegasen los buques, para que el tiempo allí de estancia fuese el imprescindible. También en el mismo lugar se tendrían que construir los hornos para el bizcocho.

Menciona también la necesidad de maíz para alimentación de las tripulaciones, que proviniese de regiones frías o templadas, ya que el producido en cálidas se corrompía rápidamente.

Habla sobre las carnes en conserva, las cecinas, de las que dice deberían ser elaboradas en el mismo puerto de Acapulco al estilo de las de las Indias de Portugal; es decir, en salmuera. El pescado recomienda pescarlo con chinchorro en Zihuatanejo y alrededores, ya que existía mucha sal para adobarlo y para llevar en la armada para otros menesteres.

Las armas para los soldados se iban a traer de Castilla. Básicamente arcabuces «de peder-nal y mecha» de Vizcaya y «de mecha», ballestas, cascos, corazas, pólvora, etc.

Adjunta también un extenso listado de matalotaje que nos permite ver perfectamente su variedad y cantidad. Los productos son diversos. Básicamente bizcocho, legumbres y cereales, carnes y pescados salados y vino.

Más interesante quizá es el resto de la carga, dedicada a mercadear en Oriente. Básicamente paños europeos, instrumentos metálicos como campanas, cuchillos, machetes o hachas, cuentas de vidrios, etc. También destaca la conveniencia de embarcar mil ducados en reales (lo que indica que llevaban fuertes sumas en moneda en estas campañas), planchas de cobre y algunas especias.

Mientras, indica comprar en Lisboa diversas prendas de vestir y paños, así como dos esclavos, uno chino o japonés y otro de las Célebes que supiesen hablar malayo.

Las instrucciones de navegación

La ruta que habían de seguir ya resulta de lo más clara en las instrucciones. La escuadra partiría desde el puerto de Acapulco. Sus virtudes ya eran de sobra conocidas. Obviamente, el plan de viaje, sin ser fácil, es expuesto con toda claridad. Desde el puerto novohispano habría de ir en la búsqueda de las islas de los Ladrones. Es decir, en búsqueda de las que luego fueron bautizadas como las Marianas y hacer escala en su isla más importante: Guaján (Guam). El propio Magallanes hizo que una nave occidental fondease aquí por primera vez. Un lugar en medio del Pacífico donde tomar agua y bastimentos; y donde, por cierto, haría escala el Galeón de Manila durante cientos de años. Se recomendaba así no pasar por las islas de los Corales (Marshall) y los Reyes (Faraulep), por ser apenas meros islotes coralinos y peligrosos. De las Marianas advierte el autor que se podría ir hacia la isla de Matalotes (Fais) y la de los Arrecifes (Yap). Allí habrían de buscar a los supervivientes de la expedición de Álvaro de Saavedra. Recuérdese que esta partió de Nueva España, del puerto de Zihuatanejo, por mandado de Hernán Cortés en 1527, en busca de noticias sobre la armada de Jofré García de Loaisa. De las tres naves que la componían, solo una llegó a Tidore. Y no pudo regresar jamás a la costa de partida por no haber hallado los vientos correctos. Precisamente el documento que nos ocupa indica que su autor había oído hablar a los indígenas en castellano.

En cualquier caso, las instrucciones indican que desde las Marianas la escuadra habría de dirigirse a las Filipinas; en concreto a la bahía de Cobo, quizá la actual Cobobay, en la provincia de Catanduanes, región de Bicolandia, hacia el extremo sur de Luzón. Este sería el puerto central de las operaciones. La geografía de las Filipinas está ya bien definida. Recomendaba también la adquisición de dos paraos esquifados, sin duda idóneos para moverse entre el gran archipiélago. Apunta el autor la necesidad de conservar las buenas relaciones con los nativos. Y así recomienda el envío de visitas a las islas de Abuyo (Leite) y Tandaya (Samar) para reactivar el comercio con los naturales. Precisamente, cuando se refiere a la isla de Samar, es cuando el autor del texto advierte que no se ha de hablar del «Capitán Calabaza» a los indígenas. En efecto, en la relación de Legazpi se le cita como apodo que los filipinos habían dado a don Bernardo de la Torre, capitán de la armada de Ruy López de Villalobos. Al parecer, las acciones de este personaje a comienzos de los años cuarenta del siglo xvi en Filipinas no habían dejado especial buen recuerdo a los indígenas. Precisamente se insiste en el buen trato que se había de dar a los indígenas. No es obviamente en la época una cuestión humanitaria. Simplemente se trata de un asunto de paz interna y estabilidad. Advierte, también, del carácter mudable de aquellos, y de lo precavidos que habían de estar los castellanos. Sin embargo, sabemos que estos no olvidaron nunca la muerte de Magallanes y la apostasía de determinadas tribus.

En cualquier caso, una vez establecidos en alguno de los puertos filipinos, recomienda el autor hacerse con dos calaluces grandes para dirigirse a las islas de Maluco. Y todo ello muy disimuladamente, en el mayor de los secretos, pues ya advierte que solo un español había de ir en cada una de estas embarcaciones. El objetivo era contactar con el cacique de Gilolo (llamado Catarabumbe o Aquichil Diaz), y presentarle cartas oficiales y regalos. Enemigo de los portu-
gue-

ses y aliado de los de Castilla desde el arribo de la armada de Magallanes, el de Gilolo podría servir bien a los intereses castellanos. También apunta lo mismo para el rey de Tidore y el señor de Machián, Aquichil Humar: que agradecerán mucho las cartas y los presentes del rey de España y del virrey de Nueva España. Indica el narrador que se les pida a estos personajes clavo de cabeza, nuez moscada y macis. También árboles de clavo pequeño, de nueces, pimienta larga y tamarindos, con destino a ser plantados en Nueva España. Incluso abre la posibilidad a que alguno de los naturales malukeños embarquen para España.

Otro de los asuntos que propone para el asentamiento y consolidación de los castellanos en la zona es el de enviar dos embarcaciones a las islas de Bandán para cargarlas de nuez moscada y macis, con destino a Filipinas. El objetivo era quedar acreditados ante los filipinos. Tras ello, las especias se trocarían en Japón por seda en madeja y tejida, rasos, damascos, tafetanes, «mulios», «branzadillos», ámbar gris, almizcle, algalia, amofar, marfil, mejuy almendrado y blanco, ruibarbo, alcanfor, palo de China, porcelanas, oro y pedrería, etc.

Sin duda todo parece indicar que las Filipinas se iban a convertir en la base de operaciones de los castellanos en el confín oriental. Así pues, advierte el narrador que, a través de los aliados que allí tienen (Bahía de Cobo, Abuyo, Tandaya y Mazagoa), los castellanos habían de hacer paces y trabar amistad con el señor de Butuan (puerto principal de Mindanao), donde precisamente navíos chinos y de Borneo iban a comerciar con oro. Igualmente insiste en la necesidad de rescatar a los castellanos que aún andaban cautivos por las islas tras las anteriores expediciones.

Otra posibilidad que da el autor para el viaje de ida a Poniente es subir por la costa americana, aprovechando los terrales y los virazones, e ir más allá de lo explorado por Juan Rodríguez Cabrillo en 1542 (la California), y descubrir la posibilidad de que, costearlo, se pudiese llegar a las costas asiáticas o, al menos, a Japón. De ser así esta posibilidad, el narrador recomienda encontrar un puerto en alguna isla de los archipiélagos japoneses, aderezar los navíos, y dar la vuelta (que, recuérdese, es el objetivo principal de la expedición). Calcula, por las relaciones y por los mapas que dice manejar, que del puerto de Navidad hasta las Filipinas habría hasta 1 300 leguas, mientras que de Japón a las costas novohispanas habría 500, por lo que, según dice, «es viaje de quinze días o veinte».

El regreso a Nueva España

En cualquier caso, una vez en Filipinas, habían de comenzar los preparativos para la vuelta a tierras americanas. Lo primero era preparar los buques para la nueva travesía. Es decir, calafatearlos y aderezarlos con todo lo necesario. No habría que hacerlo ambos a la vez. Debería de hacerlo primero uno y después otro, para tener uno siempre preparado ante un previsible golpe de mano a los nativos.

La expedición retornaría a final de abril, tomando la derrota de los Lequios o de Japón. Eran las mismas fechas en las que salían los portugueses y los mercaderes locales en sus juncos desde el puerto de Sonda, en la isla de Java hacia la China y Japón, cargados de pimienta. Coincidían las fechas también con los que salían de Malaca, Patani y Siam, así como los que partían desde los Lequios y Japón para la China continental. Lo mismo sucedía en toda la India, aprovechando los vientos propicios que soplaban hasta finales de agosto. Desde la altura de los Lequios y de Japón, ante la costa del gran continente asiático, a unos 40° o 45° sobre la línea equinoccial, sería el momento de cruzar el Pacífico hacia América. Aquí recalca la misión fundamental del viaje: «el principal intento es descubrir la vuelta». También supone la existencia de islas en aquella altura.

En cualquier caso, retoma el navegante que habría de subir, puestos «en las costas del Miaco», en 40 o 45 grados; es decir, llegar hasta donde se pudiese al norte, y desde allí emprender rumbo a Levante, a las costas de Nueva España. Es decir, saben perfectamente que han de comenzar a cruzar el Pacífico a la altura de las islas japonesas. Una vez avistadas, costear al sur con virazones o terrales era cosa fácil, hasta llegar al puerto de Navidad. Compara esta ruta con la de la travesía del Atlántico:

«... y como es notorio a todos y el viaje que hazen los navíos que salen del Nombre de Dios y de Nueva España para estas partes de Castilla para hazer buena nauegación desembarcados de la canal de Bahama, multiplicar en altura hasta ponerse en mas de quarenta y tantos grados para que, con el frescor del norte los traigan a España como vienen».

De tal forma, y para finalizar, expone una de las claves del informe y de la expedición que iba a tener lugar (y de las que habían sido hasta la fecha),

«... se cumplira lo ansi tan deseado por su magestad y por estos reynos donde tanta gente se a muerto y tantos millares de ducados se han gastado, de donde Nuestro Señor sera seruido y su Sancta Fe sea alçada y el patrominio de su magestad muy acreçentado».

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Apéndice documental¹

Siglo XVI, s.f., s.l. Instrucciones para un viaje a las Islas Maluco.
AHN, Diversos-Colecciones, 34, n.º 2.

La orden que me parece se deve tener en el descubrimiento de las Yslas del Poniente de la Nueva España es la siguiente:

Primeramente se deuen mercar dos nauios nuevos, de porte e vno de ellos de çient y çinquenta toneles y otro de çient y veynte. Estos nauios se han de [al margen: es menester llevar prouision real para aquellas gouernaçiones] mercar en Nicaragua o en Panama, a los quales despues de auerse bien calafeteado se podian emplomar vna braça desde la quilla para arriba, y lo demas que faltare hasta la lumbre del agua se emplomaran so las costuras, con que los estoperoles se alcance la caueça el uno al otro. Han de venir estos nauios bien enxarçados y con sus caretas desde el mastel mayor hasta el trinquete. Ha de llevar cada nauio de estos dos bombas puestas.

Han de llevar estos nauios dobladas anclas y cables y los demas aparejos, y de velas y lonas para hazellas, y otras cosas neçesarias triplicadas, y no auiedo buena xarçia de la de España e Nicaragua o Panama se ha de hazer de pita en la prouinçia de Guatimala.

Estos nauios han de yr artillados con artilleria de bronce, porque la de hierro en aquellas partes con la humedad de la tierra es trabajosa; y si se pudieren auer vna dozena de falcones de bronce con sus camaras que acostumbra[n] los portugueses con su peon cada vno el artilleria muy buena para el proposito. Ansi mismo se deuen llevar dos docenas de versos dobles de bronce con triplicadas camaras. Ansimismo lleuara cada nauio vn leme de respecto.

Ha se de llevar de estos reynos de Castilla quatro lombarderos estrangeros que lleuen todos los aderezos neçesarios para su ofiçio.

Ha se de procurar ante todas cosas pilotos y gente de mar que sean habiles en su arte y, si posible fuere, que dexe[n] prendas en Castilla o en las Yndias. / Esto se entiende no siendo portugueses ni gallegos, porque para el viaje no conuiene lleuallos.

Yten que en cada nauio vayan ofiçiales carpinteros de ribera y calafates, porque de mas de seruir a sus ofiços siruan de marinero.

Ha se de llevar vn herrero con su fragoa y aparejos para hazer lo que conuiene a las naos.

Asimismo conuiene llevar vn çurujano y barbero con sus medeçinas y como para tal jornada se requiere.

Yten se ha de llevar un saçerdote en cada nauio.

¹ He intentado que las normas de transcripción fuesen lo más respetuosas posibles con el texto original, sin que esto signifique una literalidad que pueda ofrecer complejidades de lectura. Así pues he procedido al desarrollo sistemático de las abreviaturas, a la separación de las contracciones y a la acentuación en los casos que se pudiera plantear malinterpretación o confusión del contenido; he respetado la letra y sin sustituirla por la *i*, así como la *u* cuando hace funciones consonánticas y la *v* como vocal. He mantenido el resto de las grafías y he puntuado el texto para que su lectura no presente excesivas dificultades, si bien por su propia naturaleza he querido ser en este aspecto lo más escueto posible, precisamente para considerar la propia fluidez que el autor plasmó en algunos casos su redacción.

Y traydos los nauios a la costa de la Noua España, al puerto de Acapulco, porque de mas de ser buen puerto es el mas çercano de la çiudad de Mexico, que esta sesenta y çinco leguas y tiene buenas poblaciones de yndios, e su comarca para lo que neçesario fuere al despacho de la Armada, el qual puerto y tierra es muy sano.

Asi mismo conuiene para quando estos nauios llegan a estos puertos, que esta en Acarnata que es el pueblo más çercano todo lo neçesario asi de bastimentos y rescates y todo lo que ha de yr en los dichos nauios, porque no se detengan alli para que luego se prosiga el viaje y no se haga costa con la gente.

Halli en el puerto se han de hazer los hornos para hazer viscocho, porque sea mejor y menos costa.

El mayz que se ha de llevar en estos nauios se ha de traer de tierra templada o fria, por causa que lo de la costa por ser tierra caliente se daña presto.

Las cezinas se han de hazer en el mesmo puerto de Acapulco a uso de las Yndias de Portugal que es en salmueras.

El pescado se ha de pescar con chinchorro en el puerto de Çigatanejo o en Asuthelan, veynte leguas de Acapulco, en el qual puerto y costa / ay mucha cantidad de sal para el efecto y para llevar para la jornada; embarcados los bastimentos, munijones y rescates y todo lo demas; y puesto todo a punto se ha de mandar que se confiesen y comulguen todos los que fueren en la flota y que cada vno haga testamento; han de quedar en tierra; y sauidos los nombres de cada vno e naturaleza se envíen a la Casa de la Contractaçion de Seuilla para que sea notorio a todos.

Y hechas las diligencias que en este caso se acostumbran, encomendados a Dios, se harran a la vela en el mes de nobiembre o diziembre, porque conuiene partir por este tiempo, pues vientan en aquella sazon nordestes y lestes y surestes; y salidos de la costa siruiendo el viento conuiene atravesar luego en demanda de las yslas de los Ladrones, que estan en mas altura que las yslas de los Reyes ni de los Corales, y porque las dichas yslas de los Reyes y Corales son muy vaxas y no se ven hasta que estan sobre ellas, y como son muchas podria hauer riesgo de dar en ellas como creo lo hizieron los dos nauios de los tres nauios que el marques del Valle embio, que nunca mas parecieron sino fue el vno que apor to a Maluco. Y muestras de ellos hallé yo en las dichas yslas, por manera que mas seguridad del viaje seria de parecer fuesemos por mas altura por entre las yslas de los Ladrones, y de alli fuesemos en demanda de la ysla de Matalotes y de la de los Arraçifes, que estan en altura de diez grados, para ver si podriamos surgir y tomar lengua de los naturales de ellas y si ay algun christiano de los que fueron en los nauios del marques del Valle que se perdieron, pues salian a nosotros haziendo la señal de la cruz y diziendo buenos dias matalotes, y rogandonos muy ayncadamente que fuesemos a sus yslas, de donde se ynfieri que estos naturales lo aprendieron de los españoles que a su poder vinieron, porque son muy ymportunos en todas aquellas partes por aprender nuestra lengua, y aquel paraje de aquellas yslas no es viaje para seguir ningun crhistiano.

Y luego conuiene seguir la derrota en demanda de las yslas Felipinas, que / en altura de treze grados y vn terçio sy antes que a ella llegaren tocaren en la ysla de Maçagua, que es vna ysla de hasta çinco leguas debaxo en la qual preguntaran por el señor de ella, que en tiempos de Magallanes se bautizo y se llamo don Carlos y después se torno a su gentilidad, el qual muestra ser amigo de los vasallos de su majestad y por tal se tiene, y si fuere muerto preguntaran por Catanao su hijo y heredero, de los quales o de sus principales daran raçon de los cristianos que quedaron cautivos en la ysla de Mindanao y Filipinas para que se de orden a rescatallos, pues

darán gran lumbré y auiso de las particularidades de la tierra, y auisalles como vamos a surgir con los nauios a las dichas Filipinas a la vaya de Cobos para que allí acudan con lo que huieren sauido y para que nos puedan por nosotros dineros vender de las cosas que vuieremos menester; y ansimismo se deuen procurar que nos den dos paraos esquifados, que son nauios que ellos acostumbran, para que vayan en nuestra compañía hasta desxarnos surtos en la vaya de Cobos, y siruira con bien aquellos naturales de aquella comarca viendo yr a estos de Maçagoa en nuestra compañía; estaran seguros y no reçiuran alteración [tachado: alguna], a los quales se les daran algunos rescates de los que se lleuaren.

Llegados a las dichas Filipinas a la Vaya de Cobos se hallaran buenos puertos donde poder estar seguros; y toda esta tierra es muy poblada y de buena gente, y ay en ella el mantenimiento de la tierra en abundancia.

Surtos los nauios conuiene luego embiar a la ysla de Abuyo y Tandaya, que son los amigos connoçidos que allí tenemos de quien reçiuimos muy buenas obras, a los quales conuiene hazer mucha cortesía y dalles rescates para de nuevo ganarles las voluntades, porque nos seran muy provechosos para todo el tiempo que allí estuviéremos, y los demas naturales se aseguraran viendo que los otros naturales / son amigos; y si el principal llamado Tandaya fuere muerto porque hera muy viejo se preguntara por vn principal del dicho pueblo que se llama Dusmona.

Asimismo conuiene por intercesión de los amigos que tenemos llamar todos lo principales de aquella comarca y dalles a entender cómo queremos ser sus amigos, y que vamos a rescatar y no ha hazer guerra a ellos ni a nadie. Y que de allí hemos de yr a las yslas de Amaluco a fauoresçer y ayudar nuestros amigos que alla tenemos; a todo esto es menester contentalles en dalles algunos rescates de poca ymportancia porque de esta manera hazeseles de mas. Hazer ninguna cosa, y si preguntaren por el capitan Calauaça conuiene dezir nunca a él auer connoçido, porque quedaron escandalizados de él y porque la gente de estas yslas es muy sospechosa y sentida; conuiene tener espeçial cuydado que ningun natural sea maltractado de obra ni de palabra porque luego el pueblo todo por pequeña ocasión se alborotase y asi mismo toda la comarca.

Y como los naturales de esta tierra son cobdiçiosos y envidiosos los vnos pueblos con los otros, visto que les han dado algunas cosas y les mercan lo necesario, llegaran a los nauios y diran que aquellos son ladrones y que los quieren matar, que se vayan con sus nauios a sus puertos e pueblos y que les daran lo que uieren menester, y por consiguiente haran todos los comarcanos diziendo mal los vnos de los otros por manera que conuiene agradallos a todos dandoles algunos rescates de poco valor para tenellos todos contentos, y lo que se diere a los vnos no lo han de ver los otros aprouechandose de lo neçesario, entreteniendoles con palabras y alagandoles y dandoles esperanza que venidos otros nauios que aguardan yran luego a sus puertos y pueblos, y durante este tiempo conuiene proveerse de arroz / y de las demas cosas neçesarias que uieren menester, porque como son mudables se podran arrepentir en ni vender nada y por esta causa conuiene aprovecharse de este tiempo y coiuntura.

Asimismo conuiene tener gran guardia en los bateles, porque muchas vezes acaece por no condesçender a sus demandas procuran de hurtallos visto que quedan mancos, y sin ellos no se pueden seruir ni aprovechar de esa tierra; han de estar amarrados a los bordos de los nauios con sus cadenas y metida la cadena por vn embornalle del nauio y que de continuo este gente de guardia en ellos para lo que se ofreçiere.

Asimismo conuiene que cada noche esten los bateles sobre las amarras de los nauios con gente de muy buen recaudo con arcabuces de pedernal, porque ordinariamente procuran de cortar las amarras para que el nauio dé al traues.

Es menester ansimismo que luego en llegando a esta tierra se merquen dos paraos o calaluçes ligeros, que para el seruicio de los nauios seran menester porque los bateles no se quiten del costado de los nauios.

Aduertir se ha a los que fueren en esta armada que quando estos nautrales vinieren a los nauios como lo acostumbran ordinariamente no los dexen entrar a todos sino pocos de ellos, y salidos aquellos puedan entrar otros porque son grandes traydores, y que quando entraren les quiten los crises, que son las dagas que alla acostumbran traer, y conuiene buscarselos, porque los pueden traer ocultos quando quieren cometer alguna traycion, y los paraos y calaluçes en que estos naturales vinieren a bordo los hagan arredrar del nauio porque suelen estando juntos a bordo acometer todos de golpe dando muestras de amistad y regozijo y bebiendo y / dando a beuer el uino de palmas que traen, y por la mayor parte quando quieren acometer traycion vienen algo borrachos, y otras vezes traen mugeres hermosas dando ellas el uino para que, engolosinados en ellas, salgan de la çelada todos y maten a los españoles como lo han hecho y haran no estando muy sobre auiso.

Lo mismo se ha de tener espeçial cuydado y auiso quando se hiziesen las pazes, que sangrandose de la muñeca o del pecho y beuida aquella sangre con vino de palmas entre los dos capitantes queda hecha la paz, mas entonçes conuiene estar sobre auiso, porque quando los españoles estan mas descuydados con la paz hecha los matan y roban.

Conuiene ansimismo que, llegados a qualquier de los puertos que mejor los paresçiere, tractar con aquellos principales desde en dos calaluzes grandes, que son barcos ligeros que en aquellas partes acostumbran, esquifados y con gente aperçeuida, para los enuiar a las yslas de Maluco, y que en cada vno de ellos vaya vn español, a los quales se les pagara muy bien porque lo hagan de buena voluntad, los quales yran costeando la ysla de Mindanao hasta llegar a las yslas de Çarrangan, no dando a entender que van castellanos en los dichos calaluçes, y miraran si esta tornado a poblar la poblacion principal de esta ysla donde nosotros estuuimos, y de alli yran a la ysla de Sangrin y de Talao Ynuza, y de ellas tomaran lengua de las diferencias que entre estos naturales tienen, que son muy hordinarias, y para sauer si entre ellos ay algun capti-vo christiano de los que quedaron captiuos para que, si posible fuese, de rescate; de alli atraue-saran a la ysla de Gilolo, yran derechamente al puerto donde reside el rey / Conachaque; que lleuen lo que suelen los çelebres de aquellas yslas a vender lo mas secretamente que pudieren, sin que nadie entienda que lleuan castellanos ni que quedan en Filipinas; y llegado a la ysla de Gilolo, que es ocho leguas de las yslas de Maluco, daran las cartas al rey que se llama Catarabume o Aquichil Diaz y dalles presentes de Su Magestad y ansimismo sus cartas y cartas del visorrey de la Nueva España y de los capitanes de los nauios, y auisalles de su llegada a las Filipinas, que se esfuerçe en perseuerar en el seruicio de su magestad, pues su padre se lo dexo mandado y ello ha cumplido todas las vezes que los castellanos han llegado aquellas partes, y por cosas que por aca se han ofresçido no se ha podido embiar armada para sacalle del trauajo que tiene con los portugueses, y restituylle en las tareas que le tienen usurpadas y que no van a otra cosa sino a sauer si es viuo y como estan él y sus vasallos y amigos, para probeer en la Nueva España para yrle asiento para aquellas partes; y las cartas que asi de su magestad y del virrey fueren las agradezcan mucho lo que por los castellanos han hecho, asi al rey de Gilolo como al rey de Tidori y Aquichil Humar, señor de Machian, los quales tendran en muchyo por ser cartas de su magestad, y ansimismo se les ha de embiar algun presente que sea bueno en nombre de su magestad.

Y en las cartas que lleuaren del capitan de los nauios les embien a pedir algun clauo de cabeça y nuezes moxcadas y maçes, porque los rescates que para ello lleuaran; y ansimismo les pidieran arboles de clauo pequeño y de nuezes y pimienta larga y tamarindos para traerlos a plantar a la Nueva España, todo lo qual ellos haran de buena voluntad.

Ansimismo se deue embiar a llamar a algunos principales / de Gilolo y de Tidori para que vengan a hablar con el capitan para que quede palabra, se entienda lo que pasa en aquella tierra y conuiene proueer, y para que si algunos quisieren venir a estos reynos los puedan traer, lo qual ellos haran de gran voluntad para el deseo que tienen muchos años ha.

Asimismo se les puede escribir que embien vn par de coralsias, que son los nauios que acostumbran en las yslas de Maluco, para que vayan a las yslas de Bandan, para que les traygan cargadas de nuezes moxcadas y maças, lo qual todo traygan a las yslas Filipinas; y visto por los naturales de las Filipinas y de toda aquella comarca cómo desde Maluco nos vienen a ver y traer presentes, se animaran a ser fieles y a seruirnos y para que quedemos acreditados con ellos para los que despues fueren. Aprouechara este clauo y nuezes y maças para trocallo en las yslas de Japan por seda en madeja y sedas texidas, rasos, damasos y tafetanes, mulios, brançadillos, ambar, gris, almizque, algalia, amofar, marfil, mejuy, almendrado y blanco, ruybaruo, camphora, palo de China, porçelanas, oro y pedreria y otras mercaderias que en aquella tierra ay, las quales no ay mercaderia con que mejor se pueda rescatar como con el dicho clauo y nuez, lo qual cuesta poco y lo que no se trocase de estas espeças se podra traer a la Nueva España porque se trayga muestra de todo lo que en aquellas partes ay.

Ansimismo conuiene que por ynterçesion de los amigos que en aquellas partes tuuiéremos, asi de los de los Vaya de Cobos como de los de Abuyo y Tandaya y Maçagoa, que traten paz y amistad con el señor de Butuan, que es el puerto mas principal que ay en la ysla de Mindanao, y donde los nauios de los chinos y de Borneo van a rescatar oro, que es mayor cantidad que en / toda aquella comarca, lo qual haran los susodichos por el ynterese que se les sigue de aprouecharse de nosotros, y ansimismo para que estos principales y señores procuren de saber de donde estan los castellanos que quedaron captiuos en la ysla de Mindanao para que se rescaten, porque de ellos se tomara gran lumbre para lo de adelante; y luego conuiene poner en orden en adreçar los nauios calafateallos y adereçallos de todo lo que conuiene; y mientras el vno se alimpia y adereça conuiene estar el otro puesto a punto para que no nos tomen a manos como los naturales lo acostumbran hazer; y no conuiene sacar el artilleria en tierra por ninguna via si no fuere en las cosas menos neçesarias, y an de estar puestas en vna vcriaça en tierra con guardia de dia y de noche, y auiendo dado lado a vn nauio y puesto y enxarçado adereçaran luego el otro nauio.

Llegado al fin de habril conuiene estar prestos para partir tomando la derrota de las yslas de los Lequios o de Japan, que es la mejor derrota que se puede tomar para boluer a la Nueva España, porque de mas de ser nuestro camino derecho se descubran los puertos que tienen para la nauegación de nuestro proposito y se rescataran en ellas las mercaderias otras dichas. Porque en este mismo tiempo salen los portugueses y los demas mercaderes aquellas partes en sus juncos, que son nauios en que alla nauegan del puerto de Sunda, que es en la Ysla de Jaba, cargados de pimienta para la China y para las yslas de Japan; y ansimismo los que salen de Malaca y de Patani y de Sian es en el mismo tiempo, y asimismo los que nauegan desde la ysla de los Lequios y de Japan para la tierra firme de Miaco nauegan en este tiempo, que son los vientos sur, suuestes y huestes, y lo mismo en toda la Yndia, que en aquella sazon reynan alla desde el fin de habril e hasta todo agosto, por manera que por este dicho tiempo de mayo hemos de partir de las Filipinas para yr a la ysla de los Lequios y yslas de Japan; / y desde alli con los mismos vientos hemos de atrauesar a tomar la costa de la Nueva España, y en estas yslas se rescataran con los rescates que se lleuaren las nuestras dichas, deteniendonos en las yslas que nos pareçiere el menos tiempo que pudiesemos, pues el principal yntento es descubrir la buelta y asi se prolongaran la mayor parte de estas yslas hasta llegar a vna ysla que esta junto a la tierra firme de Miaco, que vsa dozientas leguas, de la qual tengo figura y los puertos que tiene y de la calidad de la tierra, y desde esta ysla se llegara a la tierra firme de Miaco, y desde alli conforme al viento que nos seruiere hasta quarenta o quarenta çinco

grados atrauesaremos la costa de la Nueva España, en la qual trauesa estoy çertificado de los naturales de aquellas partes ay muchas yslas pobladas de las quales vienen nauios tinglados como hurcas a contractar con estas yslas, los quales no traen otra mercaderia sino barretas de plata.

Y para acreditarlos con estos japoneses y miacos conuendria lleualles aquellos duques y señores algunos buenos presentes en nombre de su magestad, espeçialmente se les puede llevar sillas ginetas con sus jaezes y sillas estradiotas con sus guarniçiones doradas y espadas y coraçines y otras cosas ricas, y seria muy açertado para acreditarlos para la contractaçion que adelante se ha de tener, pues el negoçio es tan ymportante; y aprouechara mucho para esto vn clerigo llamado Cosme de Torres Valençiano, que esta en esas yslas de Japan, que es teatino, convirtiendolos naturales de estas yslas, que paso con nosotros el año de quarenta y dos, y ansimismo se hallaron en estas yslas castellanos, y entre ellos pilotos y marineros de los que llevamos, que andan por estas yslas, los quales sauido que estamos en aquella tierra se vendran luego a nosotros y daran gran claridad de lo que ay conuiene en toda aquella tierra.

Pues como atrás dicho tengo, puestos en las costas del Miaco en 40 o 45 grados por llegarnos todo lo que fuere posible al norte, sera / muy açertado el viaje para aunque los tiempos nos escaseen puertos en tanta altura atrauesaremos a la Nueva España a tomar la costa adonde pudieremos, pues podemos yr disminuyendo hasta diez nueve grados que esta el puerto de la Nauidad, y mas vale estar a la vanda del norte para este efecto que no estar en poca altura, pues estara en nuestra mano abaxar lo que quisieremos; y como es notorio a todos y el viaje que hazen los nauios que salen del Nombre de Dios y de Nueva España para estas partes de Castilla para hazer buena nauegaçion desembarcados de la canal de Bahama, multiplicar en altura hasta ponerse en mas de quarenta y tantos grados para que, con el frescor del norte, los traygan a España como vienen, y si huuiesen de boluer por donde fueron seria muy dificultosa la buelta; e esta misma orden se ha de tener los que de aquellas partes huuieren de atrauesar para la Nueva España para que el viaje se açierte, y tomada la costa de la Nueva España donde queria que se pudiese alcançar, y sera acauado el uiaje, porque tomada la costa en la mano, aunque los tiempos sean escasos, con los terrales y los virazones llegaran al puerto donde quisieren y se cumplira lo tanto ansi tan deseado por su magestad y por estos reynos donde tante gente se a muerto y tantos millares de ducados se han gastado, de donde Nuestro Señor sera seruido y su Sancta Fe sea alçada y el patrimonio de su magestad muy acreçentado, y los de la Nueva España y Nicaragua, Panama y Peru y Chile y las demas prouinçias de todas las Yndias muy aproueçadas, de cuya causa sera conmo que todas las gentes que en todas las Yndias ay perdidas y bagamundos se podrian remediar; los que en aquellas partes de las Yndias quedaren estaran mas sosegados y con mas remedio y no avra las alteraçiones y reuelaçiones que ha auido y cada dia acaesçeran por las neçesidades que cada dia en la tierra creçen y por la mucha gente / que cada dia multiplican y con este camino que se abriera con ayuda de nuestro señor quedara todo quieto y paçifico y demas desto sera muy ymportante negoçio quando los naturales de aquellas partes vengan en sus juncos a contractar en las dichas Yndias dandoles su magestad liçencia para ello.

Por manera que conuiene en todo caso detenerse poco tiempo en las yslas de Japan sino abreuiar todo lo posible antes que los tiempos se cangen, porque a mas tardar salgan al prinçipio de lo julio de las dichas yslas para que puedan llegar a la Nueva España en el dicho mes o entrado agosto, para con ayuda de nuestro señor no se tardara el dicho tiempo hasta llegar al puerto de Navidad o Acapulco.

Y siendo caso que a vuestra señoria le parezca que el viaje de atrás dicho no se haga, han de atrauesar luego desde la costa, luego desde la costa de la Nueva España para las yslas del poniente sino que prosigan prolongando la costa de la dicha Nueva España hasta los qua-

renta y quatro grados que descubrio Juan Rodriguez Cabrillo el año de quarenta y dos, y que de alli se prosiga todo lo que fuese posible hasta ver el rumbo que aquella costa lleua, porque podria ser dar la buelta conmo arco sobre la tierra firme de Miaco y corriendo esta costa se podran ver los puertos mas conuenientes para este viaje y contractaçion, y desde alli se pueda atrauesar a la tierra firme de Miaco o Yslas de Japan y costa a las las que les paresciere hasta llegar a las Filipinas, y despues de aderescados los nauios conmo atrás tengo dicho se podran tornar a costear las dichas yslas hasta llegar a la tierra firme de Miaco y desde alli o desde atrás podran atrauesar para la Nueua España conforme el tiempo le siruiere. /

Memoria del matalotaje que me pareçe que se deue llevar en estos nauios.

250 quintales de viscocho.
 500 hanegas de mayz
 20 hanegas de rijoles.
 12 hanegas de hauas
 6 hanegas de garuanços.
 40 arrobas de azeite
 40 de vinagre
 4 pipas de vino en votijas vidriadas
 50 toçinos
 500 quesos
 50 cantarillos de miel
 6 hanegas de lentejas
 50 arrobas de pescado seco
 6 pipas de sal.

Los rescates que conuiene llevarse de la Nueua España, pues aca no ay dineros para mercallos, son los siguientes:

Vna grana de Valençia.
 Dos paños de carletines
 Dos paños amarillos
 Dos paños verdes
 Dos paños azules
 Seis pieças de terçiopelo. Vna negra, y otra blanca, y las demas de colores.
 Doze pieças de tafetanes entredobles de colores.
 Doze almayzares moriscos de poco presçio. /
 Vn cofre de ruan
 Seis pieças de Olanda delgada
 Dozientas baçinitas de laton
 Dozientas hachas terçiadas.
 Dozientos machetes
 Veynte campanas de metal al vso de la China. Han se de fundir en la Nueua España. Las quales siruen a los naturales de aquellas partes para sus guerras y regozijo.
 Çinquenta dozenas de cuchillos de Flandes con canto de laton.
 Veynte dozenas de tigeras de todas suertes.
 Espejos de todas suertes.
 Çient dozenas de caxcaueles.
 Çient campanicas chiquitas
 Quatro arrobas de cuentas margaritas
 Dos arrobas de quantas cristalinas
 Quinientos maços de aualorio verde y amarillo

Quatro arrobas de quantas de todas suertes
 Veynte platos de laton
 Algunas cosas de oro de poco peso y valor
 Algunas pieças de plata de poco peso.
 Algunas menudencias de Flandes
 Quatro dozenas de bonetes de grana sensillos
 Mill ducados en reales
 Mil quinientos de ambar en pan
 Liquidanbar liguado
 Balsamo
 Copal, que es saumedio de la Nueva España
 Ençienso de la Nueva España
 Grana de cochinilla de la Nueva España
 Diez quintales de cobre en plenchuelas
 Çinquenta rodela de la Nueva España
 Lo que se ha de llevar de Castilla es lo siguiente:
 30 arcabuzes de pedernal y mecha
 20 arcabuzes de mecha que no sean de los de Vizcaya
 Veynte vallestas con sus adereços
 50 armaduras de caueça
 12 cotas de malla
 12 coraças
 Poluora fina para los arcabuzes
 Artilleria
 Las cosas que se han de mercar en Lisboa son las siguientes:
 Dos esclauos de aquellas partes.
 El vno que sea de la China o de las Yslas de Japan, y el otro que sea de los Çelebes, y
 entrambos sepan hablar la lengua malaya
 12 patolas negras y coloradas
 6 chelas
 50 muries
 20 caudies
 20 paños malquitos
 20 paños enrollados
 20 paños llamados capas

Conmo atrás tengo dicho, si a vuestra señoria le paresçiere que salidos los nauios de la
 costa de la Nueva España prolonguen la costa todo lo que de esta costa esta descubierto y del
 cauo de ella se aya de atrauesar a las yslas de Japan, tengo entendido como atrás tengo dicho
 que ay muchas yslas en todo aquel arçipielago conforme lo tengo por relacion de los naturales,
 y hallando en qualquiera de ellas / puerto y aparejo para rescatar y adereçar los nauios tendria
 por açertado no pasar adelante sino hecho lo que conuenia a su despacho diese de alli la buel-
 ta, pues lo que en este caso se pretende es descubrir esta buelta, pues tan façil es, pues esta tan
 entendida y pues a todos es notoria la claridad que en ello ay y la breuedad con que se puede
 hazer y como paresçe por las figuras y relaciones que de alla truximos en la longitud que ay
 desde el puerto de la Nauidad hasta las Filipinas, que habra hasta mill e trezientas leguas y de
 las yslas de Japan hasta tomar la costa esta descubierta de la Nueva España abra quinientas le-
 guas, que es viaje de quinze dias o veinte.

El clauo que se coge en las çinco yslas de Maluco vn anno con otro seran hasta diez mil
 vaales de clauo, y la mayor parte de ello se coge en la ysla de Tidori, Terrenate y Machian, por-
 que en las otras dos yslas que son Motil y Baan se coge poco y no es tan bueno.

Asimismo se coge en la ysla de Amban hasta quatroçientos baares de clauo cada anno, y cada vaar es es çerca de seys quintales de los nuestros. Estos arboles de clauo no dan tanto fructo vn anno conmo otro conmo los azeytunos, y el anno que es de pocas aguas, dan gran cantidad de el anno siguiente este clauo se coge desde septiembre hasta Naudad, el qual se merca con patolos, el qual son vnos paños de la seda entre dobles pintados que traen de las Yndias de siete u ocho varas de largo, que cuestan en la Yndia a quatro y a çinco ducados cada vno; asi mesmo se compra este clauo con campanas a su dicho que se acostumbran en aquellas partes para sus regozijos y guerras. Asimismo se compra este clauo con porçelanas de la China y con ropa de algodón de Vengala, y tambien se / merca con vna çierta moneda que en aquellas partes acostumbran fundida y oradada por medio, la qual se hazen en la China y en la Ysla de Porneo, que con valor de quatro ducados se merca vn vaar de clauo, que son quatro mill monedas de estas que llaman caxas.

Del qual clauo el rey de Portugal lleua el terçio de todo a los portugueses que lo rescatan, a manera de alcauala y por el flete de los dos terçios que les quedan de lleuallo hasta Melaca en sus nauios les lleua otro terçio y a los dicho portugueses quieren llevar el dicho clauo que les queda desde Melaca hasta la Yndia les lleua quatro pargaos de oro por cada vaar por manera que el portugues que rescato en Maluco çient baares de clauo no le quedan mas de quarente y seis puestos en la Yndia que los çinquenta y seys baares se los lleua el rey; vendese el vaar de clauo en Malaca a treynta ducados vn anno con otro.

Respondio el clauo que se lleuo de la China desde Melaca por cada vaar de clauo vn para de seda en madeja que ordinariamente vale en la Yndia seteçientos y ochoçientos pardaos y lo mesmo respondio por vn var de marfil otro vaar de seda en madeja.

An se dado esta gente de la China a comer tanto clauo que gastan mas en vn anno que antes en veynte y lo mesmo hazen los de Turquía y Persia y Camboya y las demas generaciones de la Yndia por causa de los naturales de Maluco. Vista tanta resta y demanda se dan a plantar mas que solian los arboles y mirar por ellos, pues tanto ynterese se les sigue no yba a Maluco mas de vna nao de tres a tres annos y no la cargauan del todo y yba desde alla a tomar la resta de carga a la ysla de Bandan a cargar de nuezes moxcadas y maçias y agora van quatro naos / gruesas cada anno a cargar del dicho clauo.

En estas yslas de Maluco se cogen algunas nuezes moxcadas de los nogales que en ellas ay que son mejores u las que se cogen en las Yslas de Bandan y en estas mesmas yslas de Maluco ay pimienta larga y gengibre de lo qual todas aquellas yslas tienen abundançia.

En las dichas yslas de Bandan se coge la nuez moxcada y maçias a las cuales van cada anno dos naos. Cogense hordinariamente treynta mill quintales cada anno y la contractaçion que se haze con estos naturales es que han de dar siete vaares de nuezes y vno de maçias y tanto pagan por vno de maçias conmo por los siete de nuezes y estas nuezes se mercan con las mercaderias que se merca el clauo; vael el valor de esta nuez en las Yndias treynta pardaos y el vaar de maçia çient y çinquenta pardaos. Este vaar de Bandan es el mayor peso que no el de Maluco, que tiene cada vaar çerca de ocho quintales.

La pimienta se coge en la ysla de Jaba y donde hordinariamente van a cargar de ella es en el puerto de Sunda. Tambien se coge en Patam, rescataste esta pimienta con ropa de Vengala y de las Yndias y con tostones. La pimienta que se coge en Java es mejor que la de la ysla de Çamatia, ni la que se cria de Malaca que saldra cada vaar de pimienta a diez o doze ducados.

Cone la ay en la ysla de Mindanao y en la ysla de Timor, arriba de la ysla de Maçagoa, çerca donde mataron a Magallanes, no ay quenta en esta porque se vende a ojo.

El sandalo viene de la ysla de Timor, tiene poco presçio tambien / lo ay en la ysla de Macaçar aunque no es tan bueno, tambien ay en esta ysla aguila que es madera que da buen olor quemandola, con lo qual los gentiles de la Yndia queman sus cuerpos despues de muertos con ella y tambien ay esta madera en la costa de Malasca, y es mejor que la de Macaçar, y vale cada faracora que son diez y ocho libras y diez o doze pardaos de oro.

Todos estos arboles de espeçia que ay en estas partes y del sandalo y del la aguila y de la comfora y del menjuy se crian en los montes, sin hazelles beneficio ninguno, mas de a su tiempo yr a coger el fructo que dan solo el gengibre se beneficia. Todos estos arboles no pierden las oja en todo el anno. La pimienta se cria en los montes que se encarama por los arboles ni mas ni menos que la yedra de Espanna.

«Algunos indios bisayas que se han igualado a los mismos españoles en saber disponer y labrar las maderas de cuenta para los naos»¹.
 Philippine Ships and Shipbuilding in the
 Sixteenth and Seventeenth Centuries

«Algunos indios bisayas que se han igualado a los mismos españoles en saber disponer y labrar las maderas de cuenta para los naos».
 Barcos de Filipinas y de la construcción
 naval en los siglos XVI y XVII

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Abstract: When the European visitors arrived in the Philippines from the sixteenth century they encountered a vibrant maritime culture and a range of indigenous craft ranging from log boats to plank-built vessels. These boats were built in a very different style to European ships. The Spanish colonial authorities continued to employ boats built in the local tradition for communications, local trade and to suppress maritime raiders from the areas not under colonial control. They also introduced an extended tool kit for ship-building. The Spanish recognised the maritime skills of the Filipinos and were soon using them as crew on their own vessels, such as the Acapulco galleons. The plentiful suitable wood in the Philippines for shipbuilding and the skills of the local carpenters led the Spanish to construct numerous European-style vessels there, especially for the vital maritime route to Mexico.

Key words: Philippines, ship-building, wood, cordage, tools.

¹ «Some of the Bisayan people have equalled the Spanish themselves in knowing how to select and work the wood for ships». Francisco Ignacio Alcina S. J. (1668) *Historia de las Islas e Indios de Bisayas...*, translated by the presenter.

Resumen: cuando llegaron los visitantes europeos a las islas Filipinas en el siglo xvi, encontraron una cultura marítima vibrante y muy diferente a la suya, con un rango de embarcaciones desde la piragua hasta el buque de tablaje, pero con un estilo muy distinto comparado con Europa. Las autoridades españolas usaban los buques indígenas para comunicaciones, para el comercio entre las islas y contra los piratas locales. También habían traído nuevas herramientas para construir buques. Utilizaron la madera y otros recursos de Filipinas y los carpinteros locales para construir buques al estilo europeo para la ruta de comunicaciones con México, tan importante en la vida de la colonia.

Palabras clave: Filipinas, piraguas, galeones, herramientas, carpinteros.

Introduction

When the European visitors arrived in the Philippines in the sixteenth century they encountered a vibrant maritime culture and a variety of indigenous craft ranging from log boats to plank-built vessels. These boats were built in a very different style to European ships. They were particularly interested in the outriggers employed on these craft. After the founding of the colony, the Spanish colonial authorities continued to employ boats built in the local tradition for communications, local trade and to suppress maritime raiders from the areas not under colonial control (Scott, 1981: 1-38).

The Spanish also recognised the maritime skills of the Filipinos and were soon using them as crew on their own vessels, such as the Acapulco galleons. The plentiful suitable wood and other materials in the Philippines for shipbuilding and the skills of the local carpenters led the Spanish to construct numerous European-style vessels there, especially for the vital maritime route to Mexico (Peterson, 2011: 4). The trade routes based on Manila were the foundation for the Spanish colonial regime that lasted for over three centuries.

The Spanish Settlement of the Philippines

The early Spanish exploration of the Philippines was motivated by the ambition to seek an alternative route to the Spice Islands through the Pacific and challenge the Portuguese control of the Moluccas. They failed to take control of the Moluccas from the Portuguese and later the Dutch. However an alternative economic rationale for the settlement of the Philippines was provided by the prospect of trade with China and other countries of Asia. The trade with China and Southeast Asia from the Philippines had been well established prior to the arrival of the Europeans. This involved the exchange of tropical produce from the Philippines for Chinese ceramics, metals and textiles. The Spanish discovered a healthy demand for silver in China, which was being produced in large quantities in South America, particularly at Potosí in Bolivia. This trade routed through Manila provided the economic basis for the Philippine colony and funded the extensive proselytization of Catholic Christianity (Agoncillo, 1975: 27-42).

After a number of exploratory voyages, the Spanish colony was founded at Cebu in 1565. The capital was eventually fixed at Manila in 1571, which was suitably located as a trade emporium and a base for the galleon trade between Acapulco and Manila (Agoncillo, 1975: 36-37).

The Spanish soon put the Filipinos to work as sailors and shipbuilders. Initially they were employed on ship repairing after the ravages of the long voyage from Mexico, but with the plentiful supplies of timber and other materials available, the construction of galleons in the Philippines began at an early date.

Sources

The most detailed account of the local shipbuilding tradition is derived from the memoirs of Father Ignacio Alcina (1668). He was a priest working in the central Philippines in the seventeenth century. In addition to his religious duties he had built and sailed a range of the indigenous vessels. Whilst his experience was largely in the Visayan Islands the design philosophy seems to have been standardised through the Philippines and much of Indonesia (Horridge, 1978: 9, 10).

The most important source for early Spanish shipbuilding is a paper by Sebastián de Pineda of 1619 titled, *Relación hecha por el... en cosas tocando a las Yslas Filipinas...* translated as *Philippine Ships and Shipbuilding* (Blair/Robertson, 1903-1907: Vol. 18, 169-188). The accounts of Alcina and Pineda are confirmed by the memoirs of Antonio de Morga, a senior Spanish colonial administrator in his work *Sucesos de las Islas Filipinas* published in Mexico in 1609.

The history of the trade between Acapulco and Manila has been well documented, due to the excellence of the Spanish archives, particularly at the Archivo General de Indias in Sevilla. The secondary sources are still dominated by Schurz's work, although his book, *The Manila Galleon*, is now well over half a century old (Schurz, 1959). This has been supplemented more recently by the work of Fish (Fish, 2011).

Philippine Traditional Craft

The most numerous were the log boats, which were carved out of a single log and often fitted with bamboo outriggers to improve stability. The log boats were rarely extended by the use of heat and steam as there were plentiful supplies of timber. However the log boats often had extra strakes to add freeboard. They also used washboards of bark or woven bamboo for this purpose (Alcina, 2005 [1668]: 161-165, 199).

The plank-built boats used strakes hand carved from logs, usually two planks from a single timber. This avoided the heart wood of the log which in Philippine timber was often prone to rot. The strakes were held together by dowels inserted in the edges of the timber and ribs lashed to those planks, using lugs left on the inside of the planks. The vessels did not use metal fastenings at all although metal tools were used in the construction. The strakes were cut from a single timber so the overall length of the vessel was usually determined by the size of the trunks available to the carpenters, and this could reach 25 metres (Scott, 1981: 4).

Alcina describes the *caracoa*, the indigenous fighting vessel, as closely resembling the brigantines of Spain, although (the *caracoa*) was larger in size due to the outriggers, paddling seats on the outrigger booms and the fighting platforms, which were features of the *caracoa*. He suggested that «For these islands they are the best ships or vessels and the most suitable for war fleets. These people used them in ancient times when, as infidels, they went out to plunder other enemy islands...» (Alcina, 2005 [1668]: 207).

The Tool Kit

The indigenous set of tools included a range of axes, adzes, drills and other hand tools, which were manufactured from polished stone, shells and from copper and iron. According to Alcina (2005 [1668]: 165-167) the straight adze was called the *daldag* and the twisted adze was called the *bintung*. The *lukub* was a spoon bit which served as an augur or gouge. The mallet, or

pakang, was used with the *lukub* as a kind of chisel. The saw was not in use, although it had been known and used by the Chinese for many centuries (Horridge, 1978: 46). As the strakes were carved to the appropriate curvature neither heat nor steam were needed to fit them to the hull.

The Timber, Cordage and Sails

The Philippines was heavily wooded and had a wide range of hard wood timber suitable for boat building. There are estimated to be over 3 000 species in the islands and 665 valuable timber species were listed in an early American source (Ahern, 1901: 12). In the recent excavations of the Butuan site in Mindanao some ten species used in the pre-colonial vessels have been identified (Ligaya Lacsina, personal communication). *Lauan* (or *la-wan* or *lawaan*) is reported to be the preferred timber for both log boats and plank built boats, but this generic name covers a variety of species in the genus *Shorea* (Scott, 1981: 11-12). The cordage used in the indigenous boats for running rigging was the fibre of *cabo negro*, known as the sugar palm (*arenga pinnata*). (Fig. 1) This tree is called *kaong* in Tagalog and *bidiok* in the Bicol region. Sails were originally formed of woven mats made of *buri*, *gaong*, *nipa* or *pandanus* leaves (Scott, 1981: 16) (Hiquily *et alii*, 2009: 1). De Morga reports that they had already adopted cotton canvas sails in local craft (Morga, 1971: 252). Cotton was certainly grown in Luzon before the colonial settlement, but it is not clear when it was adopted for sailcloth (Reid, 1988: 90).



Figure 1. Cabo negro fibre (Photo: M. R. Stead).

Spanish Ship Building

The Spanish colonialists continued to build ships and boats in the traditional style, with minor modifications, as recorded by Alcina, as they were particularly fast and suited to local conditions, especially with the numerous shallow coral reefs (Alcina, 2005 [1668]: 207). In the original account of the 1521 visit of Magellan by Pigafetta, the indigenous *balangay* boat had been compared with the *fusta*, a light galley used by the Spanish in the Mediterranean (Stanley, 1874: 78). According to Alcina these craft became heavier when built by the Spanish, and they then found it difficult to catch similar vessels built with the traditional lightness by the Moslems (Alcina, 2005 [1668]: 207).

The Galleon Trade

The trading lifeline of the Spanish colony was the long-distance route to Acapulco in Mexico, which commenced at the founding of the colony. This was a distance of some 8000 to 9000 nautical miles across the Pacific, the longest trade route in history. This regular trade continued for 250 years from 1565 until 1815. The main cargo was an exchange of exotic goods from China, especially silk, with silver from Peru and Mexico. Other cargo included spices from Southeast Asia, textiles from India and jewellery from South Asia (Fish, 2011: 93-101). The route from Acapulco used the NE Trade winds around 13° north of the equator. The return route was further north, beyond 30°, in order to pick up the westerly winds and the favourable currents. The route

in and out of the Philippines was usually through the San Bernardino Straits and the Visayan Islands. The ships from Manila usually sailed in June or July whilst the ships from Acapulco normally departed in March (Schurz, 1959: 216-250). The usual pattern was for one to four vessels to sail each season in each direction. The usual size of these galleons was up to 2000 tons, up to 200 ft in length and up to 50 ft on the beam (Fish, 2011: 156-162). For most of this period these were the largest and most sophisticated vessels used for trade in the world.

The challenges of this voyage were mostly due to the rigours of the voyage, such as typhoons, storms and the lengthy passage, although the galleons were occasionally subject to hostile attack. The galleons were not as well armed as the Atlantic fleets, as there was much less chance of being attacked in the Pacific, and they were occasionally caught unprepared to defend themselves. The total number of voyages is unclear but Fish has tabulated more than a hundred sailings from Manila to Acapulco and some 26 vessels were lost by shipwreck (Fish, 2011: 492-523). Four ships were captured by the British in 1587, 1709, 1743 and 1762. The British also occupied Manila from 1762 to 1764, but the control of Spain was restored by the Treaty of Paris 1763 (Fish, 2003: 169). Despite a number of attacks by the Dutch they never managed to capture a galleon between Manila and Acapulco, nor did they manage to capture Manila.

Spanish Shipyards in the Philippines

The Spanish began to repair Spanish ships on the beaches of the Philippines immediately after their initial settlement and to build vessels in European styles. Apart from the difference in size, the galleons used a different technology from the traditional Philippine boats. They were built using frame first construction and massive timber components joined by metal fastenings and fittings. Apart from the timber used they were similar in style to those built in Spain. The Spanish also introduced a new toolkit, particularly the saw, but also equipment to fit the metal fastenings in the hull.



Figure 2. Shipyard at Cavite in the Nineteenth Century.

in Asia, including one in Thailand and one in Japan, but the great majority were constructed in the Philippines (Pineda, 1904 [1619]: 169-188). In 1679 an order was given for all future ships for the Manila-Acapulco trade to be constructed in the Philippines (Schurz, 1959: 196).

A key factor in the preference for Filipino yards was that the cost of construction was generally much cheaper than in European and Mexican yards due to the lower cost of labour and materials.

Shipyards were constructed at a number of locations, especially at Cavite near Manila (Fig. 2). Cavite was the port for servicing the galleons and was a protected anchorage close to Manila, where they could be loaded and unloaded (Morga, 1971 [1609]: 254). However the location of these yards was based on the availability of materials, especially timber, and a local labour force. A sheltered suitable beach was also a key requirement. Pineda refers to galleons having been constructed in Marinduque, Mindoro, Masbate and Camarines (Pineda, 1904 [1619]: 174). A few of the galleons were built in Mexico and in locations

Filipino Manpower

The Spanish settlers were very limited in numbers and the defence and viability of the colony and the development of the trade network was very dependent on the use of Filipino labour. The indigenous population was never very large and the traditional raiding activity in the islands was often in the form of slaving expeditions. Whilst the population evidence is thin, there is little sign of a collapse in local population as had been the case in much of the Americas. The Filipinos had enjoyed earlier trade contacts with the Eurasian landmass and were not so vulnerable to imported disease. The only time the colonial population appears to have been under pressure was during the Dutch wars, when much of the burden fell on the Filipinos (Peterson, 2011: 8).

The ship building industry required large numbers of Filipino workers. Massive amounts of labour were needed for cutting and transporting the timber needed for the ships, estimated as 2000 trees per galleon (Fish, 2011: 129). The construction also required an extensive labour force in the yards and forced labour was used, although the labourers were usually paid. In addition many skilled tradesmen were needed, who were frequently drawn from the Chinese artisans who had settled in the Philippines. Pineda refers to four categories of labour from the wood cutters and labourers, to tradesmen, smiths and masters. These had very different wages and terms and conditions based on their levels of skill (Pineda, 1904 [1619]: 174).

Filipino carpenters showed themselves as well-skilled and eager to learn and the local master carpenters or *panday* were sometimes given important supervisory posts in the yards. Alcina records two such *panday*, Figuman and Francisco Polacay, who were used as well-paid supervisors in Spanish shipyards (Alcina, 2005 [1668]: 209) This was impressive evidence of their competence as the Spanish galleon of the period was the most complicated piece of technology in the world at that time (Dizon, 2012: 71-73).

The Filipinos were also called upon to provide a high percentage of the crew for the galleons. The Spanish usually worked on the assumption that Filipinos were experienced seamen. The enthusiastic judgement of Francisco Leandro de Viana in the eighteenth century reflects this view. «There is not an Indian in these islands who has not a remarkable inclination for the sea; nor is there present in all the world a people more agile in manoeuvres on shipboard, or who learn so quickly nautical terms and whatever, in the presence of the Spaniard they show him great respect; but can teach many of the Spanish mariners who sail in these seas... these are a people most situated for the sea; and if the ships are manned with crews one-third Spaniards and the other two thirds Indians, the best mariners of these islands can be obtained, and many of them can be employed in our warships. There is hardly an Indian who has sailed the seas who does not understand the mariner's compass, and therefore on this trade route there are some very skilful and dexterous helmsmen» (Viana, 1907 [1765]: 301). Despite the skills of the Filipinos, they were usually rated as common seamen and suffered lower wages and worse food than Spaniards. They were particularly susceptible to the cold weather in the higher latitudes of which they had little experience (Schurz, 1959: 210-212). Pineda refers to seventy five Filipino crew employed on the *Espiritu Santo* (Pineda, 1904 [1619]: 184). However Pineda complains about the tendency of the Filipinos to desert in Mexico which led to the creation of local Filipino communities in the Americas and a shortage of crews for the next trip to Manila.

Raw Materials

The success of the ship building boom was due to the quality of the resources available in the Philippines. At the time of the colonial settlement the Philippines had extensive reserves of native forests with a wide range of high quality tropical hardwoods. De Morga commented «This

wood is suitable for houses and buildings as well as for constructing large or small boats. There are in addition many stout, straight trees which are also light and pliant and can be used for making masts for ships or galleons. Thus any sort of vessel may be fitted with a mast made from a single trunk from one of these trees without there being any need for splicing or fishing; or to make them up from different pieces. For the hulls of ships, for keels, futtock and top-timbers, and any other kind of futtocks, breasthooks, pueras, transoms, llaves and rudders, all sorts of good timber can easily be found» (Morga, 1971 [1609]: 253-254). There is no doubt that the Philippines were better stocked with quality timber than Mexico or Spain. For the construction of galleons the preferred wood was *molave* (*vitex littoralis*), noted for its durability and resistance to decay, but relatively easy to work when freshly cut (Ahern, 1901: 69-71). Wooden strakes of *molave* were even resistant to cannon balls. It was labelled by Ahern as «Queen of the Woods». Teak (*tectona grandis*), known in the Philippines as *teca*, was found principally in the Visayas islands but was not so common as in Thailand, Burma or India. Teak was particularly suitable for decking (Ahern, 1901: 86). *Yakal* (*dipterocarpus plagatus*), also known as *lanang*, was used for strakes (Schurz, 1959: 196). Other favoured woods were *mangachapuy* (*vatica apterantha*), and *dungon* (*sterculia nobilis*). *Guijo* (*shorea guiso*), was used widely for keels. Resistance to ship worm was a key attribute as it was voracious in the islands. *Banabá* (*lagerstraemia speciosa*) and *laguan* (probably a kind of *shorea*) were recommended by Pineda for this reason (Pineda, 1904 [1619]: 172-173). In practice there was a wide range of suitable hardwoods and there is often confusion between them due to the number of local names in different dialects. This may be the background to the comment of Alcina in the title of this paper that the Visayan Indians were just as effective as the Spaniards in selecting and working the timbers for the ships.

Iron was usually imported from China and Japan and forged by local or Chinese smiths in the Philippines. Pineda recommends that some of the key fittings would be stronger if using iron imported from Spain (Pineda, 1904 [1619]: 176). Pineda also recommends using lead sheathing for the hull to protect it from marine growth and ship worm.

The Spanish produced canvas made from cotton in the Philippines. The traditional fabric, *abel*, from the Ilocos region predated the colonial settlement and is associated with the sails of galleons (Enriquez, 2012). This contrasts with the use of hemp to weave canvas sails in early China or the use of flax in Europe.

Cordage was produced using *abacá*, which became known as Manila hemp. *Abacá* (*musa textilis*) is a relative of the banana family and is native to the Philippines. It is particularly found in Bicol in southern Luzon. This fibre was used in pre-colonial society to produce coarse fabric. Manila rope has some special features; it gives a firm grip with very little stretch, knots hold well and will not slide, it has a natural light tan colour and the tensile strength is stronger than sisal rope (Becker/Appel, 1933: 811). According to Pineda *cabo negro* was still used for less critical rigging (Pineda, 1904 [1619]: 175).

The most common caulking material appears to have been coconut fibre treated with oil from the *pili* tree (*canarium ovatum*) which is native to the Bicol region, where many of the galleons were built (Fish, 2003: 237).

In general the quality of materials was superior in the Philippines to those available in Mexico and Spain and this was a key factor in the strength of the vessels and the success of the galleon trade over a particularly difficult long-distance voyage.

The San Diego

The continuing threat from European rivals such as the Portuguese and the Dutch, as well as the danger of raids from Chinese and Japanese ships, led to the construction of trading ships which could be adapted for naval purposes. One local trading vessel built to a Spanish design was the *San Diego*. This was a *patache*, used for inter-island trading. The vessel had been built in a yard on Cebu in 1590 and had a hull length of 57 feet (rather larger than the usual *patache*). When the Dutchman, Oliver Van Noort, blockaded Manila in 1600 this vessel was pressed into service. It sank whilst attacking the Dutch fleet south of Manila, perhaps partly as a result of overloading the vessel (Fish, 2011: 219-248). The wreck was excavated in the 1990s by a joint expedition of the National Museum and the Frank Goddio organisation. The artefacts from this wreck are on display at the National Museum in Manila. As a portion of the hull survived there are a number of clues to the construction process. A total of ten timber different native Philippine trees were used especially *bitaog* known in English as Indian laurel (*calophyllum inophyllum*) and referred to by Pineda as *palo maria*. This was used for the keel and much of the planking. The keelson was of *calumpit* (*terminalia edulis*). The rudder was carved in *betis* (*azaola betis*) another timber reputed to resist shipworm. Some of the stringers were identified as *apiton* (*dipterocarpus grandifloras*) (Ahern, 1901: 22, 36, 37, 41). The caulking was coconut fibre impregnated with the oil of the pili nut tree, as described above.

Interchange of Boat Building Expertise

The shipyards eventually began to produce vessels which combined the Filipino, Chinese and European styles of ship construction. An example of this was the *lorcha*, which combined a European style hull with Chinese-style batten sales and appears to have been developed initially on the Chinese coast. It is mentioned by de Morga as in use on the Chinese coast (Morga, 1971 [1609]: 137).

Conclusion

The success of the galleon trade owed much to the quality of marine raw materials developed in the Philippines and skills of the Filipinos in building, repairing and crewing the ships. Spanish manpower remained very limited in the Philippines and without the use of the Philippines as a shipyard and home port of the galleons, it is difficult to see how the trade route to Mexico could have been maintained with such regularity over its extended life of two hundred and fifty years.

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Manila Galleon: an example of imperial logistics and control in the sixteenth and seventeenth centuries

Galeón de Manila: un ejemplo de la logística y el control imperiales en los siglos XVI y XVII

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Abstract: The Manila Galleon trade 1571-1815, linking Asia, the Americas and Europe was pivotal in the development of world economic and cultural history. Systematic trans-Pacific shipment of goods, mainly via the ports of Fujian province in China to Manila, from there to Acapulco for onward transmission via Veracruz to Seville and Cadiz, gave shape to the notion of globalization of trade in the early modern period; it changed European and New World taste. The Chinese, with their appetite for silver, were the driving force and the New World silver gave enormous impetus in the late Ming (1368-1644) to the production and marketing of their sophisticated manufactured goods – especially silk and ceramics. The trade also represented a triumph of colonial Spanish logistics in navigation, shipbuilding, coordination of transport by land and sea, mining, production and distribution, mobilization and management of manpower, and hydraulic engineering.

Key words: Silver, silk, logistics, Sangleys, Potosí.

Resumen: el comercio del Galeón de Manila (1571-1815), que vinculaba Asia, las Américas y Europa desempeñó un papel central en el desarrollo de la historia económica y cultural del mundo. El intercambio trans-Pacífico sistemático de mercancías, principalmente desde los puertos de la provincia de Fujian en China a Manila y de allí a Acapulco pasando por Veracruz con destino a Sevilla y Cádiz, dio forma al concepto de la globalización del comercio en el periodo moderno temprano, transformando el gusto en Europa y en el Nuevo Mundo. Los chinos, con su anhelo por la plata, constituyeron la fuerza motriz y la plata del Nuevo Mundo dio un enorme impulso en el periodo tardío de la dinastía Ming (1368-1644) a la producción y comercialización de sus manufacturas sofisticadas, especialmente seda y cerámica. El comercio constituyó también un triunfo de la logística colonial española en navegación, construcción naval, coordinación de transportes terrestres y marítimos, minería e ingeniería hidráulica.

Palabras clave: plata, seda, logística, Sangleyes, Potosí.

When the Spaniards arrived in Manila in 1571 they encountered something new in their colonial experience: the presence of non-indigenous people of another powerful empire – the Chinese. From small numbers this presence would rapidly increase in size and economic importance. Soon vastly outnumbering the Spaniards themselves, the Chinese became a vital if mistrusted and resented presence. This difficult relationship lay nonetheless at the very heart of the Manila Galleon trade. Without it the trade would not have happened.

I also comment on the astonishing logistical achievements of the Spaniards. This brief survey will go from the seabed via the shipyards of Cavite up to more than 4000 m above sea-level.

So two empires: both sophisticated, organized societies, articulate in administrative method and artistic expression. Coincidentally, both had a history of silk manufacture and exporting high quality ceramics (though not porcelain in the case of the Spaniards).

But in the context of the Manila Galleon it is no longer possible to talk about two empires. The Sino-Hispanic relationship was asymmetric. No direct relations Beijing-Madrid, despite proposals for embassies to the Wanli emperor, never carried out.

The Spanish were state-sponsored, hands-on managers, proselytizers, empire builders. The Beijing government remained aloof, leaving things to the privateer traders mainly of Fujian province.



Figure 1. 16th century Chinese silk made for the Iberian market (Metropolitan Museum of New York).



Figure 2. Chinese porcelain wine ewer Ming Dynasty (Wanli Emperor 1572-1620) British Museum.

Figures 1 and 2 offer examples of the type of high quality Chinese goods which could be traded via the galleon: silk and porcelain. It also illustrates the asymmetry of the relationship: a double-headed eagle, an official symbol of the Habsburgs and a porcelain trade item, rather than the Chinese imperial symbol of, say, five-clawed dragon. (The collection of Philip II contained a porcelain item identical to that shown here.)

The trans-Pacific trade from Manila to Acapulco and return was a turning point in world economic history; it initiated truly intercontinental trade linking Asia, the Americas and Europe. This trade, based largely but not exclusively on the exchange of American silver for Chinese silk, would last nearly 250 years from 1571 to 1815, despite colossal physical and political odds against. Imagine one sea, one vast ocean a land crossing plus another ocean, against a background of persistent and vociferous peninsular protectionism.

To finance the trade Spain had already invented a new currency, the famous «pieces of eight» (pesos de a ocho reales), the most widely accepted international currency – the US dollar of its day.

But China's role as a major international trading partner did not start with the galleon trade. There are a number of wrecks as well as documentary evidence to confirm that China had been an active trader at least since the Han dynasty (206 BC-220 AD). Fast forwarding to the Tang dynasty (618-907) the Belitung wreck gives an illustration of the sheer scale of China's mass production and distributive machine: 56 500 pieces of stoneware from the Changsha kilns in Hunan province, as well as other finer pieces from a variety of kilns widespread over different areas of China.

In terms of documentary evidence I fast forward again some 800 years to draw particular attention to a remarkable rediscovery of fairly recent date: the Selden map of China in the Bodleian Library in Oxford.

This remarkable watercolour map dates to about 1620 when the Manila galleon trade was in full swing. Who painted it; who commissioned it etc. remain a mystery.

Figure 3 is the author's sketch version intended to show more clearly one of the map's most striking features: the fact that it made maritime trade routes, with their Chinese compass bearings, its primary focus – interesting, when for much of the Ming dynasty private overseas trade was officially prohibited. The map also shows familiarity with a number of port towns on the west coast of Luzon, not marked on my sketch. I suggest that the map with its carefully plotted sea routes may have an underwater archaeology potential.

Into this world criss-crossed with Chinese trade goods sailed the Spaniards: they were the newcomers – their maritime empire was not yet 80 years old compared with centuries old maritime traders of China. Now the Chinese were looking for silver and in a big way.

Many Chinese took up residence in the Philippines where they were known as Sangleyes, a corruption of a Chinese expression which the Spaniards seem to have taken from the indigenous Filipinos. The Sangleyes soon played a dominant role in Manila's domestic economy. They were versatile and industrious; they dominated local economic activity – making every conceivable product from strictly utilitarian to purely decorative; they even made bread, hardly a staple in the Chinese diet, but they made it for the Spaniards. They provided loans and financial donations. It was their products which also dominated the external economy via the Manila galleon.

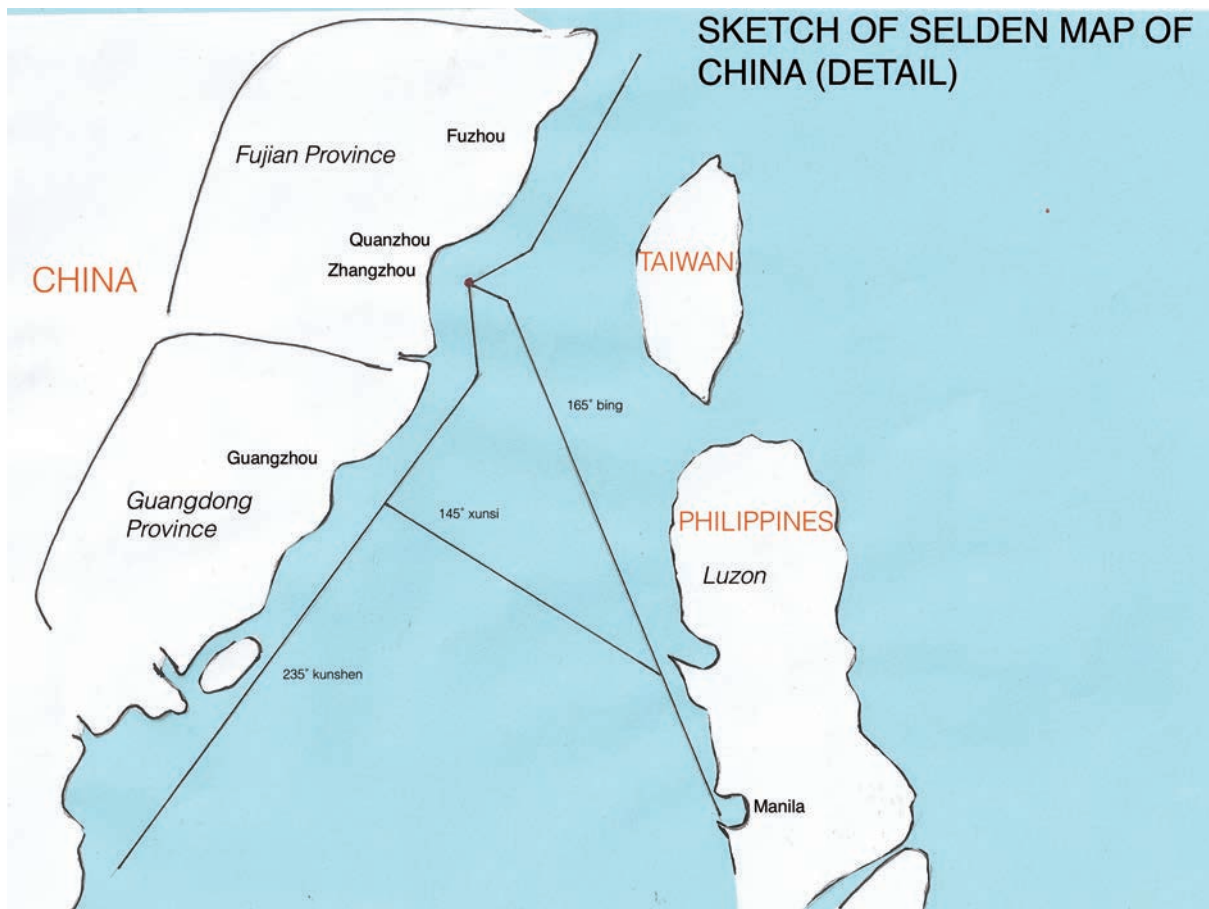


Figure 3. Sketch version of Selden Map of China (detail) showing maritime trade routes with Chinese compass bearings.

Though in a minority compared with the native Filipino population Chinese far outnumbered the Spanish colonial power. In 1620: 2400 Spaniards v. 16 000 Chinese –a simple demographic reality which preyed on Spanish feelings of insecurity, and periodically spiralled into genocidal violence (1603, 1639, 1662) and expulsion in 1755.

Despite these tragic setbacks this European and Chinese relationship between two peoples as culturally and ethnically diverse as it is possible to imagine would last some 300 years. But, it was obvious that the usual Spanish colonial methods such as the quixotic *requerimiento* and *encomienda* would not work with the Chinese as they had for the indigenous populations in the Philippines and the Americas.

The three main methods of imperial containment as regards the Chinese in the Philippines, were: residence permits at eight pesos per person (scope for official corruption); the Parián, a Chinese *barrio* set apart from Spanish Manila officially established (in 1580) –a Chinatown buzzing with commerce and small manufactures, but a ghetto all the same and a predominantly male ghetto– hardly a recipe for stability; and the *pancada*, a system of collective purchasing so that the Chinese would not be able to play off their Spanish customers one against the other. This would be discontinued after less than a hundred years, though the Parián continued. The Sangleyes enjoyed some degree of autonomy: their own mayor (a Christian Chinese) but a Spanish governor and frequent Spanish interference.

Abiding mutual mistrust and unrest led to massacres of the Sangleyes. It would be cynical to describe this as a technique of colonial control, but it was a sad reality.

Expulsion was much discussed. But the expulsion of non-Christian Chinese finally ordered in 1686 was implemented only in 1755 – an indication of the ambivalence of colonial policy.

But whatever their nature formal structures of colonial control are no guide to reality. There was hardly a law or requirement which was systematically enforced. Bribery and corruption were rife among both Spaniards and Chinese. Viceroys used considerable discretion in implementing their instructions.

The whole revolved round the principle of *obedezco pero no cumplo*, obedience without compliance.

In 1586 Viceroy Villamanrique of Mexico, when requested to put an end to the China/Manila trade in response to the protectionism of Seville said, «I have seen fit to disregard your Majesty's orders, until you direct me further». Success in conversions to Christianity, he argued, would be undermined, maintaining the trade was a way of retaining influence over the Chinese who would otherwise resume their heretical and evil practices. How could such an argument not appeal to the ultra devout Philip?

Customs regulations were not enforced and attempts by Crown officials to do so were resounding failures. They wanted nothing more than to enforce customs inspection of consignments, instead of merely relying on the word of a «gentleman» and his *factura jurada*. Failure to implement customs inspection, however, suited both colonial merchants and the Sangleyes.

The *San Diego*, sunk in 1600 in action against the Dutch, investigated by Franck Goddio and his team, seems to reveal yet another example of the evasion of the law. Quite apart from the valuable detail it provides about life on the Manila Galleon at the dawn of the seventeenth century, it seems also to show that the galleon was built in flagrant disregard for the maximum permitted tonnage at that time of 300 tons. Michel L'Hour's careful argument points to about double that limit. *San Diego* was by no means the only example of a vessel whose tonnage was well in excess in the prescribed limits.

I have described the Spaniards as newcomers, but how quickly they adapted to the reality of managing a distant outpost of empire. Two areas of logistical achievement stand out: shipbuilding and silver mining and refining.

A major shipbuilding industry came to be based in the Philippines mainly in Cavite (Manila), but there were other shipyards in the islands. Supplies of timber and labour were cheap but a major effort of coordination was needed: selecting and felling the timber in the forest, transporting it to the yards, instructing and overseeing the carpenters, sailmakers, caulkers and the rest, through to the final fitting out and manning. Construction of the galleons, the Boeings or Airbus of their time, represented an astonishing achievement. It consumed almost a third of annual expenditure of the Philippines. The Philippine yards evidently turned out a good product. In 1602 the Tokugawa Shogun, Ieyasu, made a formal request to the Spaniards of Manila to send their master tradesmen and workmen to build ships in Japan. Spain declined.

The Englishman, Woodes Rogers, who captured the *Nuestra Señora de la Encarnación* in 1709 observed that «few of our shot entered her side to any purpose». Shipbuilding came also of course at an enormous human cost, as a result of the *corvée* system of forced labour known as the *polo*.

So too did silver mining, especially in the viceroyalty of Peru. As chance would have it, the founding of Manila in 1571, roughly coincided with an exponential increase in the production of silver in Potosí, present day Bolivia, as well as the considerable output of Mexican mines. Potosí production increased fourfold from 200 000 marks or 50 000 kg in the 5-year period ending in 1575, to 212 000 kg a decade later.

What caused this upsurge in supply? Two factors: mercury and manpower.

It was the successful introduction into Peru of the mercury amalgamation process, enabling silver to be refined using lower grade ore and at much lower temperature. This required hydraulic power and heavy machinery to crush the ore to a fine powder. The solution? Just construct some thirty-two reservoirs and dams, with their conduits, aqueducts, tunnels, channels and bridges etc. at altitudes more than 4000 m above sea level to do the job. One of the great logistical achievements of the whole Spanish colonial period. Figure 4 reproduces a detail of a mid-eighteenth century painting showing some of these reservoirs and dams.

The second factor, labour, was provided by adapting the Inca and pre-Inca *corvée* system, the *m'ita*. Every year one seventh of the male population between 18-50 from a wide catchment area was required to spend a year in Potosí in mining and refining work. The same system was used for Huancavelica where the mercury was mined.



Figure 4. Painting by Gaspar Miguel de Berrío, 1758 showing a number of the dams and reservoirs, including no. 36 San Ildefonso, Museo Universitario de Charcas, Sucre, Bolivia.

The key product mercury, a crown monopoly, had to be brought in – by llama and mule train from «nearby» Huancavelica (1200 kilometres as the crow flies) initially via Cuzco and Oruro, or later by sea from Chíncha to Arica and then back up from the coast to Potosí (640 km). The silver would then do a similar journey back to Callao and on to Panama under naval protection of the Armada del Mar del Sur. A further dimension to the logistical achievement.



Figure 5. Sketch map linking Huancavelica, Chíncha, Arica, Potosí.

But, supplies of every kind needed to be brought from long distances to Potosí, at 160 000 in 1650, one of the world's biggest cities.

These great infrastructure projects with their need for labour on a vast scale provided the Spaniards with a means, if brutal, of colonial control both social and economic. Logistical genius and tenacity.

There were however some catastrophic setbacks:

- The most important dam, San Ildefonso, burst in 1626, wiping out in two hours 50 years of effort and destroying life and infrastructure.
- Mid 17th century fraud and malpractice was exposed at the Potosí mint.
- On the galleons, there was a 30%-40% death rate on the Manila-Acapulco leg, one of the most gruelling sea voyages imaginable.
- *San Diego* was a scandal in several respects.
- Manila Chinese were massacred in their thousands and expelled in 1755 (they always recovered).
- Persistent peninsular protectionism: a whole succession of restrictions and prohibitions were decreed, implemented (or not).
- It survived nearly 250 years – still the longest lasting «shipping line» known.



Figure 6. Underglaze cobalt blue and white octagonal box and lid Jiajing reign (1522-1566) and mark, Victoria and Albert Museum.

Possible areas for further research:

- Organization and coordination of Manila trade within China including maritime and inland waterway transport.
- Chinese shipyards.
- Philippine shipyards – cf. Patrick Lizé's findings in the Seville archives.
- Kari Kari reservoirs – Inca influence? The Spanish inherited water management skills from Roman and later Muslim presence. But, is it also possible that construction of the 32 lakes reveals some Inca influence?

To conclude, I have chosen to highlight another piece of high quality porcelain. We cannot know for certain whether this piece came to Europe via the galleon. See figure 6. But, again, a very similar piece was catalogued in the collection of Philip II.

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La Nao de China, puente artístico entre Oriente y Occidente

The China Ship, artistic bridge between East and West

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Resumen: las mercancías procedentes de Asia, a través de la línea transpacífica del Galeón de Manila entre finales del siglo XVI y el siglo XIX son las que centran nuestra atención en este estudio. Los galeones llevaban una gama completa de productos orientales como biombos y lacas japonesas, marfiles, abanicos, porcelana, telas de seda china, muebles (sillas, cofres) y materias primas de Filipinas, como la canela de Mindanao. Pero lo más importante de esta ruta es que el papel de los artesanos novohispanos no era pasivo. Ellos interpretaron las influencias asiáticas en la producción de sus propios biombos, cerámica y objetos lacados, así como en pinturas con incrustaciones de madreperla, conocida hoy como *enconchados*. Analizaremos estas piezas a través de algunos ejemplos extraídos de los registros de embarque de los galeones, así como de testamentos singulares.

Palabras clave: globalización, Filipinas, México, Galeón de Manila, patrimonio.

Abstract: The goods arriving from Asia, through the Manila Galleon transpacific line between the late sixteenth and the nineteenth century are those that focus our attention on this study. The galleons carried a full range of oriental products like screens and Japanese lacquers, ivories, fans, porcelain and Chinese silk fabrics, furniture (chairs, chests) and Philippine raw materials such as cinnamon Mindanao. But the most important thing in this route was that the role of New Spanish craftsmen was not passive. They reworked Asian influence into its own distinctive production of holding screen, ceramic and lacquer objects, and the paintings on wood inlaid with mother-of-pearl known today as *enconchados*. We will analyze these products through some examples extracted from the records of shipment of the galleons and singular wills.

Key words: Globalization, Philippines, Mexico, Manila Galleon, heritage.

«[...] Y de las Filipinas vienen todos los años tres o cuatro galeones cargados de ropa de algodón, terciopelo, tafetanes, vasos, damascos y mucha seda blanca [oro y pedrería]»
(Jaque, 2008: 60-61).

La Nao de China. 1565-1815¹

A partir del descubrimiento de América, la monarquía española estableció los organismos de control necesarios para supervisar la situación económica del nuevo continente, la Casa de la Contratación y el Consejo de Indias. Ambas instituciones no solo tramitarían asuntos propios de la conocida como Carrera de Indias sino que sus funciones trascenderían el marco inicial establecido en sus disposiciones fundacionales, debido a la expansión hispana hacia las Indias Orientales.

Por tanto, la Carrera de Indias, pronto se vería implementada gracias al descubrimiento de Filipinas. Esta ruta estaba conformada con dos flotas distintas anuales. Una con rumbo a Nueva España con destino final Veracruz, haciendo escalas en San Juan de Puerto Rico, Santo Domingo y Santiago de Cuba y otra rumbo a Tierra Firme con destino final en Nombre de Dios, sustituida desde el siglo XVII por Portobelo, en el istmo de Panamá, con escala en Cartagena de Indias. Ambos convoyes después de invernar en Indias se reunían en el puerto de La Habana en primavera para una vez juntos emprender su regreso a la Península.

Paralelamente, Miguel López de Legazpi, el 21 de noviembre de 1564 partía del puerto de Barra de Navidad, en el estado de Jalisco, México, para establecer el viaje de tornavuelta desde las islas Filipinas hacia Nueva España y la metrópoli. Años antes, en 1521, Fernando de Magallanes había conseguido arribar al archipiélago filipino, llegando a la isla de Cebú, aunque desgraciadamente nunca regresó de su heroica hazaña al ser ajusticiado por el líder de la isla cebuana de Mactán, Lapu-Lapu, dejándole sin alcanzar el deseo de completar el primer viaje alrededor del mundo, reservado para Juan Sebastián Elcano, quién tomó el relevo de la expedición y regresó a Sanlúcar de Barrameda en 1522 con una tripulación muy mermada. El reto de Legazpi era descubrir ese itinerario de tornavuelta directo a Nueva España, labor que le sería encomendada a Andrés de Urdaneta. Hombre experimentado, ya que se enroló en la expedición de García Jofré de Loaísa en 1525 junto a Juan Sebastián Elcano, cuando era un joven soldado y partió en la expedición de Legazpi como misionero agustino. Urdaneta fue, por tanto, el encargado de trazar la línea marítima más directa desde Filipinas hacia Nueva España, zarpó del archipiélago en 1565 y puso rumbo hacia el paralelo 40 donde gracias a la corriente de Kuro Siwo en Japón les condujo hacia el cabo Mendocino, en California, desde donde bordearon la costa hasta Acapulco, donde llegó tras cuatro meses de travesía.

El establecimiento de esta ruta marítima desde 1565 hasta 1815, haría que los barcos que la realizaban se conocieran como Galeón de Manila, Nao de China o Galeón de Acapulco, en definitiva un itinerario transpacífico que permitía unir el archipiélago filipino con Nueva España de una manera directa. Las mercaderías asiáticas, ampliamente valoradas en los mercados europeos y novohispanos llegaban al puerto de Acapulco, consagrado este como clave en la ruta por tener mejores condiciones de fondeo que Barra de Navidad. El fondeadero guerrerense se convertía en espacio de intercambio comercial gracias a su feria anual, momento en el que los comerciantes mexicanos y peruanos principalmente, aprovechaban para abastecerse de los pro-

¹ Para el estudio del Galeón de Manila (Yuste, 1984; Schurz, 1992; Yuste, 2007).

ductos orientales, y distribuirlos vía terrestre hasta México y de allí a Veracruz, para tomar nuevamente la vía marítima de la Carrera de Indias, con destino a España. Esta no comercializaría directamente con Filipinas hasta el siglo XVIII a partir de la creación de la Real Compañía de Filipinas, impulsada por el rey Carlos III, respondiendo a sus planes científicos, comerciales y de prestigio social, y siguiendo en parte los modelos que Holanda, Inglaterra y Francia habían creado con anterioridad. La Compañía abriría una ruta directa Manila-Cádiz a través del cabo de Buena Esperanza o el cabo de Hornos, modificando sustancialmente la ruta del Galeón de Manila.

En 1813, las Cortes de Cádiz decidieron suprimir el comercio con Acapulco. Esto, sumado al proceso de Independencia de México, provocó que este itinerario quedara mermado, aunque la circulación artística perduró con navíos particulares, continuando gracias a la apertura del Canal de Suez en 1869 décadas más tarde, asunto que se excluye del ámbito cronológico que tratamos.

Mercaderías «de la China»

Esta línea transpacífica transportó en las bodegas de sus embarcaciones delicadas piezas procedentes de Asia con destino a los puertos novohispanos y españoles, invirtiéndose la procedencia de los productos manufacturados que se cargaban en su regreso a Cavite (Ruiz, 2005). Aunque hay que tener en cuenta que el creciente gusto de mercaderías «de China» que se refleja en los inventarios particulares así como en los libros de sobordo, hay que tomarlos con cierta cautela, ya que este concepto comprendía un comercio global con el continente asiático. No solo se trataba pues de piezas procedentes de este país, sino que también se singularizaban ejemplos, como objetos de Japón, siendo en su gran mayoría registros de piezas anotadas como «de la China».

La situación estratégica de Filipinas en este entramado comercial repercutió en el enriquecimiento cultural, no solo del archipiélago sino de todos los territorios implicados, estableciéndose una red de contactos artísticos que dio como fruto la creación de obras de arte intrínsecamente ligadas a este itinerario transpacífico. Destacan las piezas de origen asiático, fundamentalmente porcelanas, sedas y abanicos chinos (Zhiyan/Wen, 1994; Feng, 1998: 98-102); quimonos, porcelanas y lacas japonesas (Okamoto, 1972; Nagashima, 2009: 107-118); y tejidos naturales, como la fibra de Abacá, objetos de oro y esculturas de Filipinas (Casal *et alii*, 1981), teniendo un papel primordial la eboraria con respecto a las tallas en madera, piezas estas últimas más comunes durante la etapa prehispánica (Ruiz, 2012a).

El inicio de la ruta del Galeón de Manila supuso no solo un estímulo económico y cultural para las islas sino una excelente vía para el proceso de evangelización del territorio que llevaron a cabo distintas órdenes religiosas, y que previamente habían experimentado en el virreinato de Nueva España. Como consecuencia del progresivo asentamiento de los religiosos españoles en Filipinas, se inició la edificación de parroquias a las que debían de dotar de los bienes muebles litúrgicos apropiados para las celebraciones religiosas, al igual que las que poseían en la metrópoli. Los lujosos interiores de las iglesias filipinas se han visto mermados desde su construcción por los avatares medioambientales e históricos, pero afortunadamente nos quedan los documentos que reflejan la suntuosidad del patrimonio eclesiástico, repleto de conjuntos de orfebrería, ternos bordados de seda, esculturas de marfil, mobiliario y esculturas de maderas nobles, pinturas, atriles y arquetas namban procedentes de Japón, entre otros. Un ejemplo es el de las alhajas y ornamentos de la parroquia del pueblo de Santa Ana, que anota en su visita el arzobispo de Manila, señor doctor D. Manuel Antonio Roxo del Río y Vieyra en 1776, donde se ve plasmada la riqueza de estos ornamentos litúrgicos:

«Un abito de Pequín con una Capilla y sobre pellen, Mitra, y capa blanca, un quimon, un retablo con dos nichos el uno Una Imagen de N.S. Ana y en el otro la Imagen de una Señora con cara y manos de Marfil, un tabernáculo con una Imagen del Santo Eccehomo de medio Cuerpo, un copón de plata con su tapadera del mismo»².

De tal modo que para satisfacer las necesidades de los religiosos, los artesanos principalmente chinos, conocidos como sangleyes, comenzaron a realizar las piezas vinculadas a la eboraria, orfebrería y tejidos bordados con sedas chinas. Todo hecho al gusto europeo inspirado en modelos que llevaron los españoles pero con reminiscencias orientales propias de los autores de las mismas. Con el propósito de que todos ellos tuvieran un albergue definitivo y no anduvieran dispersos por la ciudad, el gobernador Gonzalo Ronquillo Peñalosa ordenó en 1581 construir una alcaicería o parían. Dicha jurisdicción o barrio se ubicó dentro de la ciudad, y en él quedaron concentradas las viviendas, talleres y comercios de los orientales, sometidos al control de un alcalde mayor de origen español. Fray Domingo de Salazar se refiere a él, a las mercaderías que en él se comerciaban y a la calidad de los sangleyes en los oficios como plateros y escultores en su Carta-Relación de las cosas de la China y de los chinos del parían de Manila enviada al rey Felipe II.

«Hállanse en este Parián todos los oficiales de todos los oficios y artes mecánicas de una República, y de todos en mucha cantidad; y que hacen cosas muy más curiosas que en España, y algunas veces tan varatas, ques vergüença decirlo... los officios mecánicos de los Españoles an cessado todos, porque todos se visten y calçan con sangleyes, por ser muy buenos oficiales, al uso de España, y háçenlo todo muy barato; los plateros, aunque no saben esmaltar, porque en la China no usan esmalte, pero en lo demás, así de oro como de plata, haçen obras maravillosas, y son tan áviles é ingeniosos, que en viendo alguna pieça hecha de oficial de España, la sacan muy al propio; y lo que más me admira es, que con no aber quando yo aquí llegué hombre dellos que supiese pintar cosa que algo fuese, se an perficcionado tanto en este arte, que así en lo de pincel como en lo de bulto, an sacado maravillosas pieças, y algunos niños Jesús que yo he visto en marfil, me parece que no se puede haçer cosa más perfeta; y así lo afirman todos los que los an bisto. Bense proveyendo las iglesias de las ymágenes que éstos haçen, de que antes abía mucha falta, y según la abilidad que muestran al retratar las ymágenes que bienen de España, entiendo que antes de mucho no nos harán falta las que se haçen en Flandes» (Retana, 1897: 19-20).

Rápidamente, el auge de estas mercancías asiáticas en el ámbito americano hizo que la Corona española comenzara desde fechas muy tempranas las restricciones de estos mercados debido a la competencia que ejercían, sobre todo en relación a la industria de la seda en Andalucía. Esto hizo que en 1587 se prohibiese el comercio de telas chinas entre América del Sur y Filipinas, con la excepcionalidad de Perú, al que se le volvió a permitir importar desde Nueva España con licencia especial del virrey los productos asiáticos excedentes en México, pero fue reiterada la prohibición del tráfico directo con Oriente y extendida a Panamá y Guatemala en 1593 y 1595³. A pesar del veto que existía a la salida de mercancías procedentes de Filipinas del virreinato novohispano, estas lo hacían hacia Perú en gran cantidad a finales del siglo XVI. En los años siguientes, este comercio fraudulento siguió en aumento y en 1612 el virrey del Perú, marqués de Montesclaros propone autorizar solamente un navío al año para que navegue entre Perú y Nueva España, y que en el mismo, de regreso, se autorice a registrar ropas de China y España,

² *Santa Visita-Santa Ana*, 1760. Archivo de la Archidiócesis de Manila (A.A.M. en adelante).

³ *Prohibición de ir navíos de Perú a China. Traslado de una Real Cédula, por la que se prohíben que vayan navíos desde el Perú y tierra firme a la China, y a las islas Filipinas y que traigan productos de aquellas tierras*, 11 de enero de 1593, Archivo General de Indias (A.G.I. en adelante), Patronato, 25, f. 56r.

pero cobrando elevados derechos fiscales a la salida de Acapulco y a la llegada al Callao, propiciando de este modo la preferencia de negocio con Tierra Firme y no con Nueva España. En ejecución de las prohibiciones anteriormente citadas, se embargaron algunas embarcaciones y quedó al descubierto una operación mercantil organizada por el poderoso grupo de comerciantes peruleros, pero en México algunos segmentos burocráticos mercantiles decidieron resistirse a la prohibición y concedieron dudosas licencias que mantuvieron el tráfico de mercancías chinas con el Callao, vía Acapulco.

Este es el caso de D. Baltasar Rodríguez, quién desafiante a dichas prohibiciones insistía en esta ruta comercial de manera que en 1591 se le concede la licencia para que el navío Santiago pueda cargar y llevar mercaderías de China y Filipinas a las provincias del Perú, autorizado por el virrey Villamanrique, aunque a su llegada al Callao el navío fuera decomisado (Ruiz, 2012b: 13-28).

A través de algunos extractos documentales podemos comprobar como este flujo de mercaderías asiáticas no se vio mermado a pesar de las restricciones mencionadas anteriormente. Como cuando en 1581 en la relación de lo que llevó al Perú la nao *Nuestra Señora de la Cinta*, procedente de Filipinas, mandada por don Gonzalo Ronquillo como capitán: «Dos caxas de mercaderías de China. Una tina de loça dorada. Nueve caxas de loça. Una caxa de loça dorada. Seis fardos de ropa de China. Dos caxas de loça. Un fardo de sedas». En 1599 vemos un envío directamente desde China, en el listado de mercaderías que Alonso Rodríguez de León envía desde Filipinas a México, en el que aparece un cajón embarcado desde Cantón «Caxón número 3 de la nao Santa Margarita [...] Quarenta y siete cates y medio de seda de lanquin blanca fina floja [...]». En un fragmento de la carta escrita el 3 de agosto desde Manila por Francisco de Montoya, nos habla de que se embarca con destino Acapulco «seda floxa de lanquin blanca batida tangal tenida aquí y azul y verde la cossa mejor que haya visto en mi vida», dato este relevante dado que atestigua como en muchas ocasiones llegaban las sedas desde China crudas para luego teñirlas en Manila en este caso y de allí viajar a tierras americanas (Romero/Ruiz, 2010: 111-130).

También en el inventario de las mercaderías que debía transportar la fragata *Sacra Familia* desde Filipinas a Nueva España en 1719, tenemos numerosas referencias de piezas que atestiguan la presencia de estos objetos asiáticos. En ella aparecen desde telas de China, o de Bengala a quimonos japoneses, además de objetos curiosos como los que Doña Lucía Clara de Viscarra, vecina de Manila, manda en medio cajón, «un niño dormido de pasta con su catresito, trese abanicos de talco, dos tibores de loza de Japón, y un lamina grande de Macán»⁴.

Pero sin lugar a dudas una de las aportaciones documentales más interesantes de mercaderías orientales en el Galeón de Manila es el estudio de los bienes del Ilmo.Sr.D. Fr. Francisco de la Cuesta, lo que nos permitirá analizar los bienes de una dignidad eclesiástica como la que nos ocupa. Fue nombrado arzobispo de Manila de 1719 a 1721 (Lorenzana, 1769). Tomando posteriormente posesión de la mitra del obispado de Michoacán el 18 de abril de 1724, muriendo solo cuarenta y dos días después, a la edad de sesenta y tres años, dejando sus bienes depositados en su destino final, la catedral de Morelia, antigua Valladolid en Michoacán. Las piezas detalladas a continuación son solo una muestra de la riqueza de este inventario:

⁴ *Inventario de los embarques del galeón nombrado la Sacra Familia que ha hecho viaje de las Islas Filipinas a la Nueva España, 22 de agosto de 1719*, Archivo General de la Nación de México (A.G.N. en adelante), Filipinas, tomo 2, exp. 1., ff.102v-03r.

«Una docena de platos dorados de China a seis pesos, una hechura de un Santo Christo de marfil, dos tivores⁵ a doce pesos, un cajete de China Japón de una tercia de alto en diez y seis pesos, dos tinajas de China ordinarias de a peso, un viomvo⁶ de maque negro en doscientos pesos, ocho piasas de listón angosto de Pequin⁷ de cuarenta y ocho baras a dos pesos treinta pesos, dos bastones de marfil en once pesos, dos dichos (bastones) de carei a peso dos pesos, doce quimones⁸ ordinarios a cuatro pesos quatro reales cincuenta y quatro pesos, tres tazas calderas guarnecidas de metal de China a dos pesos seis pesos, catoce manserinas encarnadas y negras de maque a dos reales tres pesos y quatro reales, una colgadura de pequin en treinta y un pesos, un abanico de carei de Japón en dos pesos, setenta y seis votones de China en seis reales, una docena de platitos japones en tres pesos y seis reales, una docena de tasas calderas japonas las diez con tapaderas en onze pesos todas⁹.

Junto a estos bienes, tenemos información del Inventario de la alhajas de la catedral de Morelia, Michoacán del año 1787 (Mazín *et alii*, 1991: 240-241) donde aparecen los bienes de otras dignidades eclesiásticas, en el apartado de Expolios de los Sres. Obispos, nos encontramos algunas referencias a piezas de origen asiático, como: «Una colgadura de cama de borbones carmesí bordada en China de matices que era propiedad del Sr. Tagle y se compone de seis cortinas, cielo, sobrecama y rodapiés». No es de extrañar que Ilmo. Sr. D. Fr. Pedro Anselmo Sánchez de Tagle, obispo de la catedral de Valladolid de 1758 a 1772, tuviera ornamentos tan lujosos, dado que aunque él llevaba una vida más austera, uno de los miembros más destacados de su linaje fue Luis Sánchez de Tagle, primer marqués de Altamira, quién conformaría con otros miembros de su familia una de las mayores fortunas del siglo XVIII en Nueva España, gracias a los intereses comerciales que tenían en el Galeón de Manila.

Este flujo de objetos orientales y el incipiente gusto por lo asiático en el virreinato de Nueva España, hizo que surgieran una serie de obras novohispanas influenciadas directamente por los productos anteriormente citados procedentes de Asia (Romero, 1982; Curiel, 2009: 19-36). Nos referimos a mobiliario como armarios, papeleras, sillas, escritorios y biombos, uno de los objetos más demandados por la burguesía novohispana¹⁰, con piezas singulares elaboradas con la técnica del enconchado, inspirada en la asimilación de obras de arte namban japonés¹¹, o las múltiples referencias que encontramos en la cerámica poblana en relación a la porcelana china azul y blanca de la dinastía Ming (1368-1644)¹², así como la acomodación de algunos recipientes de este tipo de porcelana con asas y pies de plata, transformándose en bernegales, o con la incorporación de un platillo con una abrazadera circular en el centro, donde se colocaba y sujetaba la jícara para beber chocolate, dando lugar a la mancerina, nombre derivado de su promotor, el marqués de Mancera, virrey del Perú de 1639 a 1648. Incluso la reelaboración del tabor chino en chocolatero poblano con la asimilación de la forma y elementos decorativos y el añadido de la tapadera de hierro.

⁵ Tibores. Vaso grande de barro, de China o el Japón, por lo regular en forma de tinaja, aunque los hay de varias hechuras, y decorado exteriormente.

⁶ Biombo. (Del port. *biombo*, y este del jap. *byōbu*, de *byō* «protección» y *bu* «viento»). Mampara compuesta de varios bastidores unidos por medio de goznes, que se cierra, abre y despliega.

⁷ Tela de seda, parecida a la sarga, generalmente pintada de varios colores, que antiguamente se traía de China.

⁸ Quimono. Túnica de origen japonés que se caracteriza por sus mangas anchas y largas. Es abierta por delante y se cruza ciñéndose mediante un cinturón.

⁹ Inventario de los bienes del Ilustrísimo Sr. de la Cuesta, obispo de Valladolid. 1724-1733. A.G.N. Arzobispos y obispos. Vol. 6. Ff. 65r – 95v.

¹⁰ Sobre publicaciones de mobiliario y biombos novohispanos Cfr. (Aguilera, 1985; Martínez, 1994; Curiel, 1999: 9-32; Sanabrais, 2009: 69-105; Baena, 2012: 31-62).

¹¹ En referencia a los enconchados (García, 1980; Duvojne, 1984; Rivero, 2005; Ocaña, 2009: 129-150).

¹² Para el estudio de las piezas de porcelana china en Nueva España y su influencia en las artes decorativas novohispanas (Cortina, 1989: 44-55; Kuwayama, 1997; Aguirre, 1997; Connors, 2007; Bonta, 2008).



Figura 1. Agustín del Pino. Virgen de Guadalupe. Enconchado. Siglo XVIII. Cortesía del Museo Franz Mayer. México.



Figura 2. Anónimo. Lebrillo. Cerámica esmaltada. Puebla de los Ángeles. Siglo XVIII. Cortesía del Museo Franz Mayer. México.



Figura 3. Anónimo. Chocolatero. Cerámica esmaltada. Puebla de los Ángeles. Siglo XVIII. Cortesía del Museo Franz Mayer. México.

La laca michoacana, chiapaneca y guerrerense mexicana adoptó también las técnicas y motivos chinoscos¹³. Las lacas chinas tuvieron tan buena acogida, que los artistas del maque empezaron a introducir nuevas formas y diseños ornamentales en sus creaciones. A la variedad de jícaras y bateas ya existentes, se agregaron diversos muebles, entre ellos biombos y escritorios como receptores de estas aplicaciones. Además la tradición pictórica prehispánica facilitó la labor de adaptación de diseños de paisajes, flores y personajes de inspiración oriental a la producción de las tradicionales bateas (Pérez, 1987: 51-78).

Sin olvidar, la adaptación de los abanicos asiáticos al gusto de las mujeres novohispanas y europeas, destacando los conocidos como de «mil caras», por la superposición de finas láminas de marfil para los rostros de los personajes que aparecen decorando el país, destacando el minucioso trabajo que se hace en el varillaje, del mismo material, aunque en ocasiones nos podemos encontrar la utilización de nácar o carey.

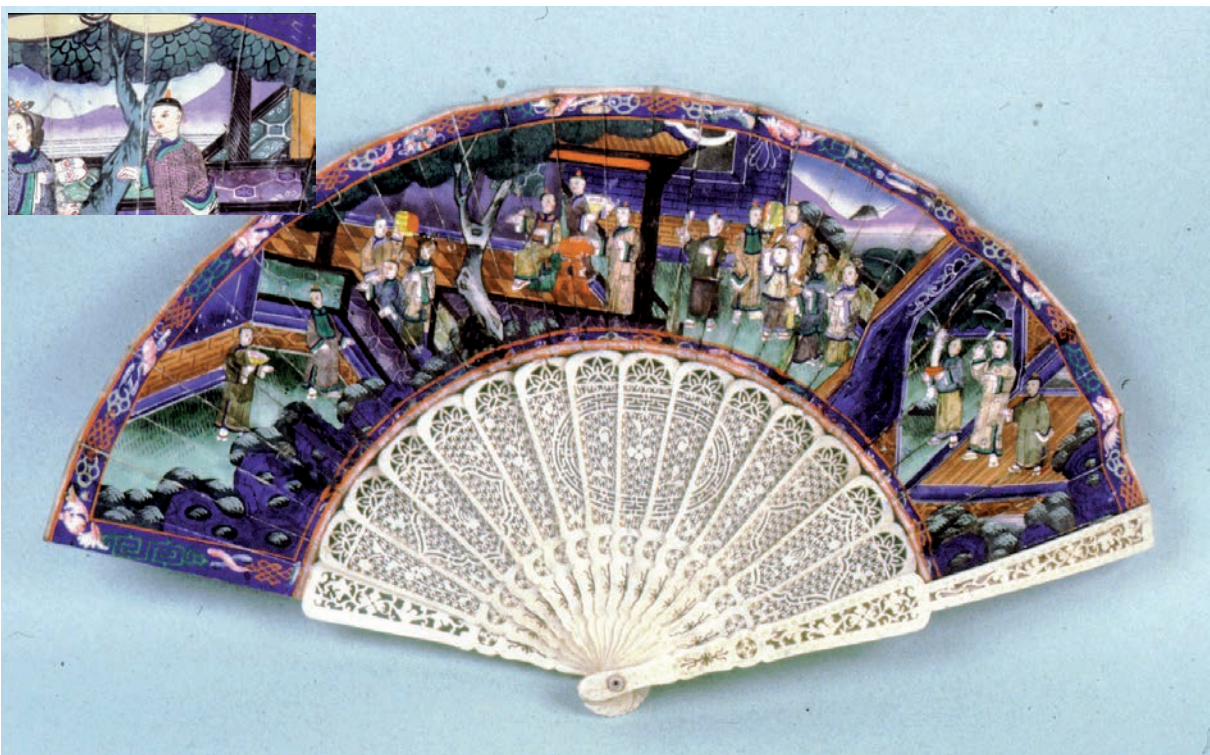


Figura 4. Anónimo. Abanico de «mil caras». XIX. Cortesía del Instituto Municipal de Museos de Reus.

Este gusto por los abanicos chinos lo podemos refrendar con la mención a los encargados para la reina en 1748, ordenando se compren especiales de China.

«El Rey manda que siempre que se tenga ocasión de comprar abanicos especiales de china, bien sea a la llegada del Galeon de Philippinas teniendo persona en Acapulco que haga a tiempo la diligencia conveniente, o bien sin esperar esta coyuntura si se hallasen de exquisito gusto, tome usted en cuenta de la Real Hacienda de ocho a diez docenas de surtidos, y los remita bien empaquetados»¹⁴.

¹³ Consultar los siguientes estudios específicos a la laca mexicana (Castelló, 1972: 33-81; Thiele, 1989; Pérez/Rodríguez, 1997: 31-51).

¹⁴ Abanico para la reina. A.G.N. Reales Cédulas Originales, vol. 68. f. 105 r.



Figura 5. Anónimo. Mantón de Manila con su caja. XIX. Colección particular.

Además de los mal llamados mantones de Manila, que provenían en realidad de las fábricas de China y adoptan el nombre del puerto del que parten hacia la península, tras el establecimiento de la Real Compañía de Filipinas en el siglo XVIII. Pronto dejó de ser un objeto de lujo vinculado a la burguesía para ser adaptado gracias a las trabajadoras de la Fábrica de Tabacos de Sevilla, convirtiéndose en emblema de la mujer andaluza. Los motivos, por tanto, pasaron de ser de influencia chinesca con crisantemos, peonías, mariposas, dragones, escenas cotidianas chinas, etc., a convertirse en un paraíso floral.

Legados artísticos singulares

La gran mayoría de las donaciones particulares pertenecían a personalidades relevantes en el archipiélago que quisieron corresponder a su localidad de origen con dádivas extraordinarias. Así, los legados que se enviaban desde el archipiélago podían corresponder a donaciones de tipo devocional, como son las fundaciones de aniversarios y capellanías, destinadas estas últimas a la celebración de misas por el alma de parientes difuntos, sufragadas con sus rentas para el mantenimiento; también a las que responden a un criterio social, cuyo objetivo es potenciar los bienes familiares y el apoyo a los habitantes de sus lugares de origen, tal y como sucede en las fundaciones para la dotación de estudiantes, doncellas, maestros de escuela, hospitales, etc.; y finalmente algunas mandas conjugaban todos los tipos antes mencionados, dependiendo de la importancia del donante, aunque también existía un cuarto tipo de legado donde se enviaba una obra de arte excepcional por su valor estético y generalmente de carácter religioso.

Algunas de las donaciones que hemos podido documentar se explican por la devoción del donante, y permitieron la fundación de capellanías o simplemente el envío de obras de arte como agradecimiento a los éxitos cosechados en su aventura y enaltecimiento personal en su lugar de origen. En relación al establecimiento de una capellanía destacamos la figura de Manuel Silvestre del Camino, natural de la población riojana de Castañares de Rioja quien para expiar sus pecados y consolidar el prestigio de su linaje, para él y su descendencia, realizó en el siglo XVIII una donación con la intención de dotar una capilla nueva que manda construir anexa a la iglesia del siglo XVI de su localidad natal (Ruiz, 2009: 76-87). Actualmente esta capilla cuenta con un pequeño retablo de un solo cuerpo, presidido por un lienzo de la imagen titular, la Virgen de Guadalupe, firmado por Miguel Cabrera. Pero lo más destacable de los ornamentos de esta capilla para nuestro estudio es la disposición en el banco del retablo de cuatro hornacinas que debieron ser ocupadas por cuatro de las seis esculturas hispanofilipinas que mandó Pérez del Camino, y que en la actualidad se conservan en el museo diocesano de la catedral de Calahorra.

Otro legado interesante es el que donó en el siglo XVIII D. Francisco de Samaniego y Tuesta, a Caicedo de Yuso, Álava, compuesto por un Cristo crucificado de marfil y una custodia de filigrana de plata, procedentes de Manila, donde ejerció como oidor de la Audiencia de Manila (Ruiz, 2007: 159-167).

En definitiva, revelar el flujo artístico del Galeón de Manila, es una labor compleja, por la pluralidad de intereses que contemplaba, el amplio marco geográfico y cronológico que comprendía y la dificultad para conectar microhistorias a través de la contextualización documental con el hallazgo del conjunto artístico. Progresivamente vamos proporcionando evidencias que nos ayuden a comprender cómo se articulaba este extraordinario itinerario cultural germen de la que se conoce como la primera globalización.



Figura 6. Anónimo. Crucificado expirante y custodia. XVIII. Caicedo de Yuso. Álava.

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Boa Vista 1 and Boa Vista 2: first data on two Early Modern ships discovered in Lisbon (Portugal)

Boa Vista 1 y Boa Vista 2: primeros datos de dos embarcaciones modernas descubiertas en Lisboa (Portugal)

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Abstract: Archaeological excavations carried out in the riverside area of Lisbon, revealed the remains of two ships: Boa Vista 1 and 2. The chronological sequence indicates that a 19th century embankment covered a wide anchorage, with archaeological remains ranging from Roman times until the 18th century. The two wooden ships were abandoned or lost in this anchorage, probably sometime between mid-17th and mid-18th centuries. Boa Vista 1 is a small vessel and features «architectural signatures» that are common in the Mediterranean area, but no clear parallels have been published to date. Boa Vista 2 is a larger vessel, and there are also no clear parallels. Both are therefore essential and unique sources to study post-medieval shipbuilding. Assuming the hypothesis that Boa Vista 1 and 2 were built on the Iberian Peninsula or on its colonial territories, they are an important starting point for the review of available sources on the subject.

Key words: Portugal, Lisbon, Boa Vista, shipbuilding, post-medieval archaeology.

Resumen: Los trabajos arqueológicos llevados a cabo en la zona ribereña de Lisboa, permitieron identificar los restos de dos barcos: *Boa Vista 1* y *2*. La secuencia cronológica indica que un terraplén del siglo xix cubría un extenso fondeadero. En este fondeadero (con uso documentado desde la época romana hasta el siglo xviii), las dos naves construidas en madera fueron abandonadas o perdidas, probablemente entre mediados del siglo xvii y mediados del xviii. El barco *Boa Vista 1*, más pequeño, presenta «firmas arquitectónicas» comunes en la zona del Mediterráneo, pero no existen paralelos claros publicados hasta la fecha. *Boa Vista 2*, más grande, tampoco encuentra paralelos claros. Ambos son, por tanto, una fuente esencial y única para el estudio de la construcción naval postmedieval. Asumiendo la hipótesis de que fueron construidos en la península ibérica o en su espacio colonial, este es un punto de partida importante para la revisión de las fuentes disponibles sobre el tema.

Palabras clave: Portugal, Lisboa, *Boa Vista*, construcción naval, arqueología postmedieval.

Introduction

Archaeological monitoring carried out in the construction area of the new corporate Head Office of EDP-Energias de Portugal, S.A., located in the riverside area of Lisbon, revealed the remains of two ships, Boa Vista 1 and Boa Vista 2.

Both were excavated between September 2012 and February 2013, in a rescue intervention carried out by ERA Archaeology Company, which requested the contribution of the Portuguese Centre for Global History (CHAM) to ensure the necessary expertise in nautical archaeology (Sarrazola/Bettencourt/Teixeira, 2014). Both vessels were recorded in situ by ERA, using rectified photographs and a total station survey. The remains were then dismantled and transferred, first to EDP storage facilities and then to a council warehouse (Câmara Municipal de Lisboa), where they are kept immersed in water tanks.

In 2013, our team took over the study of the vessels and conducted a four-month assessment of both contexts, including a phase of analysis and systematization of the field data. A general inventory of all the ship's timbers and other archaeological finds was compiled. A number of selected timbers that have crucial importance for the vessels interpretation were thoroughly recorded (Bettencourt *et alii*, 2013). This paper presents some preliminary results of this research.

The context

The vessels were found in Lisbon's riverfront, buried in the former Boavista beach, which had been a submerged zone until the 17th century, according to ancient cartography (Fig. 1). Later written sources still give a picture of a riverine environment, confirming that «faluas» (a traditional boat) often ran aground in the bottom of channels, such as Ferradeiros or Moeda (Araújo, 1938: XIII, 76). From mid-17th century onwards, iconography shows an anchorage and several wharves featuring sheds, docks and warehouses belonging to the «Junta de Comércio do Brasil» (a State merchant Company). This port structure only became truly consolidated in the following century (Caetano, 2004: 111-124).

The maritime dimension of this space and its subsequent occupation were recorded during the archaeological monitoring, and an important stratigraphic sequence was uncovered. This included the identification of a probable anchorage, located at depths between 3 and 6 meters (mean sea level), featuring ceramics ranging from the Roman period to the 18th century, as well as several iron anchors from the Early Modern period. The ship remains were found in this archaeological context. Above these levels of silty sediments, several landfills were made by means of pilings, which were the base for the construction of the «Fábrica do Gás» (Gas Plant - 1846-1880-1923), Lisbon's first power plant, disabled in the 20th century. This later occupation conditioned the preservation and the archaeological excavation of the two ships.

The Boa Vista 1 ship

The Boa Vista 1 ship was excavated in two distinct phases, due to the constraints of the engineering works.

A 12 meter long section of the ship was preserved, with a north-south orientation (Fig. 2-3). The stern was located in the southern end, starboard side slumped over, still keeping an end portion of the keel, the heel and the sternpost. At the northern end, there was a central section of the ship, which had been cut during earlier construction phases.

Component	Moulded (cm)	Sided (cm)
Keel	20	16.5 / 15
Floor-timber	13 / 10	14 / 11
Futtocks	14 / 6	14 / 7.5
Component	Width (cm)	Thickness (cm)
Ceiling-planks or footwales	20	9 / 5
Hull-planks	39.7 / 4.8 (most between 29 and 20)	5.6 / 4.5 (most around 5)
Wooden sheathing	27.5 / 23.8	2.5 / 2

Table 1. Boa Vista 1 – dimensions of timbers.

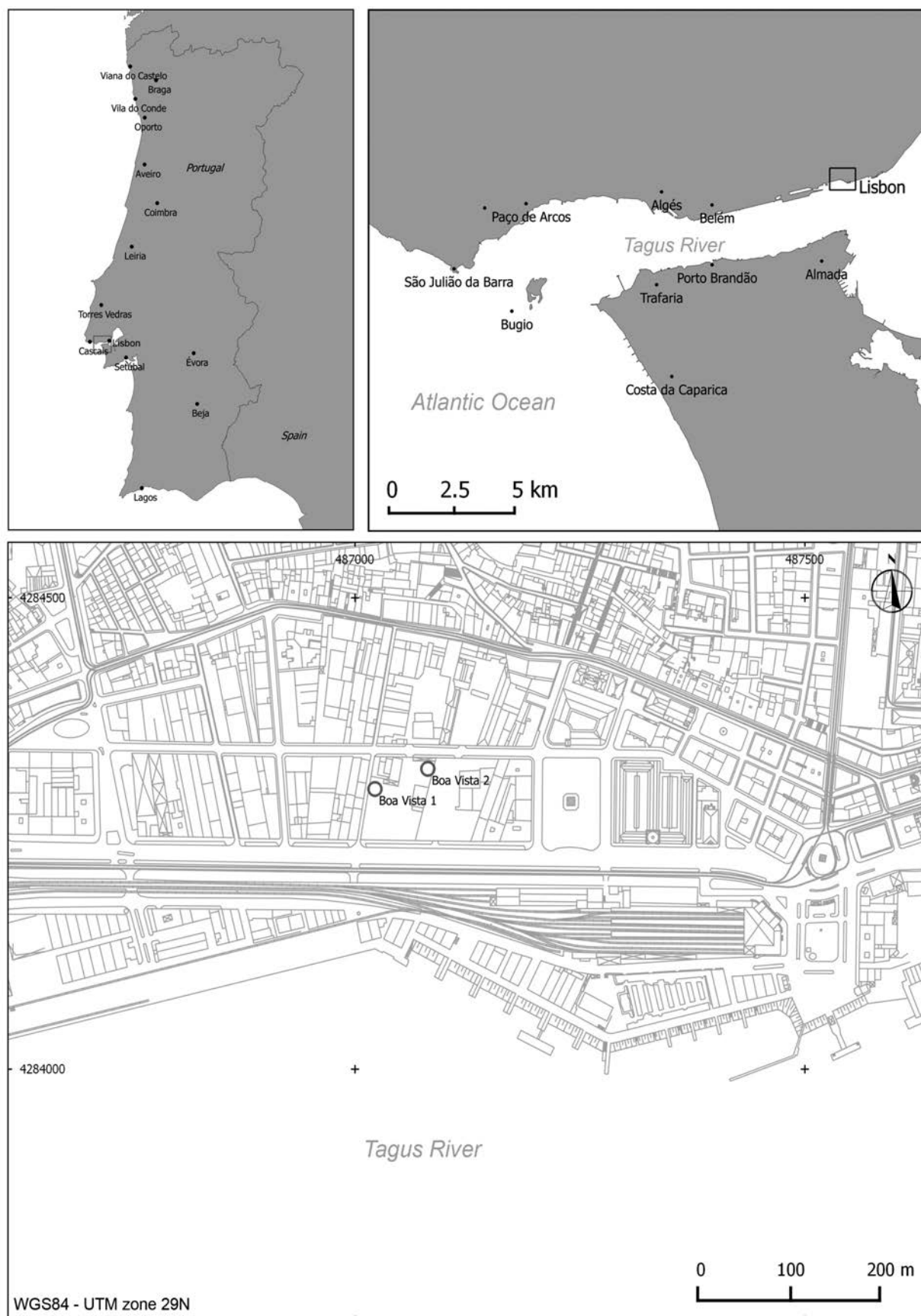


Figure 1. Location of the Boa Vista ships.

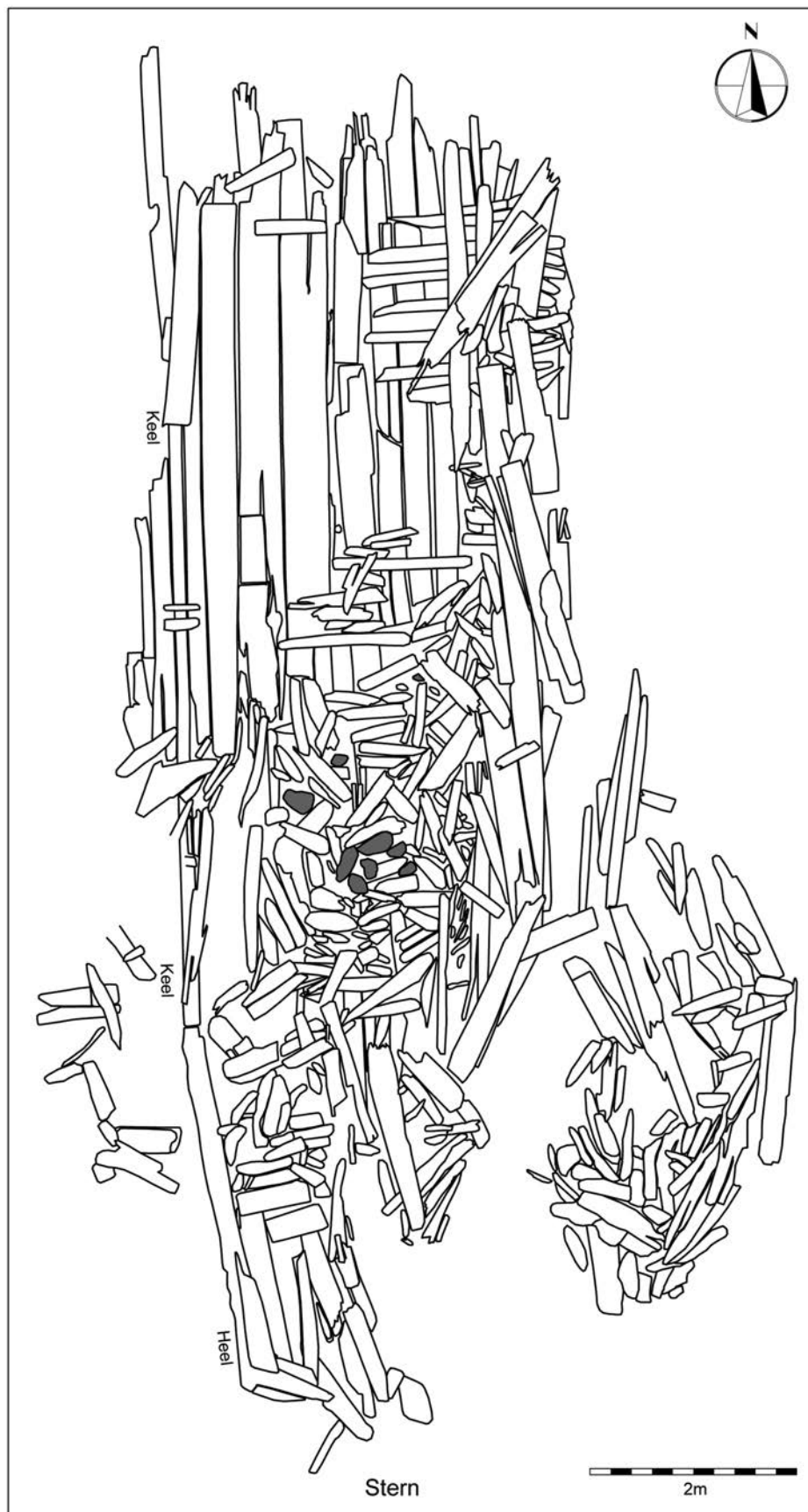


Figure 2. Plan of the Boa Vista 1 site, with the scattered timbers.

The context was heavily disturbed due to the landfill's pilings, and contaminated by naphtha, used as fuel in the Gas Plant (Fig. 4). Thus, the only elements of the hull that still kept their original arrangement were a part of the keel, the planking and some fragments of the framing.



Figure 3. a) General view from west of the Boa Vista 1 stern section. Note the difficult working conditions and the chaos of timbers. b) Coconuts stored in bottom of Boa Vista 2; c) View aft from the bow of Boa Vista 2 ship in the dismantling phase. The stem appears in the first plan.

The context was sealed by silted fluvial deposits, containing artefacts from the second half of the 17th century or the first half of the 18th century, such as Dutch kaolin pipes from Gouda, British pipes, onion bottles, probably also of British manufacture, shards of stoneware pots decorated with blue cobalt and produced in the Rhine valley workshops and several shards of Portuguese Faience.

With the exception of several pieces of wooden blocks, most of these materials are related to the use of this area as a port. However, they are a chronological indicator for the time of the ship's wreck or abandonment, which may have occurred between the last quarter of the 17th century and mid-18th century.

The analysis of the ship's hull, a complex task due to its condition, revealed several interesting construction details.

The keel was composed of three sections, connected with but joints, without evidence of any scarfs or nailing pattern. These joints feature a full width, horizontal, semi-circular section scarf that would be filled with a water stopper.

This morphology is a rare example, as the only existing parallels in Portugal were found in the 16th century ship from Cais do Sodré (Lisbon; Rodrigues *et alii*, 2001: 354-357). Nevertheless, it is also described in the 1691 *Traité de la Construction des Galères*. The transition of the keel to the sternpost with a heel is also interesting. This morphology is similar to the vessels of Iberian-Atlantic tradition. However, it features two distinct characteristics that make it a special case, since it incorporates a very important part of the keel, with a length of 3.47 m, and shows no sternpost knee, which would strengthen the connection of the heel to the keel or to the sternpost.

There were no floor timbers in connection above the keel, and the southeast part of the site corresponds to a chaos of timbers, apparently collapsed from the upper works at the starboard side of the vessel, due to site formation processes. However, the observation of the upper surface of the keel shows that the ship was built skeleton-first. This is indicated by the pattern of fastening holes, showing at least one square iron nail in each floor timber. Some also feature round iron bolts, with round countersinks in the lower surface that may correspond to the connection between keelson, floor timber and keel.

The observation of the fragments of the frames, mostly dispersed, confirms a skeleton-first construction, since it is possible to find hook-scarfs in the connection between the floor timbers and the futtocks, reinforced with at least two iron bolts, one of them nailed from the futtock to the floor timber. This is a particularly interesting feature, because it has been related to Mediterranean shipbuilding, appearing, for instance, in the Culip VI vessel (Catalonia, mid-14th century), at Yassi Ada (Turkey, 16th century), in the Sardinaux ship (France, late-17th century) or in the Kitten ship (Bulgaria, 19th century) (Rieth, 1998; Joncheray, 1998: 53; Batchvarov, 2009: 85-86). In Portugal, they appear in the 16th century Ria de Aveiro F vessel (Lopes, 2013: 32-35, 47-48). This framing had an inner reinforcement with several footwales, fixed with iron nails.

The planking is better preserved than the framing, especially in the northern part of the structure, from keel to starboard. Generally, the hull planks were connected with butt joints, nailed to the frames with square iron nails, which had round countersinks in the outer face. One plank is notched to fit under the frames, a feature that again has parallels in Mediterranean vessels, like the medieval ships Culip VI and Sorres X, excavated in Catalonia, and on the Mortella III (16th century) and Sardinaux ships (17th century), in France. It is also referred in the *Traité de la Construction des Galères* (Cazenave de la Roche, 2011; Pujol, 1992: 36). There are no treenails in the hull planking.

The hull has the particularity of being protected by a wooden sheathing of lesser thickness than the planking. The wooden sheathing was attached to the keel with small iron nails, placed near the edges of the planks. Between this external planking and the ship hull there was a coat of still unidentified animal hair. Wooden plugs that may have been used to provisionally fix the planks were also recorded during disassembly.

The Boa Vista 2 ship

The structure of the Boa Vista 2 vessel was much more impressive lying preserved up to a length of 16 m, corresponding to a portion of the bow, also north-south oriented (Fig. 5-6).

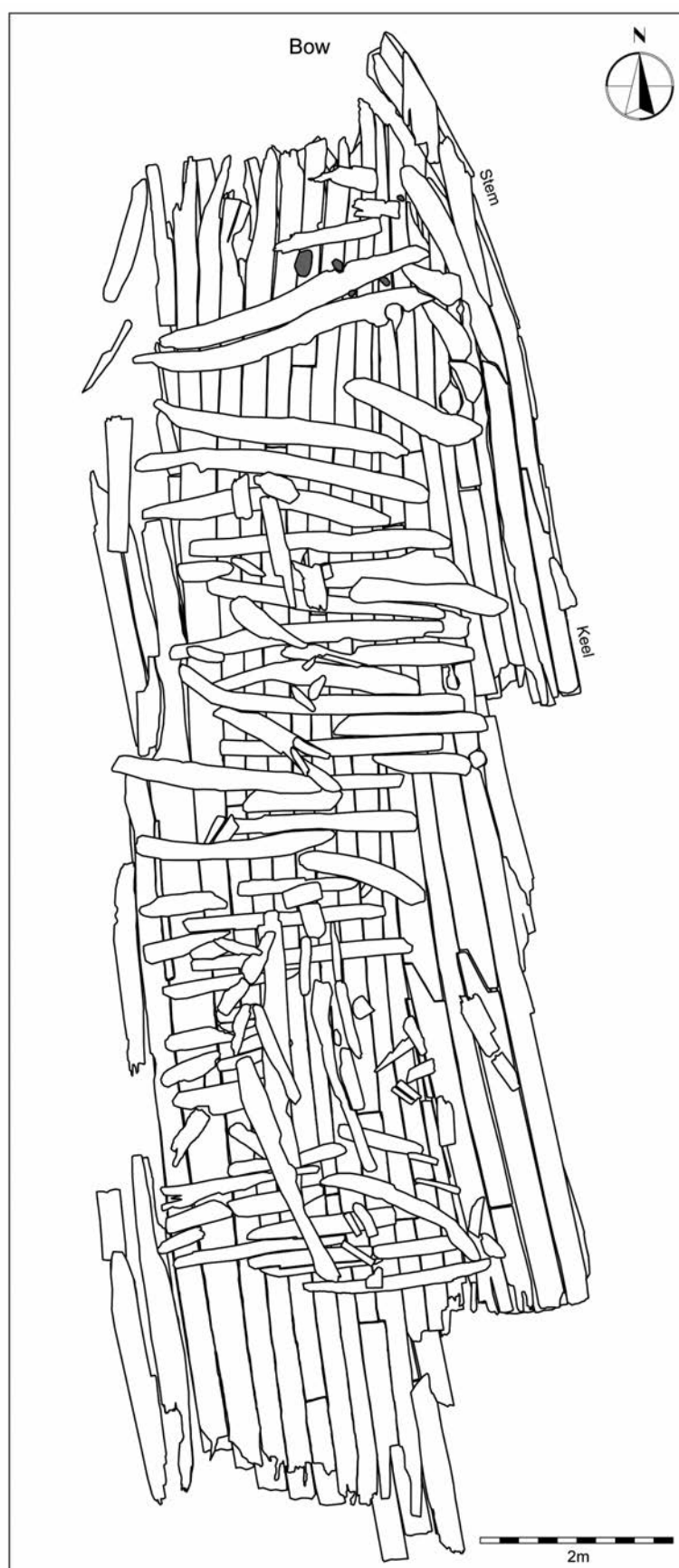


Figure 4. Plan of the Boa Vista 2 site, with the scattered timbers.

Component	Moulded (cm)	Sided (cm)
Keel	26 / 22	22
Floor-timber	25 / 19	25 / 19
Futtocks	20 / 16	20 / 15

Component	Width (cm)	Thickness (cm)
Ceiling-planks or footwales	Just one timber - >26	Just one timber - 6 / 4.3
Hull-planks	43 / 5.4 (most between 27 and 19)	7.2 / 5 (most around 6.3)
Wooden sheathing	Most between 30 and 25	Most between 4 and 3

Table 2. Boa Vista 2 – dimensions of timbers.

The ship was preserved along the port side, even though keel remains only existed close to the stem. As in Boa Vista 1, the floor timbers were badly preserved, only a few frames on the bow and some fragmented futtocks along the hull appearing in connection.

Among the archaeological finds recorded and associated with this vessel there were several coconuts, stored at its bottom (Fig. 4b), and ballast stones over the frames. However, like Boa Vista 1, the Boa Vista 2 ship was also sealed by fluvial sediments, containing artefacts dating mainly from the second half of the 17th century and the first half of the 18th century. Some examples are the Dutch or English kaolin pipes and several shards of Portuguese Faience.

The Boa Vista 2 hull is different from Boa Vista 1. The keel consists of two overlapped segments which were connected by a flat horizontal scarf, reinforced with two square iron nails and two treenails at each edge.

At the northern end, the keel ends at the beginning of the composite stem, made from a curved timber, called «couce» (Fig. 4c). This piece has two very interesting features. Firstly, the upper piece of the stem shows a double rabbet. Secondly, it shows several engraved construction marks, which should be related to the construction of this part of the hull: the first is an incised line parallel to the baseline of the keel, which should correspond to the beginning of a double rabbet; the second may be related to the curved profile projection of the stempost.

Like the Boa Vista 1 vessel, nearly all the frames were displaced and shattered, which complicates their analysis and interpretation. However, we could observe that some of them are tabbed to be fixed in the notched rising wood, as indicated by the concretions of the square iron nails connecting the floor timber to the keel. The floor timbers and futtocks of the central part of the ship were connected with flat horizontal scarfs, fixed with square iron nails. In other two futtocks, one of the joints has a scarf with a thickening along the lower edge and is also fixed with iron nails, although in one case the presence of a treenail was detected. Therefore, it is probably another skeleton-first vessel.

The hull has been reinforced by footwales in the floor timber/futtock overlapping area; they were considerably deteriorated and fragmented. The presence of square holes on the upper surface of the futtocks or on the displaced floor timbers may also be an evidence for the use of a ceiling planking on the bottom of the vessel, which was not preserved.

The hull planks were better preserved than the framing, particularly on the port side. They were connected with but joints, although there were also some horizontal scarfs. These planks were fixed to the floor timbers by square iron nails in the lower face while the outer face had round, previously opened countersinks.

The caulking between the planks and also on the rabbet was composed of a fibrous material not yet identified, in some cases reinforced by lead straps. This is a technical solution documented since the 16th century, particularly in sealing the joints of the planking of ships like Boudeuse Cay (Blake, 1986) and *Nossa Senhora dos Mártires* (Castro, 2005), both from the Portuguese India Run.

The hull was still protected by a wooden sheathing fixed with square iron nails embedded in round countersinks. Unlike the standard fastening of the wooden sheathing of the Boa Vista 1 vessel, no significant difference was noted between this sheathing and the system for fixing the hull planking, where iron nails of similar dimension were used.

This wooden sheathing overlapped a protective coating made of a whitish past that might correspond to «gala-gala», a mixture of fish oil and chalk used for the protection of the hull, known in Portugal at least since the 16th century, according to Fernando Oliveira (Oliveira, 1991: 117-198) but never found until now. In some cases, this paste may have also been used for minor repairs, appearing in small patches or in the filling areas attacked by shipworms.

Concluding remarks

The rather poor preservation of both contexts conditioned the intervention and interpretation, deferring the systematic recording of the ship's hull and its cultural integration to the laboratory analysis phase. The finds associated to the sedimentary levels that covered the ships' remains (kaolin pipes, pottery and glass) allow us to date the two ships to the transition between the 17th and the 18th centuries. But the nature of those deposits doesn't allow for a determination of the origin of the contexts –abandonment or sinking– although both vessels were covered by what had been a submerged environment until the 19th century.

The same difficulties related to the formation and dating of these contexts are again found as one attempt to assign the ships to a shipbuilding tradition. Note, however, that Boa Vista 1, a medium sized ship, features some «architectural signatures» common in the Mediterranean area, though there are no clear parallels in the currently available bibliography. Likewise, no analogies could be found in the available literature for the larger Boa Vista 2 either.

Both are therefore essential and unique sources for the study of post-medieval shipbuilding. Assuming the hypothesis that both correspond to ships constructed on the Iberian Peninsula or its colonial territories, they are a unique source and an important starting point for the review of available sources on the subject, scarcely treated by Iberian historiography and archaeology.

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El naufragio del *Nuestra Señora del Rosario*, *Señor San José y las Ánimas* ocurrido en 1753, Cabo Polonio, Uruguay

The wreck of *Nuestra Señora del Rosario*, *Señor San José y las Ánimas* occurred in 1753, Cabo Polonio, Uruguay

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Resumen: el presente artículo aborda el estudio del naufragio del navío español proveniente de Cádiz, *Nuestra Señora del Rosario*, ocurrido en la zona de Cabo Polonio en 1753. Este reviste gran importancia, a nivel de la historia local, por haber tomado el cabo su nombre del capitán del barco. Numerosos documentos dan cuenta del siniestro y describen el momento posterior a su varadura en que el casco del navío se partió en dos mitades. Asimismo, la documentación describe el cargamento del barco y menciona las pertenencias de tripulación y pasajeros. Esta investigación se enfoca, por un lado, en el análisis de la información relevada en los archivos con respecto a la situación del naufragio y a los elementos que es esperable hallar en el sitio para contrastarlos con lo registrado en las colecciones. Por otro lado, plantea una estrategia de trabajo para etapas futuras de la investigación.

Palabras clave: naufragio, Cabo Polonio, Uruguay, PAS-CIPAC.

Abstract: This article approaches the study of the wreck of the Spanish vessel *Nuestra Señora del Rosario* that occurred in the area of Cabo Polonio in 1753. The significance of this wreck partially lies, at a local history level, on the fact that the cape was named after the captain of the ship. Numerous documents account for the accident and describe the moment after the vessel's running aground when it broke in two halves. Furthermore, the documents describe the cargo

of the ship and they mention the belongings of the crew and passengers. This research focuses, on one side, on the analysis of the information located in the archives with respect to the situation of the wreck and the objects we might expect to find at the site to compare them with those recorded in collections. On the other side, it presents a working strategy for future stages of the investigation.

Key words: Shipwreck, Cabo Polonio, Uruguay, PAS-CIPAC.

Introducción

La investigación sobre el naufragio del navío *Nuestra Señora del Rosario*, *Señor San José* y *las Ánimas* se enmarca dentro de las actividades académicas desarrolladas por el Programa de Arqueología Subacuática y el Centro de Investigación del Patrimonio Costero (en adelante PAS-CIPAC) en el departamento de Rocha, Uruguay. Esta investigación se encuentra en curso y se presentan aquí algunos resultados parciales obtenidos a partir del análisis de colecciones, documentación y representaciones sociales en torno a este naufragio. Por otra parte, se presentan algunas líneas metodológicas que se espera poder incorporar en el futuro para continuar profundizando en el conocimiento del patrimonio cultural sumergido del área.

Antecedentes

El Programa de Arqueología Subacuática

El PAS (Programa de Arqueología Subacuática) fue creado en el año 2000 en la Facultad de Humanidades y Ciencias de la Educación, de la Universidad de la República, en Uruguay, como respuesta académica a los antecedentes y conflictos planteados en relación al Patrimonio Cultural Sumergido en nuestras costas y la actividad de buscadores de tesoros. El fin de este programa es el de promover la investigación científica en arqueología subacuática y la formación de profesionales en dicha subdisciplina. La investigación científica sobre la cultura marítimo-costera –la relación entre los grupos culturales y las aguas navegables y costas en diversas épocas y regiones– se logra impulsando el desarrollo académico de la arqueología y la antropología marítimo-costera, haciendo énfasis en la divulgación, pero también en la conservación y la necesidad de una urgente gestión del patrimonio cultural marítimo-costero.

En el año 2009 luego del traslado de parte del equipo al departamento de Maldonado, se creó el CIPAC (Centro de Investigación del Patrimonio Costero) como unidad asociada al PAS dentro de la Universidad de la República, y desde entonces el equipo trabaja con dos bases, una en Montevideo y otra en Maldonado, conformando el actual equipo de trabajo del PAS-CIPAC.

Desde sus inicios el programa ha tenido una estructura abierta, con un equipo integrado por egresados y estudiantes de diversas disciplinas: arqueología, antropología social, historia, biología, química, geografía, y otros como buzos profesionales y marinos. En estos años se han estrechado vínculos por afinidad con otros grupos de investigación e instituciones como el Museo Naval; el Laboratorio de Tecnología Pesquera de la Dirección Nacional de Recursos Acuáticos, grupos de investigación académica en la región como GRUPEP (Universidad do Sul da Santa Catarina-Brasil), el CEASA-Centro de Estudios en Arqueología Subacuática Argentina (CEASA) (Universidad Nacional de Rosario, Argentina), el grupo de Conservação e Restauro de Bens Culturais Móveis (Universidad Federal de Pelotas, RS, Brasil).

El PAS-CIPAC dio comienzo a las primeras actividades de investigación académica en arqueología marítima y subacuática en Uruguay con intervenciones en la Laguna de la Campana (Florida) y el Puerto Colonial de Montevideo (Lezama, 2009). También participó en investigaciones en el río Uruguay (localización de la Villa de Purificación) y en el río de La Plata, en la búsqueda del pecio de la nave capitana de Martim Affonso De Sousa (1531) (Lezama/Fernández, 2009).

En el año 2004 se obtuvo la primera zona costera asignada a la Universidad de la República para el desarrollo de investigaciones arqueológicas científicas. Uno de los primeros proyectos llevados a cabo por el equipo fue el proyecto I+D «El patrimonio cultural sumergido en la zona de Piriápolis: diagnóstico y plan de gestión», donde se aplicó por primera vez sensoramiento remoto (SBL) en convenio con un equipo francés de investigadores.

Con el crecimiento del PAS-CIPAC, diversas zonas costeras del país comenzaron a ser abordadas desde la arqueología marítima y subacuática y de esta manera un subgrupo se concentró en el área de Cabo Polonio del departamento de Rocha.

Las investigaciones en Cabo Polonio

Las actividades en Cabo Polonio se iniciaron por parte del PAS-CIPAC en el verano de 2007 cuando una fuerte tormenta de viento dejó al descubierto los restos de un naufragio enterrado bajo las arenas de la playa sur. El naufragio fue registrado por varios integrantes del equipo espontáneamente a partir de lo cual surgió el interés de abordar el patrimonio cultural sumergido de Cabo Polonio de forma metódica dando así comienzo a las actividades del grupo. Meses más tarde se llevó a cabo el primer relevamiento sistemático del pecio (Fig. 1) y se conoció que varios pobladores locales tenían diversos materiales que podrían provenir de este naufragio (Saccone, 2007). En el año 2009 Cabo Polonio fue declarado Área Protegida y esto mejoró ciertos aspectos del acceso a la investigación en el área. El grupo se formó con varios integrantes del PAS-CIPAC que han participado durante estos años de las diversas actividades de investigación, extensión y difusión en la zona.

Dos antecedentes directos de esta investigación fueron los proyectos «El rol de la cultura material en la valoración del pasado: el caso de Cabo Polonio» desarrollado durante 2010-2011 (Saccone/Bersais, 2011) e «Individualidades complejas: una aproximación a la identidad de los pobladores de Cabo Polonio» llevado a cabo durante 2011-2012 (Bersais *et alii*, 2012) ambos financiados por el programa PAIE-CSIC de la Universidad de la República. En estos proyectos se abordaron desde distintos enfoques los naufragios de la zona, como parte de la historia y hasta de la idiosincrasia local.



Figura 1. Parte del equipo del PAS-CIPAC registrando los restos de un pecio en la playa sur de Cabo Polonio, año 2007.

El naufragio del *Nuestra Señora del Rosario, Señor San José y las Ánimas*

Una vez culminados los proyectos mencionados, uno de los principales focos de atención en el área de Cabo Polonio ha sido el naufragio del navío español *Nuestra Señora del Rosario, Señor San José y las Ánimas* ocurrido en enero de 1753. Con respecto a este naufragio Lezama (2009: 111) afirma que «es un caso excepcional en la investigación histórica en el que coinciden un episodio, sobre el que disponemos importante documentación escrita y al mismo tiempo de un testimonio arqueológico del hecho». Esta coincidencia es fundamental para el desarrollo de la investigación que se ha planteado cotejar la información proveniente de archivos con la de los materiales arqueológicos provenientes del sitio.

Contexto temporal: el viaje del navío hacia el Río de la Plata

Según los documentos ubicados en el Archivo General de la Nación de Montevideo, que dan cuenta de la investigación realizada en la época sobre las condiciones del naufragio, el navío *Nuestra Señora del Rosario, Señor San José y las Ánimas* zarpó del puerto de Cádiz, el 11 de noviembre de 1753 con destino a Buenos Aires (Archivo General de la Nación, [A.G.N.] Montevideo, Índice A.G.A. N.º 2, 286, Caja 4, Carpeta 6, 1753 Febrero 6, «Naufragios» Autos sobre el naufragio del Navío «Nuestra Señora del Rosario, Señor San José y las Animas» naufragado en Castillos. f 36). Traía a bordo trescientas dieciséis personas pero ninguna pereció en el accidente (A.G.N. «Naufragios» f 8r). Durante el trayecto del viaje se registran relatos por diversos declarantes de varias situaciones inesperadas o irregulares como que poco después de partir se detuvieron varios días en Santa Cruz de Tenerife a hacer aguada y luego el encuentro con un bergantín inglés del cual se trajeron varios cajones al navío (A.G.N. «Naufragios» fs 36-36r).

A fines de enero de 1753, el navío se aproximó a tierra en la zona de Castillos (actual departamento de Rocha) y el día 31 de este mes encalló en la playa sur «a tiro de fusil de tierra» (A.G.N. «Naufragios» f 39r).



Figura 2. El viaje del *Nuestra Señora del Rosario* hacia el Río de la Plata, 1752-1753.

Ubicación geográfica: el sitio del naufragio

El pecio ubicado a aproximadamente 200 m de la costa en la playa sur de Cabo Polonio, Rocha. Por su proximidad, ha sido visitado desde el siglo XVIII hasta la actualidad por buzos y permisarios privados que han retirado materiales del sitio, algunos de los cuales se han registrado en colecciones locales.

Metodología: un triple abordaje

Hasta el momento las líneas de investigación abordadas han sido sobre el análisis de archivos, el análisis de colecciones con materiales arqueológicos del naufragio y el análisis de las representaciones sociales en torno a este.

Los archivos y la documentación

El A.G.N. de Montevideo cuenta con un legajo de más de 500 páginas correspondiente al naufragio del *Nuestra Señora del Rosario* que ha sido registrado por medio de fotografía digital para su estudio pormenorizado. Estos documentos comenzaron a generarse a partir de los días posteriores al accidente cuando los primeros náufragos en llegar a Montevideo realizan sus declaraciones ante el gobernador José Joaquín de Viana. Los registros continúan, incluyendo entre otros, declaraciones de pasajeros, listados de mercadería que transportaba, autorizaciones de buceo para la recuperación de mercaderías, etc., y se cierran cinco años más tarde, en octubre de 1758, con el cese de la búsqueda «por no hallarse más hacienda ni fragmentos» (A.G.N. «Naufragios» f 251r).

La parte documental de la investigación se ha basado en el análisis crítico de diversos aspectos mencionados en estos documentos, como la situación en que ocurrió el naufragio relatada por distintas personas y algunas particularidades de la vida a bordo que permiten una aproximación a la sociedad del momento.

Por otra parte, de acuerdo con la revisión de Picha (2009: 270-271) sobre el método histórico que destaca la importancia del uso de líneas de evidencia independientes para contrastar diversas fuentes, se plantea la contrastación de los datos obtenidos en el legajo del A.G.N. de Montevideo con la documentación de Archivos de Buenos Aires y del Archivo de Indias de Sevilla referidos a este naufragio. Al presente se cuenta con copia del legajo existente en el A.G.N. de Buenos Aires, y si bien aún no se ha obtenido el legajo correspondiente a este naufragio en el Archivo de Indias, este ha sido localizado y se planea adquirirlo en el futuro para poder proceder a esta contrastación de líneas de evidencia.

El estudio de las colecciones

La población local de Cabo Polonio, en su vida cotidiana, desarrolla una relación muy intensa con el mar que los rodea. Parte de esta relación implica el aprovechamiento de los objetos que luego de las tormentas el mar arroja a la playa y que ellos recolectan en una actividad que denominan «playear». El recolectar y coleccionar objetos hallados es parte de una forma de ser colectiva y está relacionado con la clasificación, como proceso convencional de discernir un orden, patrones o regularidades para ajustar la realidad a un esquema racional (Moutu, 2007: 98).

Durante 2010-2011, en el marco de una de las investigaciones desarrolladas en Cabo Polonio «El rol de la cultura material en la valoración del pasado», se definió el concepto de *colección* al ser utilizado como: «objeto, objetos (o fragmentos) que las personas han adquirido por distintos medios (hallazgo, intercambio, regalo) y que guardan, se apropian de ellos y les asignan un destacado valor simbólico asociado al pasado de Cabo Polonio» (Saccone/Bersais, 2011: 3). En este contexto se registraron 20 colecciones, de entre 1 y 35 objetos, que presentaban al menos uno de algún naufragio local. Estas pequeñas colecciones fueron registradas por medio de fotografías y descripciones someras de cada elemento. Se consignaron también las formas en que estos fueron obtenidos y la valoración que los pobladores hacían de ellos (Saccone/Bersais, 2011).

Si bien creemos haber registrado la mayoría de las colecciones locales, restan por registrar otras que no han permanecido en el lugar y han sido trasladadas a otras localidades de la región (Castillo, Rocha) y a Montevideo.

Las representaciones sociales

Los naufragios están muy presentes en el imaginario colectivo de la población local de Cabo Polonio, en particular, para los pobladores de más tiempo que llegaron a presenciar naufragios como el del *Taquarí* ocurrido en 1971 o, si no directamente al menos de segunda generación, el del *Don Guillermo*, naufragado en 1952 (Varese, 1998). Por medio de diversos abordajes, entrevistas, encuestas, encuentros informales y observación participante, se registraron historias, mitos o leyendas, que recuerdan y recrean los pobladores sobre distintos naufragios.

Avances de la investigación en cada área

Los datos del legajo del Archivo General de la Nación de Uruguay

Uno de los puntos mencionados recurrentemente en las declaraciones sobre las circunstancias del naufragio es que este sucedió en una noche con buen tiempo y que no hubo víctimas ya que por la proximidad de la costa y con el mar en calma se pudo trasladar a todos los pasajeros y tripulación en botes hasta tierra firme.

«Preguntado q.e numero de Jente transportava, y si perezio alguno y donde quedaron? Dijo q.e poco mas ò menos traya como trescientos y Diez y seis Hombres: que no perecio alguno de la citada Jente» [A.G.N. «Naufragios» f 8r y 9].

«[...] pícaron el Cable al ser de día para Arrimarse mas atierra, donde sebolvió adaro fondo, y haviendo hechado al Agua lancha, y bote Conto da dilijencia hecharon entierra, todala Jente [...]» [A.G.N. «Naufragios» f 14].

«Preguntado sí el navío seperdió Contormenta, opor falta de govérno diga lo que save Díjo que el Navío seperdio sinque tubiese tormenta, quenosave sí fue p. r falta de gobiérno» [A.G.N. «Naufragios» f 12].

Otros de los aspectos interesantes para tener en cuenta en los procesos de formación del sitio subacuático se refieren a la distancia de la playa que el barco naufragó y a que este estuvo durante varios días entero y luego se partió.

«[...] Bolbieron a fonde-
ar cerca de la Playa y vararon poco despues á más delas
ocho de la mañana y distancia deun tiro de fusil»
[A.G.N. «Naufragios» f 30].

«por estar el Navio encallado attiro defusil de tierra»
[A.G.N. «Naufragios» f 39r].

«[...] por espacio de 6 o siete días (hasta que se dividio el Navío)»
[A.G.N. «Naufragios» f 30r].

«mandó practicar quantas diligencias fueron dables con
vote y lancha paraponer En tierra Equipages y efectos
decarga, Cuias diligencias nocesaron mientras el
casco duró entero [...]» [A.G.N. «Naufragios» f 53r].

Un tercer punto que fue relevado en las declaraciones hace referencia a algunos detalles de la vida a bordo. En particular, en cuanto con las prácticas relacionadas con la alimentación y las injusticias cometidas que algunos pasajeros destacan, porque el capitán y sus allegados realizaban grandes fiestas mientras que los demás solo tenían dos comidas diarias.

«[...] sereconocio que ademas delasdos Comidas regulares
res que alas ôras de ordenanza practican los Navíos,
âlas diez delanoche se salían dela Camara Alta y Al
cazar Dn. Josseph Poloni el Piloto m Dn Josseph Arturo
y Dn Alejo Vertivill Pasagero y Apoderados devarios in
teresados del Navio âcompañados deôtros yse bajaban
devajo del Alcazar, donde sesupo tenian zenas âque
lla ôra y de resulta deuna subieron ala Camara alta
con sobre regular Alegría [...]» [A.G.N. «Naufragios» f 36r].

Cultura material vinculada al navío registrada en las colecciones

Entre las 20 colecciones registradas, el 80% (16 colecciones) incluye uno o más elementos identificados como del naufragio del navío *Nuestra Señora del Rosario*, *Señor San José y las Ánimas*. Se debe destacar que de las 20 colecciones, el 55% (11 colecciones) está conformado por entre uno y cuatro objetos solamente (Fig. 3). Es decir que se trata de colecciones muy pequeñas. Sin embargo esto no afecta a la valoración que hacen de estos objetos (Saccone/Bersais, 2011).

Los materiales arqueológicos registrados fueron divididos principalmente en dos grandes grupos: aquellos vinculados con la vestimenta y el adorno personal y aquellos relacionados con la alimentación.

La mirada a la cultura material hacia los pequeños objetos, puntualmente aquellos relacionados con lo textil recuperados del naufragio del *Nuestra Señora del Rosario*, se centró en hebillas, botones, gemelos, dedales y alfileres. También se registraron elementos vinculados con

el adorno personal como medallas, crucifijos, anillos y cascabeles (Larghero/Bersais/Saccone, 2010). Estos pequeños objetos pueden hacer referencia a identidades particulares y grupales, y permitir identificar grupos de género, creencias, sistemas de valores y estatus, entre otras cosas, aunque no se debe perder de vista que los objetos suelen tener múltiples significados en la construcción de estas identidades (Di Paolo/Beaudry, 2006).

Según datos de los archivos, en el navío venía un grupo de misioneros de la orden franciscana que se dirigía a Buenos Aires. La orden franciscana fue la primera congregación religiosa en el territorio del Uruguay, que desde el siglo XVII se dedicó a la labor de «catequizar infieles» y fundó las primeras poblaciones en el litoral del río Uruguay. Al momento del naufragio solo contaban con tres monjes en Montevideo pero se encontraban realizando trámites para conseguir autorización para convertir el hospicio en convento (Otero, 1908) y los misioneros que llegaban en el navío dan cuenta de que la congregación estaba en un periodo de expansión.

Los objetos identificados han sido clasificados en tres categorías: objetos de uso personal, objetos utilizados para la evangelización y objetos para la comercialización (Larghero/Bersais/Saccone, 2010). Sin perder de vista que toda clasificación es una interpretación y por tanto parcial y limitada, estas categorías nos permiten una aproximación más clara en el contexto del naufragio.



Figura 3. Imagen de una de las colecciones locales con varios objetos de *Nuestra Señora del Rosario*.

En cuanto a los materiales identificados como relacionados con las prácticas de alimentación, estos fueron registrados en diversas colecciones y se observaron una diversidad de cubiertos, tiestos de mayólica y fragmentos de recipientes de vidrio. Por otra parte, se indagaron en los autos de la investigación sobre el naufragio, las prácticas mencionadas para la travesía, relacionadas con la elaboración y consumo de comidas, así como con la conservación, almacenaje y transporte de alimentos y otros elementos asociados. De esta forma se buscó conocer mejor un aspecto de la vida cotidiana de los viajeros que a mediados del siglo XVIII se aventuraban en una larga travesía para llegar al río de la Plata, teniendo en cuenta que lo que sucedía a bordo puede ser considerado, en gran parte y más allá de los condicionamientos particulares de la situación, un reflejo de las sociedades de la época (Saccone/Larghero/Lezama, 2012).

¿Cómo se manifiestan las relaciones que en el presente involucran el hecho histórico y los restos materiales que produjo?

De las 20 personas cuyas colecciones fueron registradas (el 45%) 9 personas fueron entrevistadas y estas entrevistas grabadas. En las mismas se refleja la valoración que ellos hacen de estos objetos, las historias de los naufragios de la zona y su relación con la población local: «esos objetos te hacen desentrañar la historia». Y por otra parte refieren la relación del hombre con el mar: «siempre el hombre que vivió cerca del mar está atento al mar». Otro de los temas que se mencionan se refiere a la transmisión de estos saberes y tradiciones dentro de la población local: «la gente mayor de antes, sí salía muchísimo. A cual playeaba más. Y sabían mucho de eso» (Saccone/Bersais, 2011).

Resulta interesante destacar que en cuanto a la adquisición de los materiales de las colecciones los pobladores distinguen entre tres formas a las que asignan un valor relativo distinto. En primer lugar, el hallazgo es la forma más valorada, por algún motivo, el tener la suerte de encontrarse uno de estos objetos en la playa es considerado como algo similar a un privilegio. Es curioso observar también que en ocasiones esta adquisición puede ser considerada como de «propiedad» compartida entre las personas que se encontraban juntas en el momento del hallazgo. En segundo lugar, el regalo es otra forma de adquisición relativamente destacada que suele tener además un valor sentimental añadido. Finalmente, el intercambio de un objeto por otro, que suele darse para dar mayor diversidad a la colección (Saccone/Bersais, 2011).

Implicaciones del naufragio en la actualidad para la comunidad local

El naufragio del *Nuestra Señora del Rosario* es el que dio origen al nombre del cabo y en especial para los pobladores locales se le adscribe un destacado valor simbólico, relacionado con el origen del poblado, si bien, en realidad pasó mucho tiempo entre que el campamento de naufragos y posteriormente buzos rescatistas se retirara y se asentaran en la zona las primeras familias.

De todas formas, la historia de este naufragio se ha convertido en una especie de mito de origen para la construcción de la historia local, que luego va siendo signada por una cantidad de otros siniestros marítimos que ocurrieron con el transcurso de los años.

De la misma manera, este naufragio y otros de la zona se relacionan con la construcción de la identidad colectiva de los pobladores de Cabo Polonio. Quizás por su relativo aislamiento o por ser conscientes de la rigurosidad del clima y de la vida en el lugar, sienten cierta empatía con quienes de alguna forma u otra fueron a dar a sus costas.

Finalmente, cabe destacar que el naufragio del *Nuestra Señora del Rosario*, tiene también un valor de uso turístico. Principalmente los guías de senderismo de interpretación locales han manifestado un gran interés por conocer detalles y características del naufragio para poder incorporarlos a sus visitas guiadas y recorridos turísticos (Saccone *et alii*, 2011).

Perspectivas: incorporación de otras líneas metodológicas

Como se mencionara previamente, la investigación continúa en curso y se espera poder incorporar otras líneas de trabajo además de continuar profundizando en las ya mencionadas (documentación, colecciones y representaciones sociales).

El sitio arqueológico subacuático

En primer lugar, se espera poder realizar una primera aproximación al sitio sumergido, localizado a unos 200 m de la costa. Los objetivos iniciales serán su identificación, delimitación, registro, evaluación del estado general de conservación, conocimiento indispensable para su adecuada gestión. En etapas posteriores un registro minucioso abordará las dimensiones y características particulares del sitio, el grado de dispersión de los restos y su relación con las particularidades del siniestro, si se conservan partes estructurales y cuáles se pueden reconocer y cómo varía la visibilidad del agua en torno al pecio a lo largo del año.

Esta línea de investigación permitirá esbozar una propuesta de lineamientos generales para el adecuado manejo del sitio y definir qué potencial tiene este naufragio para ser incluido en un circuito del área protegida.

El origen del navío

En segundo lugar, interesa investigar la procedencia del navío y su posible construcción en astilleros de Dinamarca. Según indicios hallados en la documentación consultada, el alias del *Nuestra Señora del Rosario*, era el *Fedrisbergs* [A.G.N. «Naufragios» f 159], posiblemente su anterior nombre antes de que fuera comprado por España y podría coincidir con una embarcación *Friderichsborg* construida en 1749 en Copenhague y vendida a España en 1750 de acuerdo a unos planos y descripciones obtenidos de la colección naval de los Archivos Reales de Copenhague.

Evaluar la posibilidad de que el pecio de la costa sea parte de los restos del mismo naufragio

Una tercera línea consiste en abordar el sitio de la playa sur donde se espera contrastar la hipótesis de trabajo sobre los restos del navío registrado en la berma que, según algunas indagaciones preliminares, podría tratarse de parte de una borda del pecio del *Nuestra Señora del Rosario*. Estos restos fueron los que dieron inicio a las actividades del PAS-CIPAC en Cabo Polonio y fueron registrados en el año 2007 a partir de cuyo análisis se observó que se trataba de parte del casco de un navío de madera con clavos de hierro de sección circular de unos 3 cm de diámetro y de hasta 70 cm de largo. La cabeza de los clavos también era circular aunque algo irregular y medía aproximadamente 4-5 cm de diámetro. Según las medidas realizadas se calculó que la superficie de la estructura abarcaba al menos unos 33,5 m². Sin embargo, es posible que al descubrir toda la superficie esta cifra aumente, dado que no fue posible identificar si los extremos

visibles corresponden al perímetro de la estructura (Saccone, 2007). La principal dificultad para el registro de estos restos radica en la zona de la playa en la que se encuentra en la que se trabaja en condiciones difíciles (Fig. 4).



Figura 4. Fotografía del pecio de la playa sur tomada en 2007 por Carlos Calimares en Cabo Polonio.

Consideraciones finales

Cabe destacar que el hecho de que Cabo Polonio se haya transformado en un área protegida, ha cambiado la situación para la investigación, ya que contamos con el apoyo de SNAP (Sistema Nacional de Áreas Protegidas) para continuar investigando, además de contar con el apoyo de la comunidad local. Por otro lado, creemos que el patrimonio cultural sumergido debería ser parte esencial de la fundamentación de por qué proteger esta área ya que se relaciona con sus orígenes y crea la historia y la identidad del lugar.

Por otra parte, el interés en este naufragio no es exclusivo del PAS-CIPAC sino que existe una demanda local de conocimiento sobre su historia y características que ha sido manifestada en diversas oportunidades, durante actividades de extensión realizadas con la población y encuentros con distintos actores sociales. Por lo tanto, las distintas líneas en las que se ha planteado la investigación se complementan y se retroalimentan, por lo que se espera continuar trabajando en todas de forma paralela (documentación histórica, colecciones, representaciones sociales y sitio arqueológico) involucrando siempre a la comunidad local.

Finalmente, se espera poder contar con la cooperación internacional, en particular la participación de España, de donde procedía el navío y de Dinamarca, donde posiblemente haya sido construido.

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El Programa de Arqueología Subacuática de la ciudad de Buenos Aires a partir del caso del pecio de Zencity

The Underwater Archeology program of the city of Buenos Aires since Zencity's wreck case

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Resumen: el hallazgo de una embarcación naufragada en tierras de lo que fuera el viejo puerto de la ciudad de Buenos Aires permitió en una primera instancia el desarrollo de un proyecto nunca contemplado desde un organismo del Estado argentino. Con el tiempo ese proyecto posibilitó que se organizara un programa de arqueología subacuática para la ciudad, respondiendo a las necesidades planteadas por la Convención sobre la Protección del Patrimonio Cultural Subacuático de la Unesco, ratificada por la Argentina en el año 2010. Esta ponencia desarrollará los avances en la investigación y el proceso de gestión al que nos enfrentamos con el desafío del programa.

Palabras clave: gestión, investigación, patrimonio.

Abstract: The finding of a boat that sank in the land of what was the old port of Buenos Aires allowed in the first instance the development of a project never seen before from an agency of the Argentine state. Over time this project enabled a program of underwater archeology for the city, responding to the needs expressed by the Convention for the Protection of the Underwa-

ter Cultural Heritage, ratified by Argentina in 2010. This paper will develop the advances in research and the management process that we face with the challenge of the program.

Key words: Management, research, heritage.

A modo de presentación

A partir del hallazgo de los restos de una embarcación naufragada en lo que fuera el antiguo fondeadero de la ciudad de Buenos Aires y hoy debajo del actual barrio de Puerto Madero, nos encontramos con el problema de tener que retirar los restos encontrados y pensar en su preservación.

La empresa desarrolladora del complejo edilicio Zencity nos dio el tiempo necesario para resolver la extracción del buque a 10-12 metros de profundidad desde el nivel de la calle y así planteamos una excavación de rescate/urgencia que realizamos en cuatro meses.

El hallazgo de los restos del naufragio, durante la construcción del complejo Zencity, en la zona de Puerto Madero, Ciudad Autónoma de Buenos Aires, Argentina, en diciembre de 2008, compuso un cuadro relevante para la arqueología argentina. Se trata, por un lado, del único pecio rescatado y conservado hasta la actualidad en ciudad de Buenos Aires y, por el otro, se hallaron una de las más grandes colecciones de botijos españoles halladas en la Argentina. Se recuperaron tanto la parte estructural existente del barco como los objetos que lo acompañaban. Este trabajo de arqueología de urgencia tuvo lugar en coexistencia con la obra de construcción mediante el trabajo de un equipo interdisciplinario durante el transcurso del tiempo convenido.

El emplazamiento donde fue hallado el pecio de Zencity, si bien hoy día está ubicado en tierra firme, en otros tiempos formó parte del cauce del río de La Plata, el cual posee una dinámica fluvial de gran arrastre de sedimentos, por lo cual es probable que el barco quedara varado en los bancos y/o barras de arena formados a partir de esa dinámica. A su vez, los restos del pecio se comportaron, a lo largo del tiempo, como un «imán» de atracción para aquellos objetos que flotaban en su cercanía, donde también se habrían depositado los desechos arrojados desde la costa, sumándose a las pertenencias propias del barco, quedando luego como parte del proceso de transformación del sitio arqueológico a través de lo que habitualmente se conoce como procesos postdeposicionales naturales y culturales.

Tras el proceso de excavación y extracción de los materiales que conformaban el registro arqueológico, quedó la estructura del barco completamente limpia y ahora había que retirarla de su lugar de hallazgo...

A la hora de decidir qué se iba a hacer con ello los investigadores propusimos el enterramiento controlado del bien. Esta propuesta en un principio no fue del agrado de los políticos (quienes financian el proyecto) y pensaban que dejar el barco expuesto era mucho más rédito, así como tampoco fue bien recibido por el público en general e incluso por algunos arqueólogos que todavía piensan que todo debe ser expuesto originalmente.

A partir de este hallazgo se comenzó a pensar en el lugar final donde se protegieran los restos y además en un lugar donde se montara una exposición permanente que explicara no solo el proceso de investigación del pecio sino también aquellos hitos históricos y geográficos que hicieron de este lugar del mundo un punto neurálgico del comercio de ultramar y hasta estratégico para las colonias españolas del sur.



Figura 1. Mapa satelital de la ubicación del hallazgo del pecio de Puerto Madero y la relación a la Barraca Peña donde fue reenterrado.

El gobierno de la ciudad de Buenos Aires, dispuso el predio denominado Barraca Peña, como el lugar elegido para emprender un proyecto integral. Este lugar había sido expropiado hacía ya varios años y representa un bien patrimonial arquitectónico y por funcionamiento típico de la zona de La Boca/Barracas en el sur de la ciudad.

Barraca Peña es el complejo edilicio portuario más antiguo que se conserva en el barrio de La Boca, construido en etapas desde el año 1774, cuando todavía estas tierras estaban en dominio de la Corona española. Se ubica sobre la avenida Don Pedro de Mendoza al 3000 entre las calles Vespucio y Carlos F. Melo. Su valoración y recuperación da cuenta de una parte de la Cultura del Riachuelo que pedía a gritos ser preservada por su grave estado de deterioro y abandono. Cabe señalar que el 2 de septiembre de 2010, la Legislatura de la Ciudad de Buenos Aires declaró Barraca Peña como Área de Protección Histórica mediante la Ley N.º 3551, y es recién, el 4 de octubre de 2013 que el denominado conjunto Barraca Peña es transferido desde la órbita del Ministerio de Desarrollo Urbano al Ministerio de Cultura del Gobierno de la Ciudad Autónoma de Buenos Aires.

La Barraca Peña y su contexto representan un conjunto portuario urbano que conforma un escenario histórico singular en el espacio costero de la ciudad, englobando la historia portuaria, el desarrollo agroindustrial y comercial, el establecimiento de los primeros ramales del transporte ferroviario y el impulso inmigratorio, todos estos ejes de la conformación de la ciudad de Buenos Aires a lo largo de su desarrollo e historia.

Su emplazamiento y materialidad conforman un espacio urbano y ambiental de características únicas dentro del barrio de La Boca.

El sitio sería parte de un plan estratégico para revitalizar el paisaje urbano del área sur de la ciudad y se han comenzado a restaurar edificios de gran porte, incluso la estructura administrativa del gobierno de la ciudad porteña se trasladaría a la zona de Barracas a fin del año 2014.



Figura 2. Ubicación del predio Barraca Peña a orillas del Riachuelo en el barrio porteño de La Boca.

Sus instalaciones brindan un marco excepcional para desarrollar el Programa de Arqueología Subacuática a través del Museo Arqueológico del Peco de Puerto Madero y un Centro de Exposiciones Temporales, incluyendo también el laboratorio de conservación y zona de actividades con la comunidad del barrio.

La historia y conformación del predio Barraca Peña puede interpretarse teniendo en cuenta los siguientes datos:

El Riachuelo, denominado antiguamente el «Riacho de los navíos» ya que en su desembocadura fondeaban los barcos que venían de Europa, puede considerarse como eje del paisaje, no solo geográfico sino también histórico, realizando su importancia y transformación desde periodos precolombinos y especialmente desde la ocupación española a la actualidad.

En 1774 se establece en el solar Francisco de la Peña y Fernández que se instala con sus hermanos como comerciante lanero y de otros productos en la Barraca.

Para 1860 la propiedad pasa a manos de Emilio V. Bunge (nieto de Peña) quien construye los edificios que hoy siguen en pie. Su propietario fue electo en 1871 como el primer concejal por La Boca e intendente de la ciudad en 1894.

Si bien los restos del barco hoy se encuentran enterrados bajo un metro y medio de tierra en un sector de la Barraca, el programa implica una serie de actividades que optimicen y hagan efectiva la idea de tener, a través del pecio de Zencity, un centro de interpretación permanente en la ciudad. Para ello se ha comenzado en el año 2013 con las acciones de refuncionalizar y valorar el predio denominado Barraca Peña en el marco del rescate del frente fluvial urbano entendido como una nueva centralidad de la ciudad, por lo menos así lo plantea el actual gobierno porteño.

El río, el puerto, la navegación, el comercio, la esclavitud, los productos de la tierra, el ferrocarril, la inmigración, podrían ser los distintos niveles temáticos que el contexto de la Barraca Peña nos posibilitara desplegar el nuevo espacio a través de la arqueología y la historia, acercándonos a la sociedad en el lugar exacto donde se desarrollaron.

Barraca Peña y el programa de arqueología subacuática

La Barraca cuenta con tres edificios, o mejor dicho estructuras, de las cuales una es la que presenta mejores niveles de restauración y funcionalización a corto plazo. La estructura donde se encuentra enterrado el barco ha sufrido los avatares de un tornado lo que produjo el derrumbe de las paredes circundantes, esto sin afectar los restos del pecio. El edificio más antiguo presenta un gran deterioro y los arquitectos e ingenieros están estudiando las potencialidades para su restauración y futura utilización, es el más afectado y el que requiere mayor complejidad en su tratamiento. El edificio principal es el que ha sido reparado y donde se realizaron nuevas etapas a través del tiempo pero es el que se presenta como la estructura más fácil de intervenir y ocupar.

Planteamos en el programa distintos niveles interpretativos relacionados que formarán parte del complejo en los diferentes edificios.

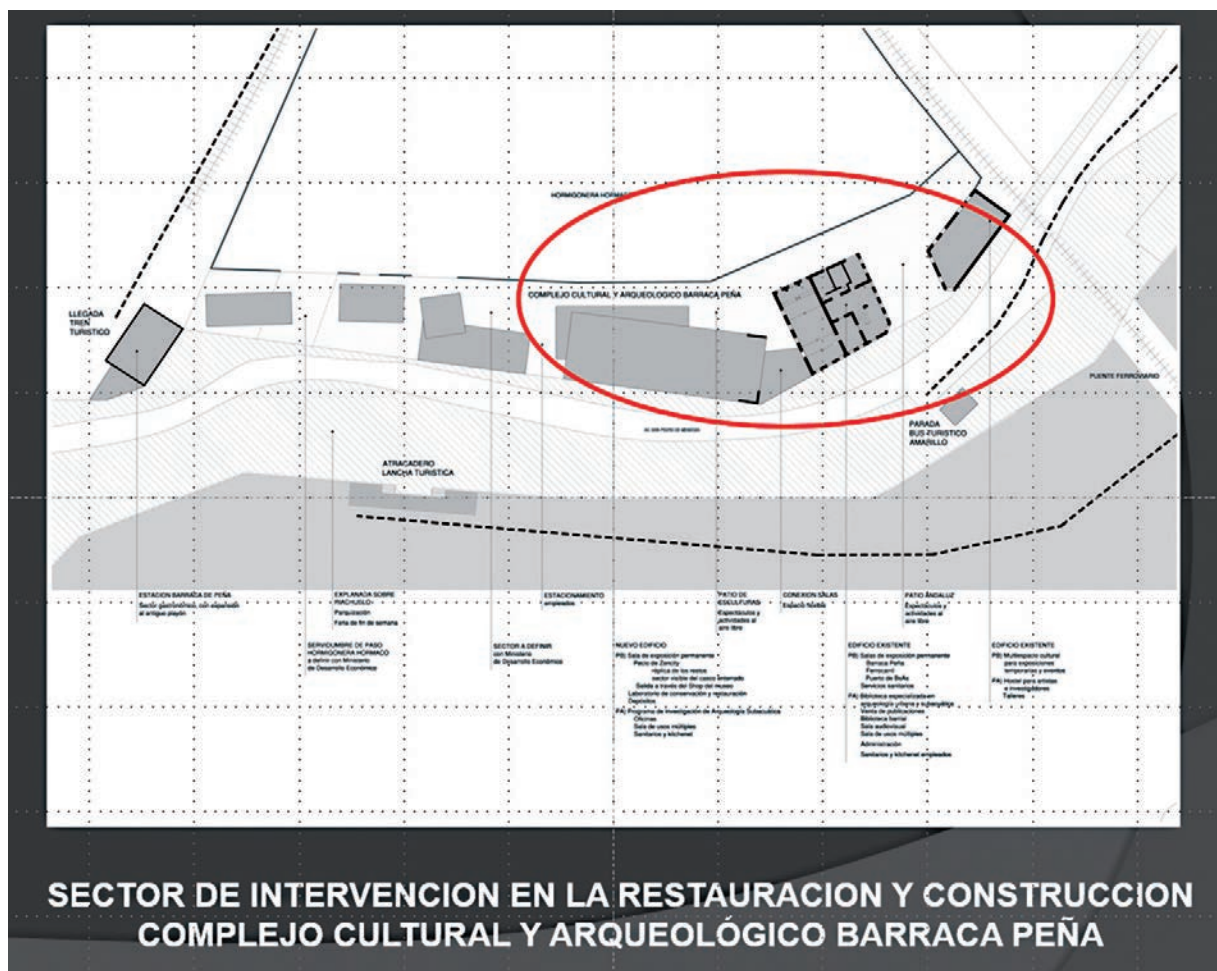


Figura 3. Planos y fotografías del Plan de Refuncionalización de la Barraca y obras realizadas durante 2014.

Edificio principal de la Barraca

Con tres salas expositivas en planta baja que cubran la Barraca de Peña, el ramal ferroviario, el puerto de Buenos Aires. Se contará también con exposiciones cambiantes sobre la esclavitud y el negro en la ciudad y la inmigración a través de los distintos grupos que migraron al país.

En un piso superior una biblioteca especializada sobre los temas que el complejo museológico desarrolla y una biblioteca barrial con material para uso de los vecinos contando con ejemplares de consulta general, material literario diverso, etc. Se podrá contar también con una sala de usos múltiples (SUM).



Figura 4. Planos y fotografías del Plan de Refuncionalización de la Barraca y obras realizadas durante 2014.

Edificio que alberga el enterramiento del pecio

Se proyectará una arquitectura contemporánea de construcción en seco y de carácter industrial que se diferencie de las edificaciones de ladrillo que se encuentran en el lugar. Se respetarán las cualidades formales típicas del paisaje costero (alturas, proporciones, etc.).

Una sala expositiva en planta baja sobre el pecio que se conecta (se debe construir la conexión que puede ser vidriada para dar marco de contexto) con el edificio anterior a la salida de la exposición del puerto. Se contempla poner a la vista un sector de los restos del pecio en-

terrado con un piso transparente, tener una maqueta sobrelevada de los restos y una exposición fija de los materiales hallados en la excavación.

En planta baja también el depósito y el laboratorio de conservación y restauración de los bienes patrimoniales. En el piso superior el Programa de Investigación de Arqueología Subacuática de la ciudad (INARSU-CABA) con escritorios y sala de usos múltiples (SUM). El programa tendrá a su cargo el desarrollo de las investigaciones, la conservación de los objetos patrimoniales, la elaboración de publicaciones, adecuándose a los requerimientos que propone la Convención sobre la Protección del Patrimonio Cultural Subacuático, específicamente de la ciudad de Buenos Aires.

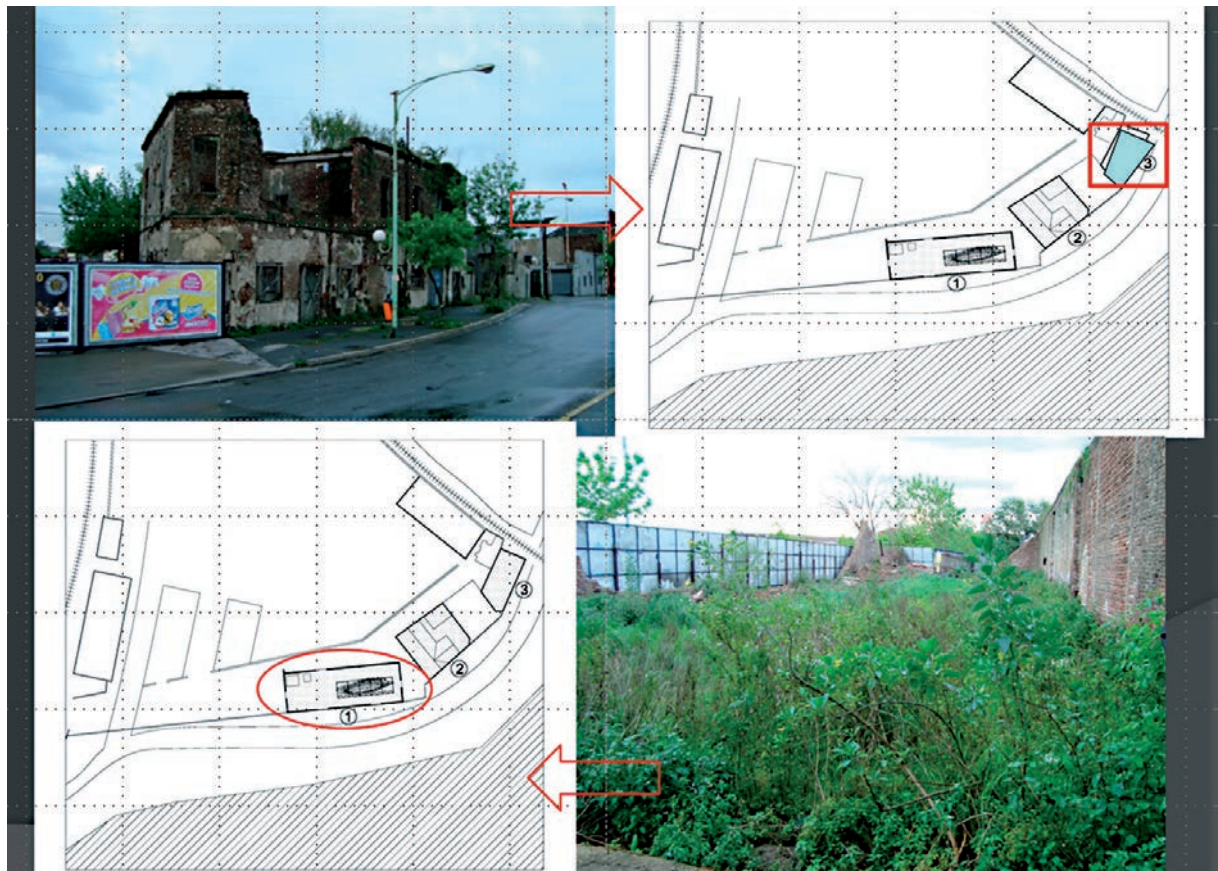


Figura 5. Planos y fotografías del Plan de Refuncionalización de la Barraca y obras realizadas durante 2014.

Edificio del almacén

El objetivo es volver a reeditar el uso de taller y *hostel* para artistas. Recordando que su uso original fue hospedaje y despensa.

En planta baja un multiespacio cultural para exposiciones temporarias, eventos, etc. y sector de talleres que podrán ser utilizados por los artistas que lo soliciten así como para compartir actividades diversas con los vecinos de La Boca.

En el piso superior un estilo hostel que permita el alojamiento de artistas e investigadores así como a los distintos trabajadores, visitantes y turistas que llegan a la zona.

Se implementarán excavaciones arqueológicas en el predio de la Barraca que complementen los datos históricos con la recuperación de evidencia material. El trabajo de campo se llevará a cabo durante el proceso de restauración y construcción del complejo antes descrito y se podrán incorporar talleres en donde los habitantes de La Boca y de Barracas participen en la recuperación de su entorno.

Los sondeos arqueológicos ya se han efectuado en los trabajos que se realizaron en el predio durante el transcurso del 2014 y se han podido relevar los distintos tendidos de vías ferroviarias que habían desaparecido con los cambios efectuados a través de los años.



Figura 6. Planos y fotografías del Plan de Refuncionalización de la Barraca y obras realizadas durante 2014.

Reflexiones finales

Lamentablemente hasta ahora (fines 2014) lo único que se ha podido realizar ha sido la primera etapa del edificio principal y ni siquiera podemos aún utilizarlo...

Dentro de la prosecución del programa hemos planteado para el 2015 el relevamiento del sector del río de La Plata de jurisdicción de la ciudad de Buenos Aires con equipos de sensores remotos y así poder establecer los inicios de una carta arqueológica subacuática de las aguas de la metrópoli, teniéndose antecedentes documentales y de fuentes diversas de un gran número de hundimientos en el río de La Plata.

Un logro a medias ha sido el proyecto de la ley de patrimonio arqueológico y paleontológico de la ciudad de Buenos Aires que necesita se ajuste a la Convención sobre la Protección del Patrimonio Cultural Subacuático del 2001 de Unesco, pero aún no se promulgó...

Es un proyecto muy promisorio ya que implicaría un espacio que musealice no solo los restos del pecio sino el desarrollo histórico del puerto, el riachuelo, la zona industrial y los inicios del ferrocarril, revalorizando un edificio patrimonial y emblemático del sur metropolitano.

Como dijimos antes el programa de relevamiento de la arqueología en contextos acuáticos de la ciudad está en marcha, el predio museal está en camino, lento pero en camino. Esperamos llegar a buen puerto lo antes posible...

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Excavaciones arqueológicas subacuáticas de dos navíos franceses napoleónicos: *Robuste*, 80 cañones, y *Lion*, 74 cañones (1809)

Underwater archaeological excavations of two Napoleonic French ships: *Robuste*, 80 guns, and *Lion*, 74 guns (1809)

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Resumen: desde 2010 se han realizado, en el ámbito mediterráneo, las excavaciones subacuáticas de dos barcos napoleónicos, el *Lion* (74 cañones) y el *Robuste* (80 cañones), con el apoyo técnico de dos organizaciones no lucrativas (el SRASSMF¹ y Areap) y el apoyo financiero del DRASSM y Éveha². Hasta la fecha, se han descubierto 14 fragmentos de estos dos barcos, todos registrados bajo la denominación común: Aresquiers 1. La interpretación de estos yacimientos es problemática. Su posible identificación como el *Lion* o el *Robuste* es solo el primer paso para determinar si los yacimientos están relacionados con el combate naval del 25 al 26 octubre de 1809. Las comparaciones entre fuentes escritas (tratados, planos de archivo, etc.) y los datos recogidos en los yacimientos pueden indicar el grado de conformidad hacia nuestro conocimiento actual.

Palabras clave: naufragios napoleónicos, arquitectura naval.

Abstract: Since 2010, underwater excavations in the Mediterranean have been carried out on two Napoleonic French vessels, the *Lion* (74 guns) and the *Robuste* (80 guns), with technical support from two non-profit organizations (the SRASSMF and Areap) and the financial support of the DRASSM and Éveha. To date, 14 pieces of wreckage linked to these two vessels have been discovered, all recorded under the common designation: Aresquiers 1. The interpretation of these sites is problematic. Their possible identification as the *Lion* or the *Robuste* is only the first step in determining if the sites are related to the naval action of 25-26 October 1809. Compari-

¹ Section de Recherches Archéologiques Subaquatiques et Sous-Marines de Frontignan (France): <http://srassmf.free.fr>.

² Éveha es un operador privado certificado para excavaciones arqueológicas preventivas: www.eveha.fr.

sons between written sources (treatises, archival plans, etc.) and data collected on the sites can indicate the degree of conformity to our present knowledge.

Key words: Napoleonic wrecks, naval architecture.

Originalmente creado en agosto de 1981 para la protección de los sitios arqueológicos de la meseta Aresquiers contra el pillaje, el Centre Nautique de Frontignan realizó campañas de prospección y sondeos en seis yacimientos supuestamente pertenecientes a los navíos napoleónicos. Más tarde pasó a denominarse SRASSMF (Section de Recherches Archéologiques Subaquatiques et sous-Marines de Frontignan), cuya misión, llevada a cabo por un grupo de buceadores voluntarios, fue la protección de este patrimonio arqueológico realizando operaciones autorizadas por el DRASSM³.

Es en el marco de la Carta Arqueológica Subacuática (Atlas) del departamento de Hérault (Francia)⁴, donde se retoma el estudio de los yacimientos de la meseta Aresquiers. En este sentido, con el fin de completar los datos registrados e insertarlos en el SIG de la Carta Arqueológica, se reinicia la investigación de los pecios al objeto de determinar su relación o no con el episodio naval de Aresquiers del 25 y del 26 de octubre 1809.

Los yacimientos forman parte actualmente del inventario de la base de datos Patriarche del DRASSM. Esta base de datos contiene sitios arqueológicos subacuáticos y submarinos conocidos, en los que se describen aspectos relacionados con la naturaleza y dimensiones de los yacimientos, su profundidad, periodo histórico al que corresponde, etc. Los restos de los pecios que pertenecen a los navíos napoleónicos *Lion* y *Robuste* están registrados bajo el nombre Aresquiers 1. Actualmente se conocen catorce sitios arqueológicos relacionados con este episodio naval. Las dimensiones de estos sitios varían entre 1 y más de 20 metros para Aresquiers 1.1. (Fig. 1).

Marco histórico

Tras la derrota de la flota francesa en Trafalgar en 1805, Napoleón (1769-1821) decidió llevar a cabo un bloqueo continental con objeto de debilitar económicamente a Inglaterra. Renunciando al control de los mares, Napoleón se centra en una política de expansión terrestre.

Con el fin de abastecer a las tropas francesas con base en Roses (España), el emperador prepara en marzo de 1809 la organización de un convoy naval. El 21 de octubre, 19 barcos mercantes y dos gabarras parten de Toulon (Francia) bajo la protección de cinco navíos militares: tres buques –el *Robuste*, de 80 cañones, el *Borée* y el *Lion*, de 74 cañones– y dos fragatas –la *Amélie* y la *Pauline*, de 44 cañones–.

Hasta el 24 de octubre, el convoy no se encontró con ninguna fuerza enemiga. No obstante, esa misma mañana y a escasas millas a la vista de las costas de Barcelona, seis velas enemigas son divisadas. El contraalmirante Baudin (1774-1842), a cargo de esta escuadra, decide separarse de las embarcaciones menores y pasar de largo de los ingleses. Buscando el refugio y protección de los cañones emplazados en las playas del sur de las costas francesas, una parte de la escuadra toca un banco rocoso el 25 de octubre. Solo el *Borée* logra salir y arribar al puerto de Sète (Francia) donde ya se encontraba la *Pauline*, mientras tanto la *Amélie* pudo llegar al puerto de Marsella (Francia). El *Lion* y el *Robuste* permanecen varados, en paralelo a la costa. La tripulación se sitúa en sus puestos de combate en el costado de babor de cara a los seis barcos

³ Département des Recherches Archéologiques Subaquatiques et Sous-Marines, Marseille (France). Ministerio de comunicación y de cultura de Francia.

⁴ Atlas bajo la dirección de Marie-Pierre Jézégou (DRASSM, France).

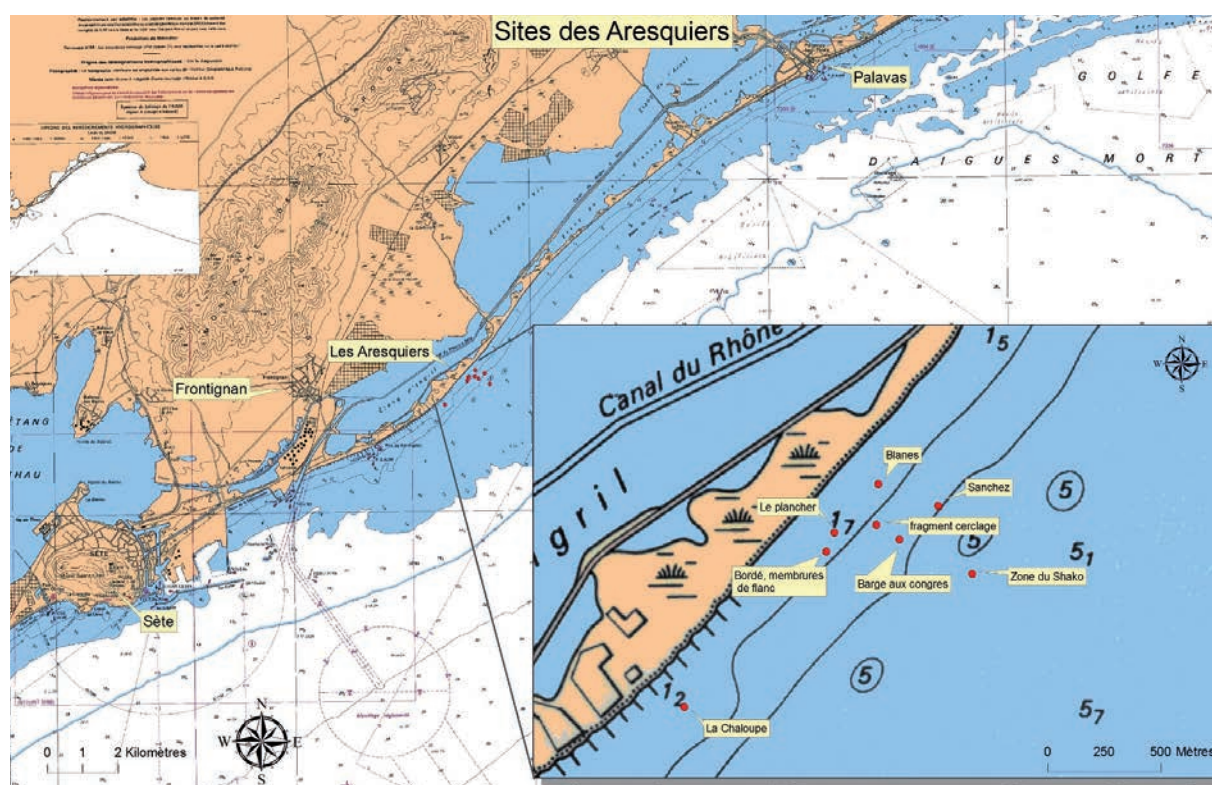


Figura 1. Localización de sitios en el mapa IGN y en el mapa SHOM n.º7053 (J. Letuppe y H. Rakrouki, SRAssmf, 2010).

ingleses. 120 hombres de los destacamentos que están a bordo son desembarcados a tierra, mientras los dos navíos tratan de salir de los bajos.

Tras algunos ataques ingleses y numerosos intentos de reflotamiento, el contraalmirante ordena la evacuación completa de ambos navíos a las 18 h, con la certeza de no haber escapatoria posible. A las 19:40 h, provoca el incendio del *Robuste*, abandonándolo posteriormente junto al comandante Legras, mientras que el comandante Bonamy se aleja del *Lion*. El Estado Mayor se reúne a bordo del *Borée* en el puerto de Sète en las 22 h. El fuego alcanzó la pólvora: el *Lion* explota a las 22 h, poco después el *Robuste*, a las 22:30 h.

Hasta la fecha, se han detectado un total de catorce fragmentos de los pecios, localizándose con precisión en la carta náutica. La profundidad en la que descansan varía entre 3,5 y 8 metros de un sitio a otro, lo que permite trabajar sin las limitaciones ligadas a los yacimientos detectados en profundidad. Se han realizado intervenciones arqueológicas desde 2010 hasta 2013, a un ritmo de un mes por año.

Datos sobre los dos navíos

La construcción del *Robuste* se ordena el 26 de marzo de 1805 a partir de los planos de Jacques Noël Sane (1740-1831). Los trabajos se inician en abril de 1805 en los astilleros de Toulon (Francia), y se bota el 30 de octubre de 1806. El 6 de mayo de 1807 es artillado en Toulon por el comandante Infernet. Del 24 abril de 1809 hasta el 1 mayo del mismo año, parte de Toulon con la misión de abastecer Barcelona, junto a otros cinco barcos bajo el mando del contraalmirante Cosmao-Kerjulien. El 21 de octubre de 1809 parte de nuevo de Toulon con la división del contraalmirante Baudin para abastecer de nuevo a las tropas francesas con base en Barcelona. Será

perseguido el 26 de octubre de 1809 por el vicealmirante Collingwood. Encalla entre Sète y Aigues-Mortes, siendo incendiado finalmente por su tripulación para evitar su captura.

La construcción del *Lion*, buque de 74 cañones, se inicia en los astilleros de Rochefort (Francia) el 30 de junio de 1802, bajo la dirección de Filhon y posteriormente de Bonjean, a partir de los planos de Jacques Noël Sane. Se hace mención de la presencia a bordo de 80 cañones. La quilla se coloca el 8 de julio de 1802. Su botadura se efectúa bien el 12 de enero o el 11 de febrero de 1804. El 10 de mayo de 1804 se artilla en Rochefort. Del 16 de julio al 24 de diciembre de 1805, bajo el mando del comandante Soleil, parte, junto a otros nueve barcos armados, en campaña como parte del «escuadrón invisible», dirigido por el jefe de la división Zacharie Allemand. El 31 de marzo de 1807 es desarmado para ser posteriormente reartillado en Toulon, el 1 de junio de 1808 bajo el mando del capitán de navío Bonamy. El 21 de octubre de 1809 parte de Toulon, como escolta de convoyes, con la división del contraalmirante Baudin para abastecer a las tropas francesas con base en Barcelona. Posteriormente, el 26 de octubre de 1809, y a causa del ataque de la escuadra del vicealmirante Collingwood, sufrirá el mismo destino que el *Robuste*.

Las campañas arqueológicas llevadas a cabo en esos dos naufragios

Aresquiers 1.1

La reanudación del estudio de los yacimientos en el año 2010 comenzó con el sitio Aresquiers 1.1, también llamado «Punto de Blanés» en virtud de su descubridor: Cécil Blanés. El sitio conserva 25 cuadernas. Cada elemento de la estructura naval detectado ha sido inspeccionado y registrado. Un análisis detallado de la carpintería ha permitido descubrir una parte de un buque datado a finales del siglo XVIII-inicios del siglo XIX. Se identifica como un barco artillado de 80 cañones que podría corresponderse con los restos del *Robuste*. Los artefactos descubiertos en este yacimiento se refieren principalmente a la tonelería, identificándose cercos de hierro forjado cuyas dimensiones corresponden a los barriles 2, 3 y 4. Las cuñas para la estiba de los toneles han sido igualmente identificadas entre las claras de la carpintería. Similares a las de los barcos del sitio de La Natière (Francia), permitían mantener en su lugar los barriles evitando que rodasen en el fondo del barco.

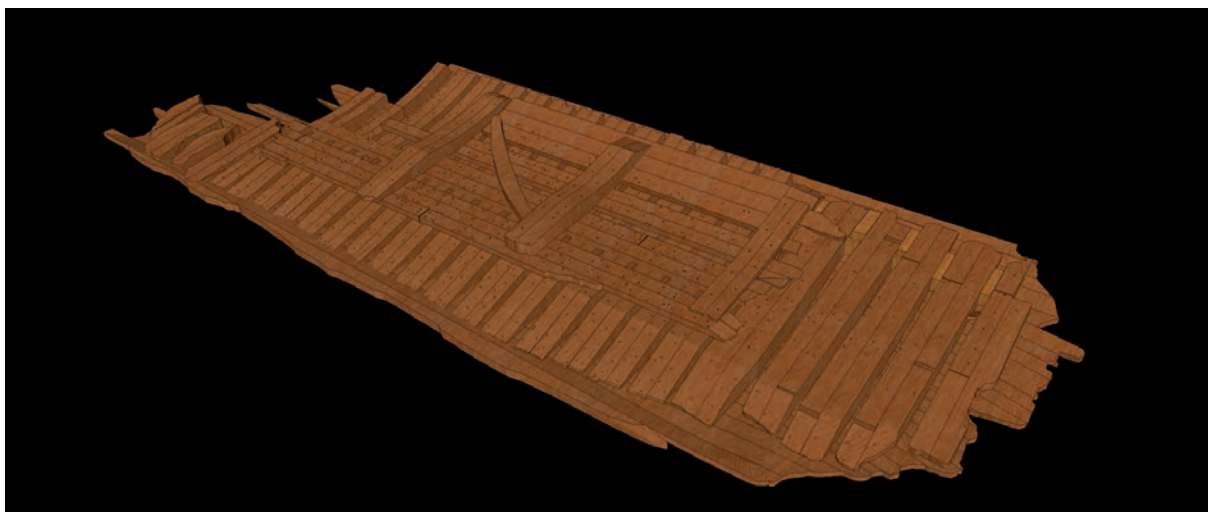


Figura 2. Plano de los restos arqueológicos de Aresquiers 1.1 (Relevos arqueológicos colectivos. Puesto en limpio: J. Letuppe, SRAssmf, 2010-2011).

El estudio de este yacimiento se da por finalizado en la campaña de 2011.

El sitio Aresquiers 1.5 sufre de un importante deterioro debido a la erosión marina, pero también a causa del expolio muy presente en esta área. La localización de este elemento arquitectural de la estructura fue posible gracias a los numerosos datos registrados sobre este sitio. En primer lugar, la presencia de la contraquilla bajo de las llaves ha permitido establecer la línea de crujía del buque.

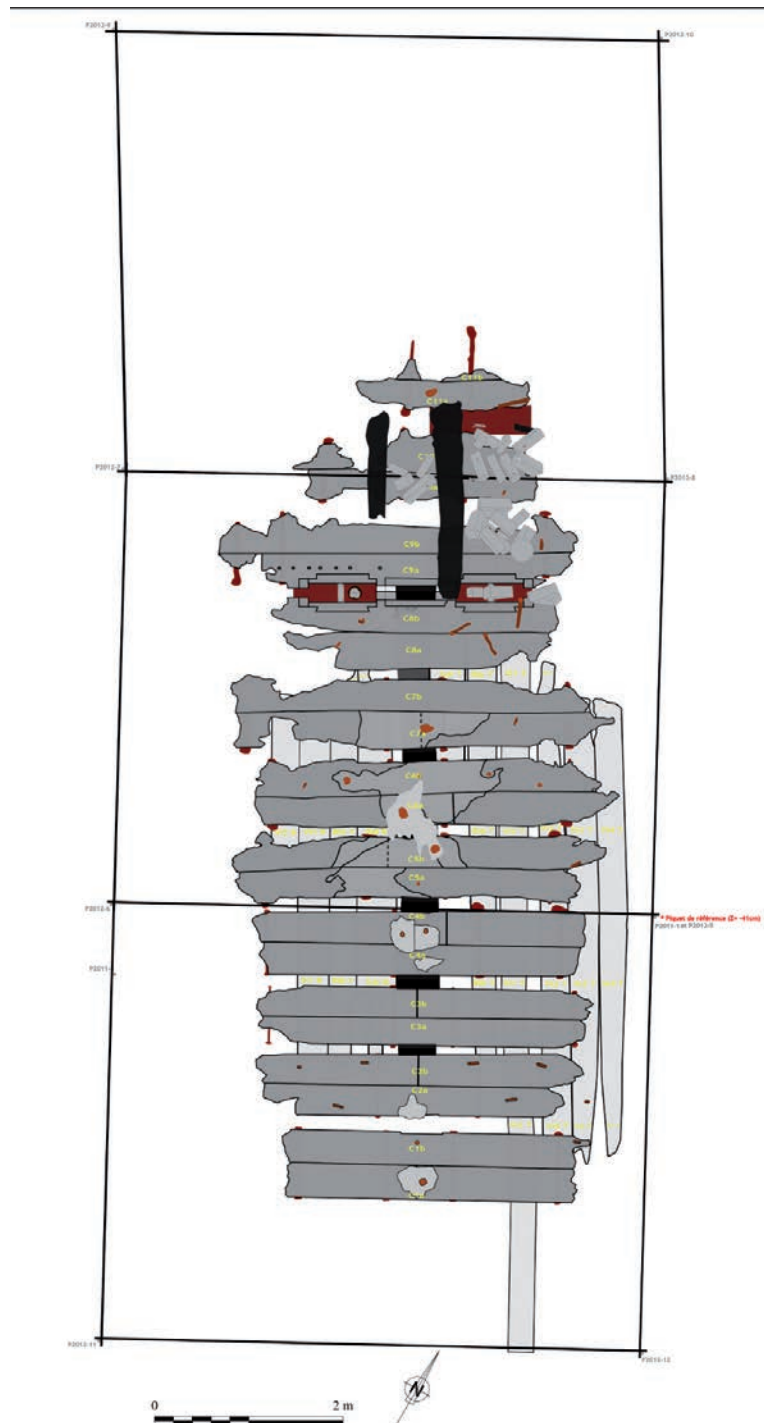


Figura 3. Plano de los restos arqueológicos de Aresquiers 1.5 (Relevos arqueológicos colectivos. Puesto en limpio: J. Letuppe. © Éveha, 2012).

El sentido de la superposición de las planchas de cobre ha podido determinar dónde se sitúan la proa y la popa; es decir, respectivamente al norte y al sur. Lo que hace pensar en la descripción de las fuentes escritas respecto a este episodio naval: los dos navíos (el *Lion* y el *Robuste*) [encallan] a causa del viento de sudeste, exponiendo así su popa hacia el mar y su proa hacia la tierra, es decir, al sur y al norte respectivamente.

La localización de las bombas de achique (Fig. 4) en este fragmento de estructura no deja más que dos posibles ubicaciones: al nivel de la carlinga del palo mayor o al nivel de la caja de mesana. Los gálibos de las cuadernas revelan un desarrollo según el cual evoluciona de norte a sur, su puja aumenta, por lo que las formas son más afinadas hacia el sur. Los ángulos formados por los pasadores de cobre en C2 muestran una vinculación con las formas de las piezas que asegura. Las dimensiones de la carpintería, anchuras y espesores, convergen hacia un barco en el que las dimensiones son similares a las de un navío de 74 cañones.



Figura 4. Bomba de achique en el sitio Aresquiers 1.5 (Cliché: J. Letuppe. © Éveha, 2012).

La presencia de lingotes de hierro, o salmonetes, apoyan la idea de las formas afinadas del casco, ya que se acepta que su localización en un navío se restringe a sus dos extremos con el fin de corregir su asiento tanto en cuanto los víveres van siendo consumidos. El lastre móvil es el lastre más práctico a bordo de un barco. Por otra parte, no hemos detectado la poza de balas, que se localiza en torno a la caja de la gran bomba de achique, ni restos de las balas. Pero aquí no tenemos la presencia de estos parques o bolas de cañones. Si estuviéramos al nivel de la carlinga del palo mayor, tendríamos una carpintería más compleja. Incluso si estas maderas hubieran sido comidas por el *teredo*, aún se conservarían los pernos que se habrían utilizado para su ensamblaje.

Teniendo en cuenta estos datos, es muy probable que este elemento de la estructura se corresponda con la zona donde se ubica la bomba de mesana, teóricamente al nivel de la cuaderna v. Pero sin los planos de construcción de los dos barcos, no podemos ir más allá. La presencia supuesta de una tercera bomba de achique, en E4, puede sugerir que nos encontramos en las proximidades del palo mayor si fueran cuatro, no obstante, no se hace mención en ningún documento a más de dos bombas en mesana. Podrían, sin embargo, ser bombas de apoyo o antiguas bombas denominadas aspirantes sustituidas por las de rosario.

Síntesis sobre el lastre

Tras el análisis de los agujeros que se realizaron en los lingotes de hierro o salmonetes, nosotros avanzamos la hipótesis de que los agujeros de 30 mm de diámetro y los de 24 mm de diámetro se corresponden respectivamente a once pulgadas y una línea y a ocho pulgadas de diez líneas. El peso total es de 590,60 kg. Los orificios de los salmonetes están entre 50 mm y 60 mm de los bordes, representando la anchura y algunos la longitud, a excepción de la pieza E5-4 que tiene uno de sus dos orificios de 70 mm desde el borde representando la anchura y 60 mm siendo su longitud. Las anchuras y los espesores son relativamente similares en todos los lingotes. Las variaciones en el peso y las dimensiones son atribuidas al proceso de su concreción.

Se presenta la cuestión relativa a la presencia, en origen, de las cajas para el lastre móvil, ya que los restos de paredes son visibles. Además, es necesario evitar dañar las bombas con el desplazamientos de este lastre a causa de los movimientos producidos por la mar gruesa, por ejemplo. Del mismo modo no debemos olvidar que el lastre debe ser fácilmente manipulable, a fin de corregir eventualmente el asiento del barco cuando se consumen alimentos. Al mirar el sistema de ensamblaje de las paredes de E2 y E1 no hay huellas de la existencia de clavos. Como hemos visto, se trata simplemente de un sistema de piezas encajadas y mantenidas por medio de una llave. Se evita, de este modo, que se produzcan choques violentos contra las paredes, afectando de otro modo el buen funcionamiento de las bombas.

Hemos podido constatar la ausencia de elementos pertenecientes a la quilla en el sondeo 1, o bien de elementos de madera o elementos de ensamblaje de tipo espiga o de clavos de cobre que se utilizaran para fijar la falsa quilla a la parte inferior de la quilla en una de los niveles estratigráficos. Sin embargo, esta ausencia se puede explicar por la siguiente hipótesis. Nos encontramos ante los restos de un navío armado, muy probablemente de 74 cañones, como lo demuestran los datos recogidos durante las campañas de 2011 y 2012. Este barco ha sufrido varias explosiones vinculadas a su propio barreno, pero también a las del *Robuste* media hora más tarde. Este segundo barreno ha tenido evidentes impactos en diferentes elementos estructurales del navío *Lion*. Recordemos que la decisión de barrenar viene del hecho de que ambos encallaron en un banco rocoso, directamente con la quilla. Una primera explosión sin duda dañó la falsaquilla y la quilla, que absorbió los choques de las diferentes explosiones. El segundo barreno, el del *Robuste*, podría haber reventado todos los elementos arquitecturales de Aresquiers 1.5, expulsándolos así del bajo rocoso.

A pesar de la posición, según el eje casi norte-sur, de Aresquiers 1.5, avanzamos la hipótesis de que este elemento arquitectural no indica la posición del barco durante su barreno.

Este sitio corresponde sin duda a los restos de una embarcación de finales del siglo XVIII-principios del siglo XIX. Las dimensiones se refieren a un navío de 74 cañones, pareciendo identificarse *a priori* con el *Lion*. La presencia de elementos de dos bombas de rosario, así como la evolución de los perfiles externos de las cuadernas, han permitido la identificación con una zona que bien podría corresponderse con la popa.

Aresquiers 1.2

Situado en la zona de baño a 300 metros, este elemento estructural (Fig. 5) corresponde a las partes superiores de un barco armado, en particular por la presencia de una cubierta con sus baos, y de una batiporta completa con su tapa de pequeñas dimensiones.

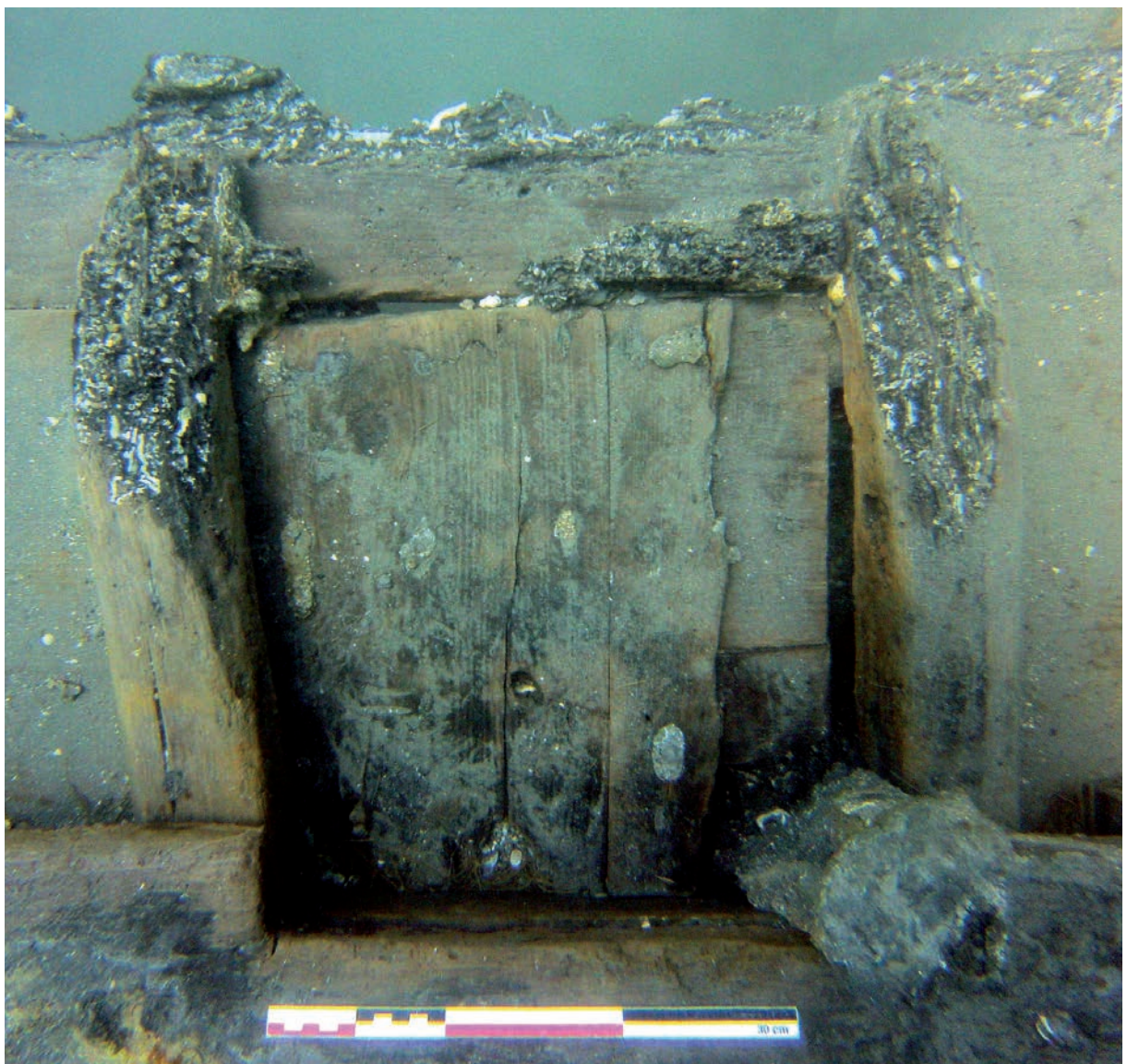


Figura 5. Batiporta (con su mantelet)(Cliche: J. Letuppe. © Éveha, 2012).

Es inusual poder observar este tipo de elementos estructurales sobre un buque de guerra de los siglos XVIII y XIX (Fig. 6). A menudo se describen en los manuales teóricos, nosotros hemos podido constatar que la realidad está próxima, pero no es similar en todos los aspectos.

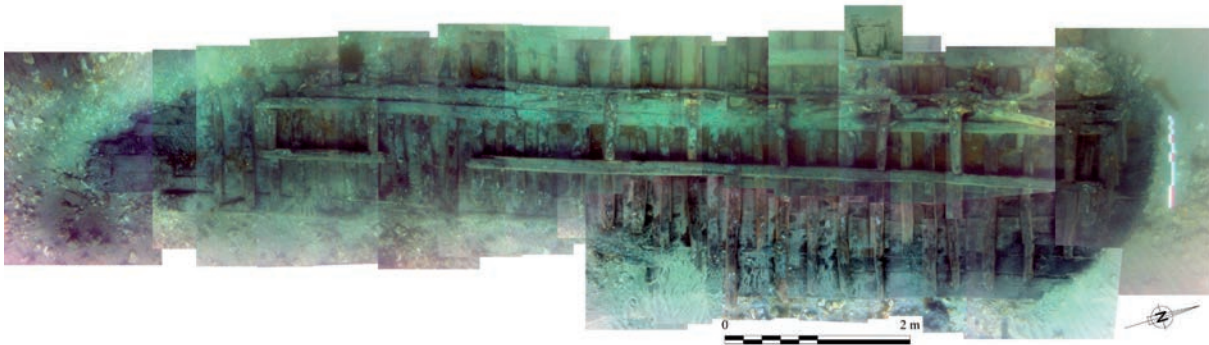


Figura 6. Fotomosaico del sitio Aresquiers 1.2 (Clichés y montaje: J. Letupp. © Éveha, 2012).

Las curvas de baos y las vagras

En primer lugar, el elemento que forma un ángulo son curvas de baos. Se contabilizan un total de siete en este yacimiento, con una distancia (tomada de centro a centro) entre 1,13 m y 1,27 m, que parecen responder a una intencionalidad en el sistema estructural. Más o menos bien conservadas, hemos elegido la curva del bao 3, situada directamente sobre la batiporta, como elemento de descripción, ya que es la mejor conservada. Fuera de la curva del bao 5, todas presentan dos clavos que vienen a fijarlas sobre su extremidad inferior contra una ligazón. Con unas medidas de 0,21 a 0,29 m de ancho, las curvas de los baos son más anchas que las ligazones sobre las que están fijadas. El ángulo formado por la geometría natural de la pieza de madera se ve reforzado con un clavo de hierro para la fijación a la ligazón. En varias ocasiones, la cabeza de los clavos de hierro estaba cubierto de plomo. No hay información sobre esta práctica en los tratados teóricos de construcción.

Ninguna vagra aparece bajo las curvas de bao. En el ángulo se encuentra el contradurmiente, que veremos un poco más adelante. Justo debajo hay una vagra. Las curvas de baos tienen todas una muesca que ha sido tallada en la cara externa, a nivel de su ángulo. En su extremo inferior se detecta otra vagra sobre la que se encargaron de hacer una muesca de las dimensiones de cada extremidad de las curvas de baos. Por lo tanto, estas últimas pueden ser de apoyo si se considera necesario. Además, la fuerza mecánica generada por la curva del bao es reenviada a la ligazón que se ha mantenido gracias a las vagras. La fuerza mecánica se distribuye, por tanto, a los diferentes elementos estructurales circundantes, reduciendo de este modo la que se aplica en la ligazón por la curva de bao.

Se tomó una muestra a fin de realizar un análisis de identificación de especies. El resultado muestra que se trata de arce (*Acer sp.*), que es una madera dura y pesada, cuyos vasos son generalmente rectos.

Los baos y barrotines

Los baos aparecen dispuestos sistemáticamente en número de dos entre cada curva de bao. De sección rectangular, en la que el lado más largo se sitúa paralelamente a la cubierta, se

colocan como pauta de construcción contra el lateral de las curvas de bao. Estos elementos soportan las tracas de la cubierta y representan un enlace transversal poniendo en contacto a las cuadernas y evitando que estas descarguen hacia el exterior. Los baos están dotados de un arco elíptico en las extremidades denominado brusca, que no podemos apreciar en este sitio debido de la mala conservación de estos elementos. Las dimensiones de los baos varían con una anchura comprendida entre 145 y 175 mm y un espesor que varía entre 90 y 135 mm.

Se tomó una muestra con el fin de analizar el tipo de elementos que constituyen los baos de la cubierta. Los resultados indican que se trata de sicomoro (*Platanus sp.*), madera muy apreciada en la escultura por sus cualidades. Se trata de una madera dura y pesada.

Los barrotines son elementos comparables a los baos, pero con espesores sistemáticamente menores o iguales a los baos: entre 75 y 90 mm. La utilidad de los barrotines reside en el hecho de distribuir mejor las cargas de las tracas de la cubierta. En este yacimiento hemos identificado tres barrotines, a razón de uno entre dos curvas de baos cuando se encuentra un entremiche. Como indican los tratados de construcción naval, su posición es central en este espacio. Solo el espacio entre CB1 y CB2 no dispone de ellos. Este «vacío» puede explicarse por las condiciones de conservación en esta extremidad, que se presenta muy deteriorada.

Los entremiches

Los baos no deben derramarse, han sido insertados entremiches entre cada uno de ellos. Estos se encuentran en teoría por encima de los contradurmientes y se encajan en las ranuras practicadas en la cara lateral de los baos.

En este sitio disponemos de numerosos entremiches, pero de un tipo diferente de aquellos rectilíneos que vienen a ocupar el espacio entre los baos. En efecto, disponemos de elementos fijados sobre el contradurmiente, no en contacto con la cara lateral de los dos baos en presencia. En otras palabras, el entremiche aquí no se encuentra en posición horizontal: parte desde una cara lateral de uno de los dos baos para terminar sobre el contradurmiente por debajo de los baos. Sistemáticamente curvado, esta pieza de madera viene a contener un bao sobre dos. La elección del bao sostenido por un entremiche parece arbitraria. Esta pieza de madera mide entre 1,21 y 1,38 m. Se fija al contradurmiente con la ayuda de dos clavos de hierro, uno en cada extremo. Observamos que se ha realizado un agujero circular en el extremo inferior de la curva de bao. Esta perforación no parece necesaria para la función de la pieza de madera. En este sentido, pensamos que se trata de una pieza que juega un papel diferente para el cual fue concebida.

La presencia de un entremiche parece ir a la par con la presencia de un barrotín. Estos dos elementos permiten, por tanto, soportar cargas más importantes. Podemos sugerir aquí que estos elementos aparecen en la carpintería naval a partir del momento en que los cañones se colocan sobre la cubierta, en su vertical. Estos datos no figuran en los tratados de construcción naval. Queda por confirmar si otros pecios presentan un sistema arquitectónico similar.

Las tracas

Conservadas hasta un número máximo de quince, el espesor de estas tracas no es comparable a las observadas en Aresquiers 1.1, 1.5 o 1.3. Correspondiente a zonas altas del barco, el sitio presenta elementos de dimensiones más pequeñas en su sección. En cuanto el espesor del forro, varía entre 38 y 43 mm por un ancho de 0,16 a 0,22 m.

Las tracas parecen estar ensambladas a las ligazones únicamente con clavos de hierro. No se han observado clavijas sobre las ligazones, a pesar de una inspección detallada de estos elementos.

Se tomó una muestra de las tracas, su análisis determinó que se trataba de pino marítimo (*Pinus pinaster Aiton*) que es una madera dura, pesada, resistente y poco deformable.

El material arqueológico

Puesta en marcha desde la campaña de sondeos en 2010, esta base de datos recopila la información del conjunto de artefactos arqueológicos recogidos en los sitios de Aresquiers 1. Se trata de 465 registros. Las múltiples entradas permiten realizar búsquedas relacionadas con: familia funcional del sujeto, el sitio al que pertenece, el informe en el que aparece, registros fotográficos, el tipo de material, etc. Una compilación de muchos datos que no solo nos permitirá realizar comparaciones con otros naufragios napoleónicos, sino también establecer un catálogo del tipo del material arqueológico que se encuentra en los barcos de guerra franceses de comienzos del siglo XIX.

Agradecimientos

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Tróia 1, a journey in time and sea. Shipbuilding and the shipwreck

Tróia 1, un viaje en el tiempo y el mar. La construcción naval y el naufragio

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Abstract: The 19th century is considered the epitome of shipbuilding techniques employed in Iberian dockyards. The increasing need to carry products over longer distances at higher speeds promoted the building of vessels and challenged the basic rules of buoyancy and maritime safety. In parallel with the need to produce more advanced vessels, shipyards also had to respond to new commercial interests that increasingly exploited existing maritime trade routes. The preliminary conclusions presented here describe multicultural and multifunctional ports where crews, passengers, dockers and sometimes shipowners interacted in such a small space. Based on this socio-economic, maritime and cultural context, this paper will focus especially on the shipwreck of *Tróia 1* which sunk in the second half of the 19th century, near the city of Setubal, Portugal.

Key words: Maritime archaeology, shipbuilding, maritime routes, contemporary Age.

Resumen: el siglo XIX es considerado el epítome de las técnicas de construcción naval empleadas en los astilleros. La creciente necesidad de transportar más productos, a través de largas distancias a mayor velocidad, promovió la floreciente construcción de navíos que desafiaron las leyes elementales de la flotación y la seguridad marítima. En paralelo a la necesidad de producir navíos más avanzados, los astilleros también tuvieron que ajustar esta nueva realidad para poder corresponder a una interesada demanda comercial en el extranjero. En este siglo se asientan las rutas de comercio marítimas y los puertos representan una multicultural y multifuncional imagen, donde tripulaciones, pasajeros, estibadores, y a veces los propietarios de los barcos se cruzaban en un espacio tan reducido. Este artículo se centrará especialmente en el pecio de *Tróia 1* que se hundió presumiblemente en la segunda mitad del siglo XIX, cerca de la ciudad de Setúbal, Portugal.

Palabras clave: arqueología marítima, construcción naval, rutas marítimas, edad contemporánea.

Concepts and thoughts

Historians and archaeologists seek to reconstruct the past by reading and analyzing written sources and excavating structures and artifacts. Steffy is changing the way of looking at the past with his remarkable *Wooden Ship Building and the Interpretation of Shipwrecks* (Steffy, 1994). This teaches us that the act of reassembling the pieces of a long lost vessel, consists of much more than simply record their spoils. His concept allows us to think and go further than just the simple approach of trying to understand the remains of a vessel. A ship is born when the owner is moved by his desire to increase profit or the dream of exploring new worlds. The ship's writers and carpenters bring to life their thoughts and experience when the first basic lines started to be drawn and the first timbers started to gain the correct shapes. Their knowledge passed from generation to generation and demonstrates the complexity required to build a vessel capable of leaving a port, crossing an ocean and reaching its destination safely. With these ideas inspiring their actions, the shipwrights, carpenters and blacksmiths teach us today how they were able to convert hundreds of trees in the most diverse shapes and dimensions. Once built and launched on the water, the vessel becomes the residence of its captain and crew. These humans act as fishermen risking their lives in the North Sea or merchants who moved from port to port.

Analysis and interpretation of the wood structures and methods of shipbuilding

The remains of the Tróia 1 are completely scattered on an area of approximately 13 000 square meters, where different wooden fragments of the hull may be seen.



Figure 1. Tróia 1 Archaeological site.

The wooden structure located in the central core is a fragment of the ship's hull where several planks are still attached to the timber frames. The wooden hull fragment close to the set of two anchors toward east-west (central core-spot «0») has a similar configuration to the first wooden fragment. At the west sector a fragment of a deck knee can be seen as well as the presence of beams. However, this section of the deck is displayed in an inverted position enabling the full visual observation of the deck planks. The keelson, and second keelson or buttress, were isolated from other hull structures after the collapse of the vessel and dragged through the bottom of the sea.

The anchor type «admiralty» located near the central core, presents a similar configuration to the other located at spot «0». Although it only remains a fragment and it's presumed wooden stock.

During the excavations the late finding of the bow proved to be critical for the interpretation of the shipbuilding method used in the manufacture of the ship. As a result of further analysis it was possible to identify and assess the possible dimensions of the vessel and to develop a theory as to the ship's size and function. Moreover, the positioning of the remains with respect to their geographical orientation provided useful information about the heading of the vessel. The bow was facing north which means that the ship's crew was trying to enter the Sado estuary bearing northeast. The winch also facing the same way, apparently fell on top of what would be the mooring storage and has not moved since the ship structure has collapsed. However, we still have not concluded where the ship was built or its provenance on its last journey. The timbers were analysed and we conclude that the hull is made from *Ulmus Minor* (elm) and *Abies Mill* (silver fir) (wood anatomy analysis developed by Claudio Monteiro (project curator)).

Another unanswered question that remains is related to the ship's propulsion. Given the presence of huge set pieces of rigging, the absence of any mechanism to add propulsion (such as boilers or any other kind engine), shaft, or bearings, and propellers. In order to address this question, it was necessary to analyse similar ships to understand the shipbuilding methodologies employed. The remains of the schooner *Novos Mares* displayed nearby the Maritime Museum of Ilhavo were analysed as well as the publications written by shipwriters and shipbuilders (Desmond, 1919; Castanheira, 1991; Silva, 1948). Table 1 shows the results of that analysis where the different measurements (schooner *Novos Mares*, Tróia 1 and the guidelines from the shipbuilder Silva Valente (1948: 33) are displayed.

Timber Typology	Ships		Rules for shipbuilding from the shipbuilder Silva Valente			
	Troia 1	Schooner Novos Mares	Basic measurements			
futtocks:			vessel configuration	length between perpendiculars	45.50 m	
	futtock configuration	double		double	floating length	10.60 m
	thickness	16 cm		15 cm	deck length	10.60 m
	width	14.5 cm		15 cm	careens depth	4 m
	length	n/d		35 cm	aft draft	5.05 m
	spacing	17 cm		15 cm	fore draf	3.82 m
planks:			bottom-line of the hull and the perpendiculars fore and aft	bottom-line to the line	4 m	
	outside	6 cm		10 cm / 8 cm	bottom-line to deck	7.75 m
	inside	4 cm		9 cm / 12 cm	bottom-line to the castle	10 m
					bottom-line to the bow top	10.80 m

Timber Typology		Ships		Rules for shipbuilding from the shipbuilder Silva Valente		
nails:	iron	n/d	1.5 cm	heights in the master frame	from bottom-line to deck	6.60 m
	copper	1.5 cm	n/d		bottom-line to top	6.60 m
					bottom-line to fluctuation	4 m
kell:				height aft	bottom-line to deck	6.25 m
	shape	n/d	composite		bottom-line to castle	8.50 m
	thickness	n/d	51 cm		bottom-line in the middle of the stern contour	5 m
	width	n/d	n/d	length of castles, depending of perpendiculars in overall length	sft castle	11 m
	length	n/d	n/d		Bow castle	15.50 m
					keel width	0.50 m
keelson:					keel thickness	0.50 m
	thickness	15	29 cm			
	width	35	32 cm			
length		43.68 m		53 m		
width		10.41 m				
depth		4.91 m		5.6 m		
Tonnage (bruta)		433.74 tons		between 110-1200 t		
tonnage (Liquida)		334.66 tons				

Table 1. Comparison Table between the dimensions of Tróia 1-Schooner the *Novos Mares* and Valente (1948, 36) and Desmond (1919, 22) tables.

Based on the foregoing table, it is possible to find answers to questions relating to the type, measurements and chronological period. For instance, there are some similarities in measurements between Tróia 1 and *Novos Mares*. Especially in timber thickness and width, the inside and outside keelson and lining as well as the thickness of the pins. The vessels therefore could have similarities in type or function. Moreover, according to the records the *Novos Mares* has strong similarities with the rules written by Valente, and in the applied scale we may achieve the Tróia 1 measurements by the rule $(\text{length} \times \text{pontal } \textit{Novos Mares}) / \text{length} = (43.68 \times 5.6) / 53 = \pm 4.91$. These measurements and analyses allow us to fit Tróia 1 into the typology of a schooner.

The last large wooden ships built in the country until the mid-twentieth century had bolts, rivets and iron nails (Silva, 1948). Although in some cases they could still be manufactured in brass materials to reinforce the assembly used in areas below the water line. However, neither

of these situations applies to Tróia 1, since in all wooden structures bolts, rivets and nails of bronze were used. This indicates that the Tróia 1 was first built between the beginning of the 19th and the first quarter of the 20th century.

According to the current stage of the site formation, its positioning, the scattering of remains found and the absence of structural parts of the hull, including the keel, may lead us to think that the reason that the vessel sank was a wrong approach to the deepest canal of the Sado (northeast). Where soil conditions promote significant variations on the water column that goes from depths below 20 m to 8 m and then to 4 m in relatively short distance. This may have influenced or originated a crash against the sand banks, causing massive and ongoing destruction of the hull along the entire length of the shoal.

Other issues arose during the research, such as: What was brought on board? We have not yet reached clear conclusions related to the cargo or structures and containers, but based on the existing archives (Torre do Tombo, Arquivo Distrital de Setúbal), the port of Setúbal, was commonly used for trading fish and raw material such as salt. So we may conclude that the Tróia 1, *as* a schooner would have possessed a significant space for cargo and its main activity was likely related to the transport of salt, fish or other goods in bulk.

Historical background – the navigation and maritime routes

To make possible the interpretation of traces related to underwater cultural heritage in the Sado region, as well as the strategic importance of the delta of Sado, it is necessary to go back in time until the moment that people, having the need to transport more quickly, crossing a river or to navigate goods between islands, soon began to build small boats. Along with the evolution of the people and improving techniques of shipbuilding, work continued on a rolling process that has been recorded up to the present day. Tróia was located on the south bank of the River Sado during the Roman period (1st to 6th century of our era) and was an important center for the fish industry which benefitted from the significant abundance of salt and fish in the cool seawater. High levels of production and an expansion of the industrial compound also contributed to the increase maritime traffic. Not only with the intensification of fishing, but also with an increase in the number of vessels used to carry the fish products that mostly supplied Rome (Almeida: 2008, 12). However, the use of salt for the purposes of industry or trading was not only developed during the Roman occupation, but the beginning of it through centuries.

Since the early 1950s most of the archaeological artefacts recovered from the river Sado (especially in the Caldeira de Tróia) are mainly related to the Roman period. Although, the archives refer to a large number of shipwrecks in the Sado estuary especially at its mouth. There are just a few located shipwrecks though, and mainly from the second half of the 20th century, which made the finding of the Tróia 1 very significant for the area and its chronology.

For a better understanding of the importance of the sea and the estuary of the River Sado for the population of the surrounding towns, we can highlight two different usages of the water. The first one refers to a partnership with the sea, with populations in which its economy was based on the shipbuilding industry, stowage and transportation and fish commerce. For the second, the more restricted usage of the confined water of the estuary. Based on the nautical history perspective, we are in the presence of a population in which their livelihood is based unequivocally on activities related to the sea and the river. There are several factors that contribute to the success of this industry, such as the geomorphological setting of Sado region. Which is the first natural harbour for vessels sailing from south to north, which has ideal conditions for the safety of populations settled in nearby villages. This provided two things – easy access to the sea, essen-

tial to their livelihood; and a broad estuary capable of hosting an extensive and varied range of vessels regardless of their type, size or functionality. Strongly attached to *Sadino* culture, salt has over the centuries been of the utmost importance and reaches a greater significance in the mid-19th century, when the need to preserve food items was essential during long ship journeys. Thus it achieved the status of essential good, and became vital for countries producing goods with basic conservation needs, but were not salt producers themselves. For instance, countries in northern Europe, particularly Ireland with unsuitable atmospheric conditions for the production of salt, had a need to import in order to safeguard the production of artisanal butter (which was Europe's largest producer), and meat preservation for consumption across regions.

1. Bovine cattle, low metabolic productivity but very important as they were the typical *milch cows* of this landscape, are responsible for the production of milk and therefore the production of butter.
2. Swine cattle, which was considered highly productive but exclusively targeted for immediate consumption, since without salt for conservation, this could not be sent to British colonies.

During this process, operating in the prevailing commercial and maritime corridors between the two countries, the commercialization of salt saw it named locally as *white gold*. The salt, traded on a frequent basis but in small amounts, would eventually prove essential to the populations of Cork (Horta, 2005) whose livelihood was based almost exclusively on the production of handmade butter. However, Portugal later realized the importance of Cork, which proved to be decisive in establishing trade between the two countries, becoming one of the main destinations for the trade of domestic products (Horta, 2005).

The port of Cork, set in the south of Ireland and geographically aligned with the Atlantic Ocean currents, proved to be a strategic port for maritime trade between Portugal and the British Empire. The established shipping lanes and business relationships that came to develop, accelerated the trade in various goods such as salt, wine, cork and fruit (Horta, 2005). These products were transported almost exclusively by Portuguese vessels enhancing the economy of Portugal – particularly for shipbuilding and other labor associated with marine industries as well as all the necessary logistics for export (crews, ports, shipyards, etc). It became necessary to establish consular offices across borders in order to protect the rights of Portuguese navigators and sailors. Trade regulation was established including customs duties and aid to Portuguese vessels in case of wreck or accident. The importance of this export trade was so large that consuls and vice consuls were installed in many different areas such as Dublin, Limerick, Waterford, Belfast and Derry, embracing all Irish territory (Horta, 2005).

Salt production was carried out seasonally, which suited the slower and purely handmade production of butter in the country side cottages. In the return circuit, butter from Ireland was received in the port of Lisbon and then consumed in all regions of Portugal, which was the second largest consumer of butter immediately after England. This justifies the intense maritime traffic between the two countries, and highlights the fact that the port of Setúbal was the largest port of exports to Ireland, and Lisbon – the main destination of vessels from Ireland.

Considerations

The remains of Tróia 1, represent the first known underwater archaeological site near the mouth of the river Sado. But, as mentioned before, it likely represents just a small portion of the maritime heritage. The archives may tell us much about incidents related to ships, but under the perspective of an archaeologist it is far more interesting if we join the archives with material evidence. The Tróia 1 Project was developed during three (amazing) years where «us» archaeol-

ogists had the precious help of marine biologists, geologists, hydrographers, conservators, enthusiasts, and undergraduate and postgraduate students. This project was born from the will to know more about tremendously scattered ship remains. The dedication and enthusiasm of the team led to the development of the research project and it is expected that the answered questions constitute only the starting point for another three years of research. Every one that was involved in the diving operations soon became more and more interested to know about the site formation. The hull fragments, by the way they are displayed tell us so much, that sometimes we just stayed looking at it trying to figure out where to start. The Tróia 1 research project brought to light that a team with completely different backgrounds may work for the same purpose.

At the beginning no matter from which perspective we look, the wooden fragments remained a mystery. The devastation caused at the moment that the ship was sinking and successive winter seasons and storms, covered most part of the hull timbers. The first results only started to be achieved when the team learned when were the best tides to collect data during the dive operations. The site is predominantly plagued by strong tides and waves due to its 6 meters depth (in other places – such shallow remains are an advantage!). In this particular case there is an asymmetry between the northern and southern shore of the mouth of the river Sado. In the north where the navigation channel is established, the depth and tidal currents are stronger, but the bottom of the sea maintains its shape. However, in the southern channel, which today is only fit for the navigation of small boats, the depth changes from tide to tide. Day by day we may see a different sea landscape, which generates a permanent seabed mutation. This, the essential task of collecting data took us more time than expected. But yet, now we know with reasonable confidence that the Tróia 1 ship is very similar to a topsail schooner; the crew was trying to enter in the Sado estuary, possibly was bringing bulk products; the hull shape represents a shipbuilding methodology used between mid-19th century and the early 20th century; and, finally that the eventual cause that led to its sinking was a wrong approach to the entrance of the river, which was significantly violent to destroy the ship over a vast area.



Figure 2. General view of ship wooden remains.

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Submarino Peral. Arquitectura naval, historia, restauración y valoración

Peral submarine. Naval architecture, history, restoration and public access

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Resumen: la primera navegación submarina de la historia: después del primer grupo de ensayos, se llevó a cabo el segundo el 07 de junio de 1890. Esto implicó dos inmersiones y emergencias a 10 metros consecutivos en el tiempo de una hora. A las 15:00 h el submarino se sumergió a la profundidad requerida mientras se movía a toda velocidad y hacia el oeste. El buque mantuvo su equilibrio durante la primera hora, con un ambiente respirable a bordo. El «aparato de profundidades» mantuvo al submarino a la profundidad especificada, controlada por el capitán. La luz a esa profundidad era suficiente para leer y escribir sin necesidad de iluminación artificial. A las 15:59 h, un minuto antes de la ascensión, la tripulación vitoreó a la reina, España y la marina, lo que confirma su éxito a diez millas de la costa en el mar abierto, donde el agua estaba a 70 metros de profundidad.

Palabras clave: submarino, Peral, navegación, construcción, Cartagena.

Abstract: The first submarine navigation of the history: After the first set of trials was concluded, the second was undertaken on 7 June 1890. At 15:00 the submarine submerged to the required depth while moving *full speed ahead* and *westward*. The vessel maintained its balance throughout the first hour, with a completely calm on-board environment. The «depth device» kept the submarine at the specified depth with fluctuations of an amplitude of less than 30 cm, controlled by the captain, which sometimes took as long as 10 minutes to reach. The light at that depth was sufficient to read and write with no need for artificial lighting. The «depth device» also operated

without a single incident. At 3:59 PM, one minute before the ascent, the crew cheered the Queen, Spain and the navy, confirming its success ten miles off the coast in the open sea where the water was 70 metres deep.

Key words: Submarine, Peral, navigation, construction, Cartagena.

Arquitectura naval y construcción del submarino Peral

Gracias a los más de 380 planos originales que se creían destruidos y que se encontraban desde 1972 en el Archivo Histórico Nacional, a la memoria del submarino escrita por Peral y el libro de oficios del submarino, ahora podemos saber cómo funcionaba este logro de la ingeniería naval de finales del siglo XIX.



Figura 1. Submarino Peral 8 de septiembre de 1888 día de la botadura.

La idea surgió en 1884, pero no se construyó hasta 1887, fue botado en 1888 y terminado a primeros de 1889.

Prácticamente todos los materiales usados para la construcción fueron traídos del extranjero. Isaac Peral se documentó en revistas técnicas inglesas, alemanas y francesas sobre lo último en tecnología naval, electricidad e ingeniería.

Para calcular las dimensiones y forma del submarino, Peral se sujetó a las reglas y tablas ofrecidas por el ingeniero y arquitecto naval John Scott Russell, siguiendo el sistema de líneas de olas para su hidrodinámica, salvo las inevitables, atendiendo entonces a las opiniones del profesor Rankine sobre la elección de curvas conveniente para la forma de la parte anterior, central y posterior del barco.

Todos los submarinos contemporáneos al «Peral», buscaron la mejor hidrodinámica posible siempre pensando en la navegación submarina, por ese motivo todos utilizaban esas líneas cilíndricas y cónicas que siendo la mejor en inmersión, en superficie demostraron no ser la mejor opción, por el balanceo originado por las olas sobre todo cuando venían de costado. Este diseño cambió radicalmente años más tarde con los submarinos de la Primera Guerra Mundial.

Isaac Peral se comprometió en construir el submarino en 9 meses, pero no pudo ser pues los materiales llegaban a Cádiz a cuenta gotas. En Alemania se adquirió la bomba de aire y el tubo lanzatorpedos Schwartzkopff, con él podía disparar y recargar hasta tres torpedos, siendo el primer submarino en realizar esta proeza.

En Inglaterra se compraron los dos motores eléctricos Immisch de propulsión de 30 caballos diseñados por el propio Peral, uno de 6 caballos y dos de 4 para la inmersión del submarino.

El acero en planchas y barras eran Siemens comprados a la casa Tenaunts de Londres, dos aneroides y una corredera eléctrica que indicarían la distancia recorrida y por consiguiente también la velocidad de la nave.

Cuatro hélices; dos de propulsión y otras dos de profundidad y los ejes fueron comprados en Londres a la casa John Thornycroft. Una aguja náutica construida por la casa Lilley & Sons que indicaría al submarino la orientación bajo el agua. Para protegerla de las desviaciones magnéticas y campos eléctricos la instaló en el exterior del submarino. A la casa de los señores Ferman Son, se le encarga la construcción de las piezas del codaste y los marcos de los timones.

En París se compraron los aparatos para la torre óptica de visión indirecta que asomándola a superficie y por medio de un prisma, proyectaba lo que ocurría en el exterior sobre una mesa que se regulaba en altura para enfocar la imagen sobre un papel milimetrado. Con este aparato se calculaba la distancia a la que se encontraba el objetivo con el fin de realizar el disparo de torpedos.

La electricidad era el corazón del submarino. Hasta esa fecha nunca se habían alimentado equipos o motores a 500 voltios y 50 amperios siendo Peral el primero en conseguirlo. Utilizó para ello 613 acumuladores comprados a la Sociedad L'Electrique de Bruselas. Este acumulador Peral lo perfeccionó cambiando las cajas de madera por otras hechas de ebonita estancas; modificó las placas positivas para aumentar su duración; sustituyó los ácidos y colocó limitadores que evitaban la sobrecarga y la generación de gases nocivos.

Pero su mayor invento, y secreto, fue el aparato de profundidades. Era un aparato mecánico-eléctrico, que funcionando en automático, permitía que el submarino se sumergiera a la profundidad deseada siempre en horizontal.



Figura 2. Submarino Peral cargando baterías.

Esta era la diferencia más importante con los submarinos de la época, mientras el submarino Peral bajaba a la profundidad deseada en automático ya en movimiento o en reposo, los demás utilizaban la fuerza humana moviendo los timones de profundidad constantemente para mantener la profundidad y nunca con el buque en reposo.

El logro más importante fue realizar la primera navegación submarina de la historia. El 7 de junio de 1890, el submarino se sumergió a 10 metros, navegó a esa profundidad durante una hora y emergió en unas coordenadas ya preestablecidas.

La iluminación interior la resolvió por medio de 14 portillas con cristales Fresnel que aumentaban la luz natural, pero también colocó 20 lámparas, 10 de sistema Edison y 10 de Brush.

Cuatro depósitos y un purificador de aire permitían que una tripulación de 12 hombres pudieran respirar con autonomía más de 50 horas.

Todo este conjunto de aparatos y equipos que configuraban el submarino de Isaac Peral, marcó la base de los submarinos actuales.

Historia del casco del submarino

A principios de 1891, se abandona el proyecto de seguir adelante con las pruebas de mar del submarino Peral, quedando este varado en el mismo lugar donde había tenido lugar la botadura el 8 de septiembre de 1888.

Al poco, empiezan a serle desmontados todos los elementos, tanto externos (hélices, líneas de ejes, candeleros, torre óptica, aguja náutica, corredera...), como internos (baterías, aparatos de precisión, elementos de gobierno, mesa de visión indirecta, etc.). Igualmente, le es desmontado el tubo lanzatorpedos, para lo cual sufre la primera de las agresiones, pues el casco es cortado a la altura de la proa en sentido transversal, aumentando de este modo el calibre del orificio donde está «incrustado» el tubo de lanzar, a fin de poder sacarlo. Se puede afirmar que al submarino le faltan, aproximadamente, unos 20 centímetros de eslora.

También se le practica una cesárea al casco a la altura de la quilla en la parte de popa, con el fin de poder extraer los motores eléctricos y aquellos otros equipos que debido a su tamaño, no podían ser sacados de otro modo.

El elemento más importante, el aparato de profundidades, sería destruido a golpe de marro por los propios colaboradores del inventor.

En 1892 el tubo lanzatorpedos se ordena trasladarlo a Cartagena, donde se encontraba la Escuela de Torpedistas, y donde se destinaría a uso didáctico.

Por Real Orden de 3 de noviembre de 1913, se decreta el desguace del Submarino Peral. Al llegar la noticia a esta su ciudad natal, la corporación municipal solicita al ministro de Marina que sea trasladado a Cartagena para su conservación.

El ministro Miranda se interesa y solicita al almirante jefe del Arsenal de La Carraca un informe del estado del submarino, pero este responde recomendado su desguace, debido al «avanzado estado de deterioro» y al elevado coste que supondría su reparación.

Por Real Decreto de 17 de febrero de 1915, se crea el Arma Submarina Española, siendo bautizado con el nombre de Isaac Peral el primero de los submarinos que vino a incorporarse a la nueva Arma, y unos años después, el 16 de julio de 1919, toma posesión como capitán general de Cartagena, don Pedro Mercader Zufía, único miembro de la dotación del Peral, que consiguió llegar al Almirantazgo, el cual visita esta nueva unidad, en calidad de máxima autoridad de la Armada en Cartagena. En octubre de 1922 es destinado como almirante jefe del Departamento de Cádiz, donde al llegar puede comprobar el lamentable estado que ya presenta el submarino en el que él mismo había navegado, hacía ya 33 años.

Pasados otros cinco años, en noviembre de 1927, en Cartagena se erige un mausoleo para albergar de manera definitiva los restos mortales de Isaac Peral, por lo que se vuelve a retomar el asunto de evitar la inminente pérdida del submarino, que en esa fecha ya lleva 38 años arrumbado en el Arsenal gaditano.



Figura 3. Submarino Peral abandonado en el Arsenal de La Carraca.

En 1928, es nombrado ministro de Marina el almirante Mateo García de los Reyes, primer Jefe que había tenido el Arma Submarina, el cual visita Cartagena, a mediados de septiembre de 1929, con motivo de celebrarse aquí unas importantes maniobras navales.

La ciudad le rindió diversos homenajes y como agradecimiento da la orden de preparar el casco, que llegaría finalmente remolcado a Cartagena en el otoño de 1929. Unos meses después, en marzo de 1930, es finalmente puesto en seco quedando como ornato de los jardines de la Base de Submarinos.

En esa ubicación, en la que entre otras vicisitudes se salvaría milagrosamente de los intensos bombardeos aéreos que en la Guerra Civil sufriría el Arsenal de Cartagena, permanecería hasta diciembre de 1965, fecha en la que el Delegado de Turismo solicitó a la Armada que accediera a sacarlo fuera del Arsenal, con el pretexto de que podría servir como «reclamo turístico». Trasladada la petición al ministro de Marina, Almirante Antúñez, este autorizó un «cambio de ubicación», para lo cual se cortó en tres trozos, opción elegida al no disponerse de otros medios más apropiados.

Una vez en su nueva ubicación, y tras ser soldadas las partes, pronto se convirtió en el «icono» de la ciudad.

En octubre de 1991 es llevado por carretera a la Expo de Sevilla, siendo su nuevo hogar temporal el Pabellón de Murcia, regresando al finalizar a su anterior emplazamiento de la plaza de los Héroes de Cavite, corriendo el mes de octubre de 1992.

En 2002 fue reubicado y de nuevo 10 años después se pudo comprobar que la corrosión en él avanzaba a pasos agigantados, planteándose entonces la necesidad de tener que tomar medidas urgentes, no solo para frenar su deterioro, sino también para restaurarlo y darle el tratamiento que merece esta pieza única de nuestra historia naval del XIX, creándose una comisión que estudiaría las acciones que había que tomar, llegándose a la conclusión de que el sitio idóneo debía ser a cubierto, protegido tanto de las inclemencias del tiempo como de la acción corrosiva del mar.

La elección recayó en el antiguo taller de fundición del Arsenal de Cartagena, nave contemporánea al propio submarino, por las tremendas posibilidades que la misma ofrecía de poder ser musealizada con diferentes objetos íntimamente ligados a la historia del submarino y del propio inventor, pues se pensó que todo ello formaría un conjunto único en la pasada historia naval de España. Finalmente el traslado se efectuaría el 15 de diciembre de 2012.

Esa última singladura del submarino que diseñara y construyera el teniente de navío Isaac Peral, puso fin a una azarosa vida de 125 años a la intemperie, en la que ha sufrido tras ser abandonado a su suerte, desde la acción de quienes lo desvalijaron, los avatares de la política, el peligro de llegar a Cartagena remolcado –podría haber resultado hundido en la travesía–, el riesgo de las bombas durante la Guerra Civil, los distintos cambios de ubicación, con el peligro que ello conlleva para su integridad física, las inclemencias del tiempo, y un largo etcétera.

Hoy día, reposa feliz y tranquilo a cubierto en el Museo Naval de Cartagena. Yo les invito a visitarlo y a que vean *in situ* los resultados de la musealización.

Restauración del submarino

Con la pieza a resguardo ya se podía iniciar la fase de restauración. Fueron varios los frentes acometidos.

- Análisis patológico: el Departamento de Arqueología del IPCE, a través de la sección metales del Servicio de Conservación y Restauración de Obras de Arte, Patrimonio Arqueológico y Etnográfico, realizó el estudio del estado del acero, limpieza y primera fase de tratamiento del casco.
- Análisis de pinturas: el Centro Tecnológico Naval y del Mar CTN y la UPCT analizaron la pintura del casco hasta detectar 21 capas diferenciadas. Las manos de pintura se aplicaban cada 3 o 4 años, una sobre otra, sin retirada de las capas precedentes, llegando a formar una costra de 1,5 mm de espesor, de consistencia plástica y rígida, sin unión con el casco dejando un cámara de aire donde se embolsaba el agua de lluvia y de rocío (Fig. 4). Se utilizaron instrumentos de alta tecnología como el microscopio de barrido de electrones.
- Análisis estratigráfico/constructivo con el que se trataba de datar, situar y relacionar cada elemento del casco desde el análisis estratigráfico, deduciendo su función en el conjunto de la máquina.
- Análisis fotogramétrico o medición precisa con escaneado en 3D del interior y el exterior.

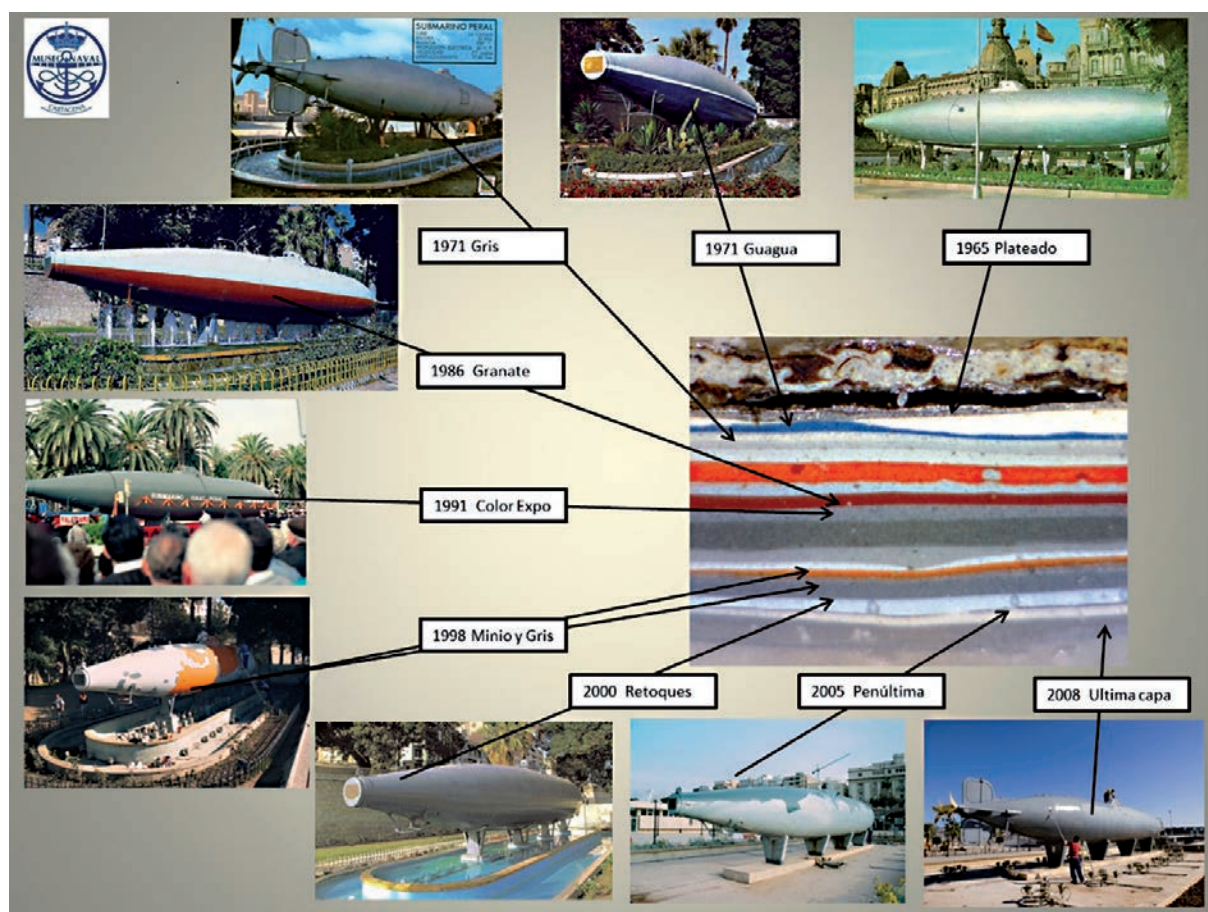


Figura 4. Más de 22 capas de pintura del Submarino Peral antes de la restauración, de 1965 a 2008.

Proceso de intervención

- Eliminación de restos de pintura vinílica y masillas.
- Eliminación de óxidos con medios manuales y mecánicos.
- Limpieza con etanol de la superficie para eliminar polvo, grasa y restos de óxido.
- Aplicador de inhibidor en áreas oxidadas.
- Aplicación de imprimación de un componente con fosfatos como pigmentos inhibidores de la corrosión.
- Aplicación de una capa cromática de la superficie. El análisis de las capas de pintura arrojaba que la más antigua databa de la década de 1960. Iniciamos una investigación encaminada a averiguar el color original del submarino. Las fotografías de la época en blanco y negro nada aportaban. Gracias a varios testimonios escritos y a algún cuadro coetáneo pudimos determinar su aspecto.

Musealización

El objetivo marcado por el Museo Naval no se detuvo en la restauración del submarino torpedero. Había que exponer la pieza ya en condiciones de revista, explicar su funcionamiento, cuáles fueron los adelantos tecnológicos aportados por Peral a la ciencia del momento y sobre todo, aproximar al ciudadano la historia de este ilustre marino.

La aparición de los planos originales abrió nuevas vías de experimentación para la valoración de la pieza. Superada la misión fundamental del proyecto, restaurar el acero del maltratado casco, se decidió abrir una nueva línea de trabajo: reproducir las piezas que componían en origen la imagen exterior del submarino. Se realizó un trabajo de interpretación de los planos originales, apoyando la investigación en documentos periodísticos y fotográficos que mostraban muchas de las piezas y componentes que conformaron su formidable aspecto de máquina submarina y cuya recolocación ayudaría a facilitar la interpretación sobre el funcionamiento del artefacto.

Profesores y alumnos de los centros de F.P. de Salesianos e Instituto Politécnico se aplicaron durante cuatro meses a la tarea de reconstrucción de las piezas que hoy reproducen con mayor fidelidad la imagen que el submarino tuvo en sus días de gloria: candeleros, escuadras, tragavientos, torre de visión indirecta y prisma óptico, aguja náutica, corredera eléctrica, timones, mástil de bandera, etc.

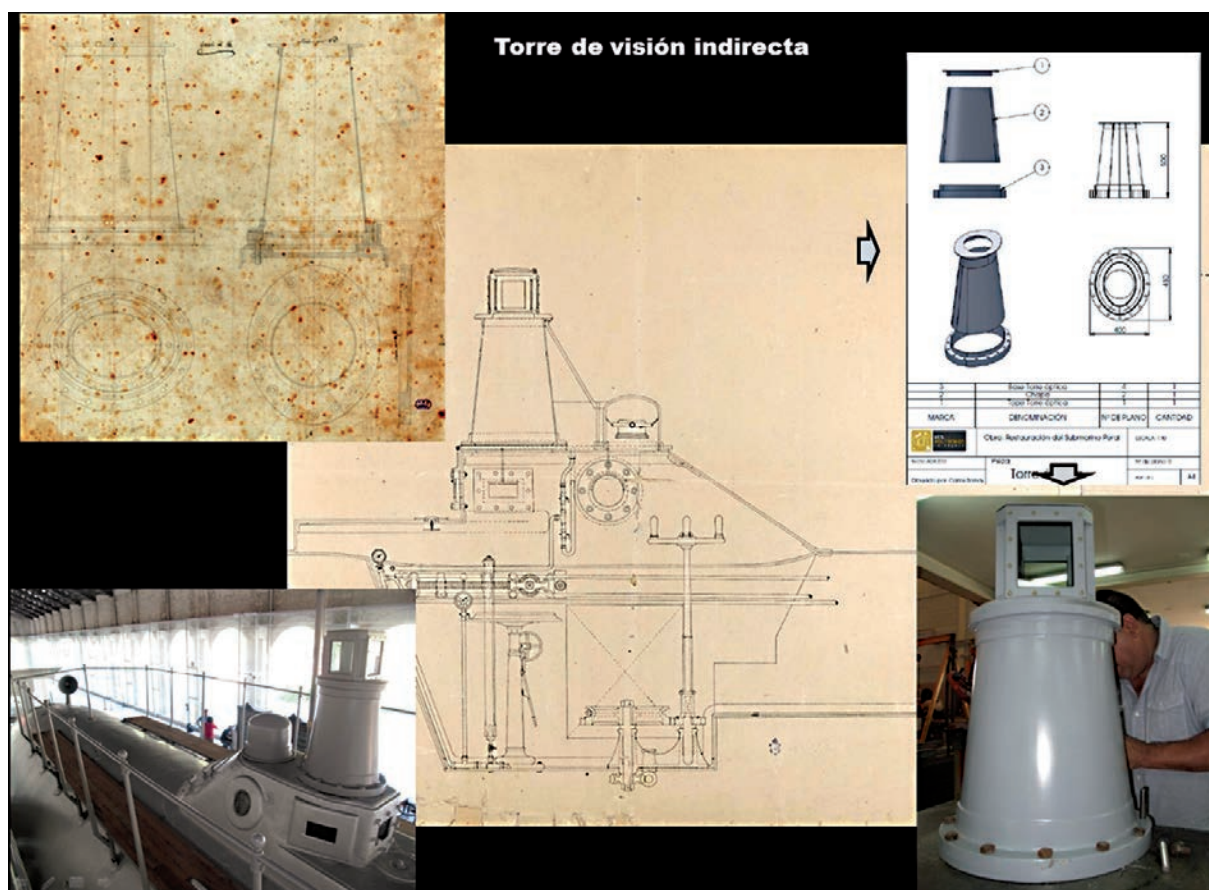


Figura 5. Realización de piezas por alumnos y profesores del Politécnico y Salesianos siguiendo los planos originales dibujados por Isaac Peral.

Las piezas nuevas han sido tratadas con textura y acabado diferente al del casco del submarino con la finalidad de evitar malas interpretaciones o falsos históricos.

Capital social como activo en la recuperación del patrimonio. Actividades desarrolladas para la divulgación del 125 aniversario. Patrimonio inmaterial recuperado

El submarino torpedero desarrollado por este cartagenero ilustre pertenece ya al pueblo que lo hizo suyo, lo que le convierte en un objeto con profundas connotaciones culturales. Más allá del significado que pudo alcanzar como máquina en el último cuarto del siglo XIX, hoy día se comporta como catalizador de emociones y sentimientos. Razón suficiente para hacer partícipe de este proyecto a todo el pueblo de Cartagena.

Conscientes de la importancia de trasladar los resultados del día a día de los trabajos de restauración a la opinión pública, se trazó un plan de desarrollo de diferentes acciones culturales que permitieran la participación de la ciudadanía con un triple objetivo: contagiar el entusiasmo del proyecto a la población, hacerla partícipe de este histórico acontecimiento y mostrarles, como nunca se había hecho hasta entonces, la verdadera historia del teniente de navío Isaac Peral y Caballero y las excelencias de su invento.

Actividades para la divulgación

- Visitas guiadas al taller de fundición «Abierto por obras»: durante los meses de verano se organizaron visitas guiadas al recinto donde se estaban desarrollando los trabajos de restauración por el personal cualificado.
- Exposición de fotografía «Emerger»: la retirada manual de la pintura dejó a la vista una superficie marcada por un siglo de calamidades. Cientos de heridas y cicatrices quedaron a la vista. Aquella circunstancia nos abrió un nuevo sendero que debíamos transitar: la oportunidad de documentar fotográficamente el maltrecho casco. Fue así como entró en escena el fotógrafo José Carlos Níguez dispuesto a captar la esencia de aquella piel metálica ajada por los años. Se originó un nuevo documento, riguroso, científico e imprescindible para futuros estudios. El fotógrafo descubrió un paisaje erosionado, jalonado de texturas, de superficies ásperas, de afiladas aristas y sembrado de reveladoras cicatrices. La carga plástica de las imágenes permitió abordar un nuevo proyecto: una exposición fotográfica vinculada a la propia restauración del submarino. Gracias a la labor del fotógrafo ese paisaje efímero ha quedado archivado para la historia como documento científico. Se cuadró la exposición con la publicación del libro conmemorativo *Emerger* en el que se recoge la restauración ilustrada con las magníficas fotos.
- Concierto de la Banda del Tercio de Levante. Partituras de Peral. Patrimonio inmaterial rescatado: fruto de la investigación de Diego Quevedo son las 21 partituras históricas, contemporáneas al inventor, compuestas por diferentes autores como homenaje a su figura. Se interpretaban en los diversos actos honoríficos que le brindaron numerosos municipios de la geografía española. Estas partituras escritas para piano han sido orquestadas por los alumnos del último curso del Conservatorio Superior de Música de Murcia e interpretadas, en doble concierto, por la Banda de Música del Tercio de Levante de Infantería de Marina. Entre las composiciones destacan varios pasodobles, zorcicos, valses, polca, jota aragonesa, malagueñas, pasacalles, seguidillas, etc.
- 1.ª Regata Isaac Peral en el puerto de Cartagena: el Real Club de Regatas de Cartagena organizó la primera regata náutica homenaje a Isaac Peral.
- Conferencias / Ruta cultural / Carrera conmemorativa / Muestra de modelismo naval: a lo largo de los meses de septiembre y octubre se celebraron ocho conferencias diversificadas en torno a la figura de Peral y de su invento. El 8 de septiembre se celebró frente a la fachada del Museo Naval una demostración de modelismo náutico. Recorrido guiado por la ciudad en el que se visitaron los hitos relacionados con la figura del

inventor: su tumba mausoleo, su casa natal y finalmente el submarino en su nueva ubicación.

- Concurso de fotografía: se organizó un concurso de fotografía con el submarino como protagonista. La convocatoria pretendía invitar a los ciudadanos a que rebuscaran en sus álbumes familiares. En el último medio siglo ha sido costumbre visitar a la pieza histórica para retratarse junto a su desnudo casco. Aparte del gesto simpático del concurso, los documentos fotográficos presentados añadieron nuevos y valiosos datos al conocimiento que de la pieza íbamos adquiriendo.
- Acuñación de moneda, Lotería Nacional y de la ONCE y sello conmemorativos: uno de los escaparates de mayor difusión para extender la importancia del evento a toda la geografía española era el de las loterías y apuestas del Estado a través de la Lotería Nacional y de la ONCE. Igualmente la Fábrica Nacional de Moneda y Timbre editó un sello y una moneda conmemorativos de curso legal.
- Inauguración por S.A.R. el príncipe de Asturias.

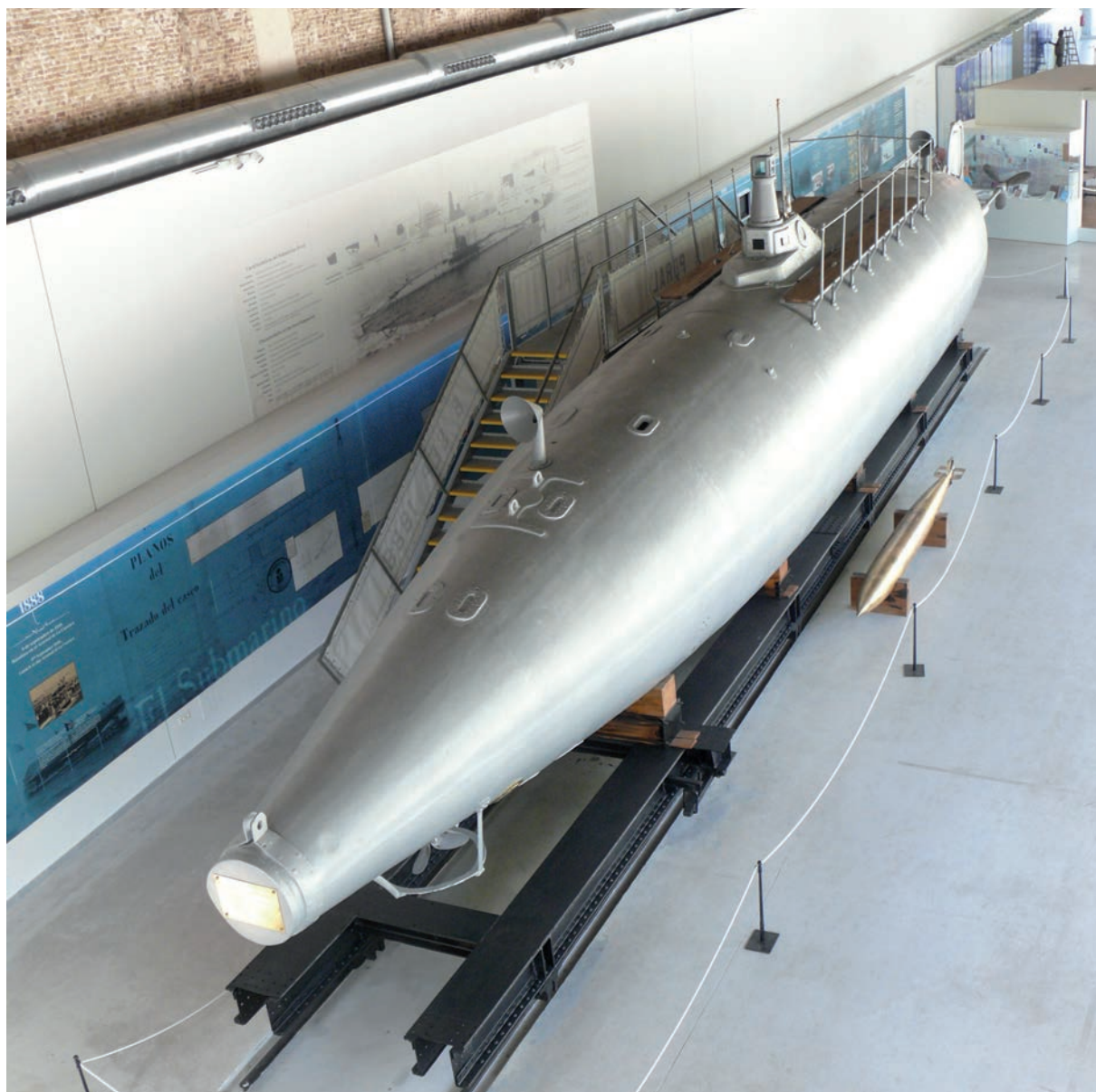


Figura 6. Submarino Peral restaurado, 12 de septiembre de 2013, día de la inauguración de la sala Isaac Peral.

Fin de la cuenta atrás

A través de este proyecto el Museo Naval junto con la sociedad cartagenera desea compartir su estrategia de gestión como un instrumento de desarrollo, que permite potenciar la identidad de una sociedad a través de un elemento clave de su patrimonio cultural, Isaac Peral y el submarino torpedero, en un momento en el que la crisis económica hace necesaria la adopción de nuevas fórmulas creativas y participativas, donde la educación y la formación de los ciudadanos se convierte en el punto fuerte del proyecto.

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The context of Ria de Aveiro F site (Ílhavo, Portugal): at the confluence of shipbuilding traditions, between Late Middle Ages and Early Modern Age

El contexto del yacimiento Ría de Aveiro F (Ílhavo, Portugal): en la confluencia de las tradiciones de construcción naval, entre finales de la Edad Media y principios de la Edad Moderna

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Abstract: The Ria de Aveiro F shipwreck site dates from the 16th century. Several well preserved wooden structures belonging to the ship's hull were recovered from the site, as well as a series of block and rigging elements, some fragments of pottery, ballast stones and a limestone projectile. Discovered in 2002, during the Aveiro seaport expansion works, this was the oldest shipwreck site ever found in Portugal at that time. The shipwreck features structural elements and planking from a carvel built hull and also elements from a clinker hull, belonging to another vessel or to a mixed planking hull. The ship could be of South American origin, possibly from Brazil, according to the identification of wood species found in the shipwreck. However, a Mediterranean origin cannot be excluded, since the ship features several characteristics found in other vessels from that area. Therefore is a curious case because it combines architectural solutions from multiple maritime spaces and different chronologies.

Key words: Shipbuilding, 16th century, block, rigging.

Resumen: el sitio de naufragio Ría de Aveiro F está fechado en el siglo XVI. Se recuperaron varias estructuras de madera bien conservadas, pertenecientes al casco de un buque, restos de poleame y cordaje, fragmentos de cerámica, piedras de lastre y un proyectil en piedra caliza. El

yacimiento fue identificado durante las obras de ampliación del puerto de Aveiro en 2002. Incluye elementos estructurales y de tablazón del casco de un buque construido con tablones lisos, y también elementos de un casco a tingladillo que pertenecería a otro buque, o tal vez a una embarcación de casco mixto. El origen del buque puede ser Sudamérica, probablemente Brasil, de acuerdo con la identificación de las especies de madera. Otra posibilidad es que pueda pertenecer al mundo Mediterráneo, ya que presenta varias características que se encuentran en buques de esa zona. Por tanto, es un caso curioso porque reúne soluciones arquitectónicas, con influencias de varios espacios marítimos y diferentes cronologías.

Palabras clave: construcción naval, siglo XVI, poleame, cordaje.

The context of Ria de Aveiro F (Ílhavo, Portugal): confluence of shipbuilding traditions between Late Middle Ages and Early Modern Age

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Introduction

The Ria de Aveiro is situated on a coastal and estuarine region in the Northwest of Portugal, where the Vouga river lies along with other small water courses. It had its origins around the 10th/11th centuries, when a sandy shoal began to form in Espinho area heading South. Thus, a coast in the shape of a large bay between Vila Nova de Gaia and the Cape Mondego was gradually being transformed into a straight coast, as can be seen today (Freitas e Andrade, 1998:68-69).

The Ria de Aveiro shipwreck (RAVF) was discovered in February of 2002 as part of the expansion of the port of Aveiro, during the archaeological monitoring of the dredging construction of roll-on/roll-off terminal. The results of radiocarbon analyses of the early traces of wood dated the context between 1280 and 1460 (Rodrigo, 2002:1).

The place where the wreck occurred was a space that over the centuries between has changed back and forth from silted area to navigation channel. These changes were caused by the increase or decrease of sediment deposition, influenced by the



Formation of the Ria de Aveiro (Freitas e Andrade, 1998:69)



Geographical location of Aveiro (Google Earth, 05/09/2014)



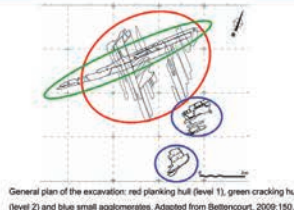
Aerial view of the Ria de Aveiro (interviewed area)

The Site

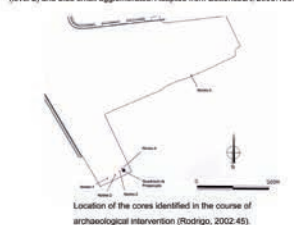
The RAVF context consisted in two major structures, wood cores, one in planking hull and another in cracked hull, forming the central core, but also a number of other small agglomerates of wood, some still in connection and other dispersed by the local. In addition to these, five more isolated cores were identified (Rodrigo, 2002:8-10).

The core of the planking hull (level 1) corresponded basically to a stem with a maximum length of 3.8 m and was constituted by a sternpost, Y-shaped floor timbers and part of the starboard and port side planking. This planking was smooth and the fastening were in iron, with no trace of wooden dowels (Rodrigo, 2002:5). In the port side besides the planking fixed to the Y-shaped floor timbers and sternpost, there was a set of six planks that appeared to be the continuation of the planking board, but that were not physically connected to it. The starboard had three wooden planks under the sternpost, overlapping one another, forming a cracked hull (Rodrigo, 2002:6).

The partially visible cracked structure (level 2), was constituted by three planks, that are 3 and 4 cm thick 14, 30 and 23 cm with respectively, and a total length of the set of 6.30 m (Rodrigo, 2002:8).



General plan of the excavation: red planking hull (level 1), green cracking hull (level 2) and blue small agglomerates. Adapted from Bettencourt, 2009:150.



Location of the cores identified in the course of archaeological intervention (Rodrigo, 2002:45)

The Ship

Sternpost

The sternpost was preserved *in situ* and still in connection with some planks, corresponding to an incomplete single piece with 1.59 m length by 11.5 cm thick in the extension of the keel, and 13.5 cm in the start of the sternpost, and 21 cm and 34 cm wide respectively. It had carvings for fixing the rudder fittings that would be axial. Along part of each side, there was a rabbet about 1.5 cm deep. The fastening was made with foursquare section (1x1 cm) iron nails.

Framing

Most of it was Y-shaped floor timbers (only four *in situ*) and there were also some frames scattered and torn by dredge action. The fastening system was composed entirely foursquare section (1x1 cm) iron nails that were placed in a previously made hole and in the oblique face of the bow or stern towards the keel. The frames and futlocks had hook scarfs, 1.5 cm deep, linking their ends. These links were reinforced by three foursquare section iron nails.

Planking hull

The identified planks had between 6 and 38 cm width, and 3 and 5 cm thick. The original length was not preserved, although the maximum extension registered was 2.97 m, and the average was around 1 m. The entire fastening was in foursquare section (1x1 cm) iron nails using together two or three nails by connection. It was also identified a fragment of the garboard plank, faceted and with chamfers on two of the faces so it would fit rabbet.



Sternpost (port view)



Y-shaped floor timbers found in situ



Garboard plank and detail of the chamfers

The Ship

Cracking hull

The identified planks overlapped length wise forming a cracked hull and had from 13 to 31 cm width and 3 to 4 cm thick. The length varied according to their state of preservation with the having 6.30 m. This set belonged to the bulwark area, since there were found some oarlocks with their respective shutters plus a thole with a cylindrical section. The fastening should be a mix of foursquare section (1x1 cm) iron nails and wooden dowels with 2 cm of diameter.



Photomosaic of the greater core of cracking elements

Mast step

It was found quite lacerated at both ends, with 2.07 m long, 41 cm wide and 35 cm thick. In the lower surface, it had a jagged that fit over the upper side of the frames, pressing them against the keel. On the upper surface, it had the sink of mast step of rectangular shape (47x21x17 cm), where the heel tenon of the mast would rest. The fastening system was mix foursquare (1.5 cmx1.5 cm) and circular section (2 cm diameter) iron nails and wooden dowels with 2 cm diameter.



Mast step (lower surface view)



Sink of the mast step

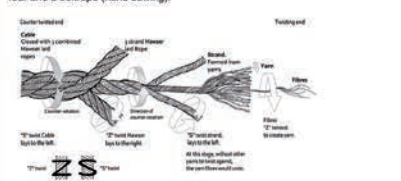
Block

Standing blocks - three dead eyes, one heart block and two toggles.
Running blocks - three tackle blocks and one block.



Rigging

Were analysed 81 fragments: 48 foxes of three, 28 spinnys, 1 cable, 4 foxes of four and a boltrope (hand sewing).



Composition and formation of cables



Several types of identified cables



Boltrope (mascara)

Conclusions

The hook scarfs are characteristic of the Mediterranean between 14th and 17th centuries, as we can see in the ships Culp VI (mid 14th century), Yassi Ada (16th century) and Sardinaux (late 17th century).

The fastening system is almost entirely in iron, also a featured from the Mediterranean that finds parallel in the ships above mentioned and also in Villefranche-sur-Mer (16th century), and Calvi I (late 16th century).

The presence of the sternpost as a single piece and the fact that the mast step appears to have been notched as a expanded part of the keelson are characteristics of the Atlantic (Oertling, 2001:236).

The typologies of pulley block find clear parallels in the mid 16th century ships *Mary Rose*, (1545) and *San Juan* (1565) (Grenier [et al], 2007; Marsden, 2009).

The origin analyses of the wood samples indicate that those have the characteristics of tropical timbers species, present in South America, with higher incidence in current Brazil.

Therefore, RAVF seems to be a vessel of the early/mid 16th century, which may have been built in the Mediterranean and suffered repairs in South America, or been built in a colonial space. On another hand, the wreck orientation and the fact that the woods of the cracked hull are also from South America, may indicate that the context includes two vessels: the main ship (planked) and a support boat (cracked) which would have been built from scratch in that territory.

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Oriental ceramics and Chinese porcelain from a Portuguese Indiaman, the presumable *Nossa Senhora dos Mártires* (Tagus River, Portugal)

Cerámicas orientales y porcelana china de un barco mercante portugués, presumiblemente el *Nossa Senhora dos Mártires* (río Tajo, Portugal)

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Abstract: Regular sea connections between occidental and oriental communities were established through the India Run, during Ming dynasty. For nearly a century, the actions of captains, merchants and missionaries granted the Portuguese an almost exclusive control over the Asian trade, including the Chinese porcelain trade. The rare and exotic oriental goods and particularly Chinese porcelain were a vast trade area that inspired the artistic sensibility of the Portuguese society – a fashion trend that extended until the 18th century. That trend is well represented by the collection recovered from the remains of a probable Indiaman, sank in the Tagus River (Portugal) in 1606. Among other materials, Chinese porcelains, from Ming Dynasty, Wanli period (1573-1619) were identified, as well as oriental ceramics from the Southern China (16th-17th centuries). The cargo was bound for Lisbon, the main receiving center and distribution hub of rare commodities from Eastern markets and their local ceramic products.

Key words: India Run, *Nossa Senhora dos Mártires*, material culture, Lisbon.

Resumen: las conexiones regulares por mar entre las comunidades occidentales y orientales se establecieron durante la dinastía Ming, a través de la Carrera de Indias. Durante casi un siglo, los portugueses tuvieron derechos casi exclusivos sobre el comercio con Asia, asegurando también el comercio de porcelana china. Los bienes exóticos del Oriente, y en particular las porcelanas chinas, fueron una vasta área de comercio que inspiró la sensibilidad artística de la sociedad portuguesa: una tendencia de moda que perduró hasta el siglo XVIII. Esa tendencia está bien representada en la colección recuperada de los restos de una posible nave mercante, hundida

en el río Tajo (Portugal) en 1606. Entre otros materiales, se identificaron porcelanas chinas de la dinastía Ming, periodo Wanli (1573-1619), así como cerámicas orientales del sur de China (siglos XVI-XVII). Estos productos iban destinados a Lisboa, el principal centro de recepción y distribución de materias primas raras y de sus productos cerámicos locales.

Palabras clave: Carrera de Indias, *Nossa Senhora dos Mártires*, cultura material, Lisboa.

Oriental ceramics and Chinese porcelain from a Portuguese Indiaman, the presumable *Nossa Senhora dos Mártires* (Tagus River, Portugal)

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Introduction and archaeological works

The main objective of this research, developed in the scope of the authors' Master thesis project, is the study of the ceramic assemblage found at São Julião da Barra (SJB) underwater site, located between Oeiras and Cascais (Lisbon, Portugal), at the mouth of the Tagus River (Fig. 1).

This assemblage features ceramics and other remains, among which the presence of pepper grains stands out, and has frequently been associated to the cargo brought aboard the *Nossa Senhora dos Mártires* Portuguese Indiaman that sailed from Cochín, on January 1606, and sank near São Julião da Barra Fortress on September 14, 1606 (Castro, 2001). The area was surveyed and excavated between 1994 and 2000 by a CHANS team. Diverse archaeological sites were identified, including part of the hull of a large ship.



Fig. 1 - Site location.

On the hull area, named São Julião da Barra 2 (SJB2) and located south-southeast of the fortress, several fragments of Chinese porcelain plates, bowls and bottles were found, mostly from the Wanli Kingdom of the Ming Dynasty (1573-1619). Further finds include oriental jars and a large quantity of pepper grains, found between the joints of the planking and scattered throughout the archaeological site (Aves, 1994; Castro, 2001).

The collection

The ceramic collection is a significant part of the remains found on this archaeological site, although the present study refers only to the analyses of the oriental ceramics - a total of 240 fragments, including 139 shards of jars and 101 fragments of Chinese porcelain (Fig. 2).

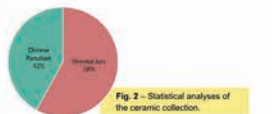


Fig. 2 - Statistical analyses of the ceramic collection.

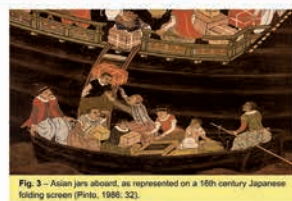


Fig. 3 - Asian jars aboard, as represented on a 16th-century Japanese folding screen (Pinto, 1986: 32).

Oriental Jars

These containers were used to store liquids and solids and also as a form of packaging suitable for transporting goods aboard ships (Fig. 3).



Fig. 4 - Statistical analyses of the oriental jars.

The collection from SJB can be divided into five categories:

Group I - *Martaban* jars (32 fragments); Group II - *Tradescant* jars (32 fragments); Group III - Other Chinese productions (52 fragments); Group IV - *Tai* stoneware jars (1 item) and Group V - *Tsubo* jars (1 item). The collection also includes 19 fragments of undetermined jars (Figs. 4 and 5).



Fig. 5 - Oriental jars.

Chinese Porcelain

The porcelain includes open forms - such as dishes and bowls - and closed containers - cups, jars and bottles.

They can be divided into two distinct categories:

Group I - White porcelain decorated with blue cobalt beneath the glaze (10 fragments) and Group II - *Kraak*porcelain (74 fragments). There are also 17 fragments of undetermined porcelains (Fig. 6).

Group I - White porcelain decorated with blue cobalt beneath the glaze

This first group includes jars produced in white porcelain decorated in shades of blue cobalt beneath the glaze, dated from the Ming dynasty, specifically from the Wanli Kingdom. Despite having a deep blue shade, it is possible to visualize a thickening of the ceramic clays, when compared with the productions from previous kingdoms. Pots were identified in this group (Fig. 7). Some pieces are decorated in the bulge, formed by branches of a pine tree, with herons flicking their wings between the branches; the depiction of a monkey perched upon a branch. This Taoist iconography - herons, cliffs and pine trees - is characteristic of Wanli creations (Matos, 1996: 276; Pijl-Ketel, 1982: 273), from the Jingdezhen workshops, in the Jiangxi province (Fig. 8).

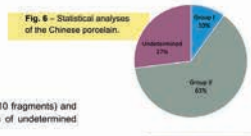


Fig. 6 - Statistical analyses of the Chinese porcelain.



Fig. 7 - Chinese porcelain pots.

Group II - *Kraak*porcelain

These porcelain fragments have a delicate body, light and sonorous, and both surfaces coated with a very bright glaze. The fragments correspond to dishes with flattened rims, dishes with straight rims, bowls/cups with flattened rims, bottles and jars (Figs. 9 and 10).

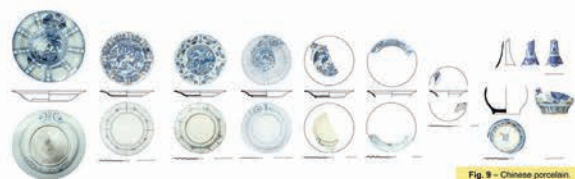


Fig. 9 - Chinese porcelain.

The dishes feature the most outstanding innovation of *kraak*porcelain, consisting in the interior rim, the cavetto and the flared rim being treated as a single unit, divided into panels and separated by bands alternately filled with symbols depicting prosperity and flowers (Fig. 11).



Fig. 10 - Statistical analyses of the Chinese porcelain forms.

Usually, the central decoration of *kraak* displays landscapes with moving deer, insects, birds and plant motifs, sometimes combined with cliff and lagoon landscapes (Matos and Salgado, 2002). Four rim variants were also identified (Fig. 12) and four types of centre/rails (Fig. 13), variant B and type I being the most abundant.

Variant A - Simple panels separated by vertical bands enclosing bead or pearl strings		22%	Type I - Round medallion outlined by two concentric lines		70%
Variant B - Raised panels separated by vertical bands enclosing bead or pearl strings		35%	Type II - Bracket-lobed medallion		2%
Variant C - Simple panels separated by bands of blue wash		11%	Type III - Bracket-lobed medallion with decorated panels		9%
Variant D - Decorated band outlined by two concentric lines; the upper line, close to the rim, is bracket-lobed		31%	Type IV - Bracket-lobed medallion with decorated panels, separated by ruyi heads		18%

Fig. 12 - Typological analyses of the rims.

Fig. 13 - Typological analyses of the centre/rails.

Concluding remarks

The oriental jars would be used for packaging and transportation of foodstuffs, liquids and certain goods. Considering that a large quantity of pepper grains was recovered among several architectural parts of the ship, some of the jars might have been used to transport this spice.

The Chinese porcelain is the best represented group. The most common forms are good quality dishes, bowls, jars and bottles, mostly belonging to the group of porcelains known as *kraak*porcelain, produced at the Jingdezhen workshops. Therefore, these materials attest the commercial activity carried out at that time, revealing the interest for utilitarian objects, especially tableware, even if some of them may also have had a decorative function.

The collection from SJB is representative of the main types of porcelains acquired and consumed in Portugal by the beginning of the 17th century. Similar examples occur in coastal cities, such as Lisbon and Oporto, or in Portuguese inland cities like Évora, under convents, palaces or contexts pertaining to the wealthier classes. They also appear in Portuguese museum collections as the Casa-Museu Dr. Anastácio Gonçalves, the Fundação Camões e Costa and the Museu Nacional de Arte Antiga (Lisbon, Portugal), as well as at a room of Santos Palace featuring a roof entirely covered with porcelain, where similar artifacts can also be found.

This collection is also similar to the ones recorded elsewhere in Europe or in the colonial territories occupied by the Spanish (Canepis, 2012), corresponding to a mature phase of commerce and consumption of Chinese porcelain. They have been found in several Portuguese wrecks such as *Espirito Santo* (1608), *Nossa Senhora da Luz* (1615), *São Gonçalo* (1630) and *Santa Maria de Madre Deus* (1643); in VOC ships as *Mauritius* (1609), *Banda* (1615) and *Witte Leeuw* (1613); in Spanish ships as *San Felipe* (1576), *San Diego* (1600), *Santa Margarita* (1601) and *Nuestra Señora de la Limpia y Pura Concepción* (1638) and in the Ming collections preserved in Paris (Guimet Museum), Persia (Ardebil) and Turkey (Topkapı Sarayı Museum).

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New discoveries in Estonia: An Intact wreck of 17th century merchant ship

Nuevos descubrimientos en Estonia: un pecio intacto tras el naufragio de un barco mercante del siglo XVII

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Abstract: The cultural-historical sources typical of the underwater landscape of the Baltic Sea comprise numerous wrecks of different eras and types whose abundant presence is due to the long maritime history, the numerous reefs as well as the favourable preservation conditions in the sea. Therefore, the preservation value and scientific potential of the cultural heritage of the Baltic Sea are enormous. The coastal waters of Estonia, with its plentiful shoals and changeable weather conditions, still posed a serious threat to seafarers as recently as 100 years ago. Evidence of this is provided by the large number of shipwrecks at the bottom of the sea. In 2012, the wreck of a merchant ship was found at a depth of 60 m in the coastal waters of Estonia. The discovery offers new knowledge about 17th century shipbuilding. The aim of the poster presentation is to introduce the initial research results of a well preserved shipwreck.

Key words: Baltic Sea, shipwreck, 17th century, merchant ship, maritime archaeology.

Resumen: las fuentes histórico-culturales características del paisaje submarino del mar Báltico comprenden numerosos restos de naufragios de diferentes épocas y tipos, cuya abundante presencia se debe a la larga historia marítima así como a las favorables condiciones de conservación submarina. El valor de preservación y el potencial científico del patrimonio cultural del mar Báltico son enormes. Incluso hasta hace un siglo, las aguas litorales de Estonia eran una seria amenaza para los marinos. Prueba de ello es la gran cantidad de restos de naufragios que pueden encontrarse en el fondo del mar. En 2012, los restos del naufragio de un barco mercante fueron encontrados en las aguas costeras de Estonia, a 60 m de profundidad. Este descubrimiento ofrece nuevos conocimientos sobre la construcción naval en el siglo XVII. El objetivo de la presentación es mostrar los resultados de la investigación inicial de los restos bien conservados de un barco naufragado.

Palabras clave: mar Báltico, naufragio, siglo XVII, barco mercante, arqueología marítima.

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New discoveries in Estonia: An Intact wreck of 17th-century merchant ship

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The knighthead is "trapped" by the windlass.
Image: National Heritage Board/ T.Urm 2013.



On both sides of the front stem there are hawse holes. The decorated thickenings of their edges have preserved only partially.
Image: National Heritage Board/ SubZone OY 2014.

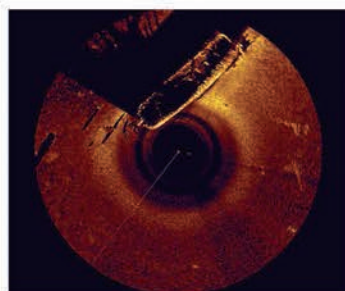


These bottles were used in northern Europe for a long period of time – more actively so from the end of the 15th century until the 19th century. This bottle has been dated to the 1st half of the 17th century.
Image: National Heritage Board/ T.Urm 2013.



On the seabed next to the bow there is another figure of a man.
Image: National Heritage Board/ T.Urm 2013.

The underwater landscape of the Baltic Sea is a unique ecological and cultural-historical environment due to the combination of a long and rich seafaring history and ideal preservation conditions. The coastal waters of Estonia, with its plentiful shoals and changeable weather conditions, still posed a serious threat to seafarers as recently as 100 years ago. Evidence of this is provided by the large number of shipwrecks at the bottom of the sea, as well as written and oral heritage.



There are many important features visible on the scanning sonar image. The inward-turning frame ends are clearly distinguishable at the stern part of the wreck.
Sonar image: Tuukritööde OÜ.

In 2012, during fieldwork carried out by the Estonian Maritime Administration the wreck of a merchant ship was found at a depth of 60 m in coastal waters of Estonia. The Estonian National Heritage Board carried out additional studies of the wreck in 2013. The discovery offers new knowledge about 17th-century shipbuilding. Throughout all these years the wreck has remained untouched also by damages that could be caused by fish trawling which has left a destructive mark on so many wrecks in Estonian waters. The only direct indication to human impact is the paravane lying on the seabed close to the stern – these paravanes were used to detect anchor mines from WWI and WWII.

On the image captured with a scanning sonar the hull of the ship with slightly round edges and quadrangular ends can be clearly distinguished. All masts have probably broken already in the course of the accident. There are inward-turning frames which get narrower towards the tip visible from the keel line towards the stern and an anchor lying on the seabed next to the bow. Another anchor which is missing one of its arms has fallen over the wooden windlass. The windlass originally stationed behind the front mast has fallen off from its mountings and is lying diagonally on the deck. The main deck level starts from

the bow and ends by the pumps. The stern constructions are scrambled and broken. On either side of the aft stem there are windows which most probably belonged to the aft cabin. The remains of a former fireplace are visible on the port side of the aft which refers to the location of the galley.

There are distinguishable details underneath the sediment covering the wreck which evoke an image of the once glorious ship decorated with wooden details. Many of these wooden decorations have fallen next to the ship, but some of them are still located on their original place. There are two clearly distinguishable knights on the deck which have man's head wearing a round-shaped hat. Similar knightheads have been found on several 17–18th century shipwrecks in the Baltic Sea and the most famous example is definitely the Swedish warship *Vasa*.

The items found on the wreck and its structural features help to detect the approximate age of the wreck. In order to provide a more precise dating two completely preserved clay vessels with two handles were recovered from the wreck. These red ceramic bottles of Scandinavian origin were used in the end of the 16th century and in the 17th century. Along with the glass objects still located *in situ* on the deck of the wreck, the sailing ship most probably foundered in the beginning of the 17th century.

The heavily inward-turning frames and the sides that therefore are narrowing upwards are typical to Dutch flutes built in the 17th century and onwards. In the 1st half of the 17th century the Dutch merchant fleet was at the peak of its glory. The most common ship type of the time was the flute which was inexpensive to build and operate. Because of their typical roundish shape and flat or nearly flat bottom the Englishmen called them sneeringly "Dutch butterboxes". Flutes were built as merchant ships and therefore they usually did not carry any cannons. The lack of armament and relatively simple rigging enabled to operate the ship with a smaller crew consisting of approximately 6–12 men. Even though flutes were massively used in the 17th century, there are only around twenty known archaeological finds. Most probably the wreck of the sailing ship in question belongs to a flute.

There are many well preserved wrecks of sailing ships found in the Baltic Sea from different centuries which represent a unique source material not only in the context of Europe but the whole world. The Baltic Sea States are cooperating to value and introduce this unique heritage on a wider scale and therefore preparations have begun to submit a nomination proposal for the underwater cultural heritage of the Baltic Sea to be considered for inclusion in UNESCO's World Heritage List.

El pecio de Matagrana. Un mercante de construcción inglesa de los siglos XVII y XVIII

Matagrana's wreck. A merchant ship of English construction from the 17th and 18th century wrecks

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Técnico de Investigación

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Resumen: en el invierno de 2008, los fuertes temporales provocaron el retroceso de la alineación de dunas de la playa de El Portil (Huelva) dejando al descubierto los restos de una embarcación de madera. Tras valorar los riesgos físicos y antrópicos a los que estaba sometido el pecio, se decidió acometer una actuación de urgencia. La investigación arqueológica llevada a cabo determinó que se trataba de un barco mercante de construcción inglesa adscrito a una cronología de finales del siglo XVII a mediados del XVIII. El pecio de Matagrana ha sido el primer barco en ser excavado con una metodología científica y rigurosa en contexto terrestre en el marco de la Comunidad Autónoma de Andalucía.

Palabras clave: siglo XVIII, pecios, construcción naval inglesa, Huelva, Matagrana.

Abstract: In the winter of 2008, the heavy storms caused the decline of alignment beach dunes of El Portil (Huelva) revealing the remains of a wooden boat. After assessing the physical and anthropogenic risks that were affecting the wreck, it was decided to undertake an urgent action. The archaeological research conducted found that it was a merchant ship of English construction attached to a chronology of the late seventeenth century to the mid-eighteenth. The wreck of Matagrana was the first ship to be excavated in terrestrial context by the autonomous community of Andalusia with a scientific and rigorous methodology.

Key words: 18th century wrecks, English Naval Construction, Huelva, Matagrana.

EL PECIO DE MATAGRANA

Un mercante de construcción inglesa de los s. XVII y XVIII

INSTITUTO ANDALUZ DEL PATRIMONIO HISTÓRICO:
CENTRO DE ARQUEOLOGÍA SUBACUÁTICA
CONSEJERÍA DE EDUCACIÓN, CULTURA Y DEPORTE

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EL HALLAZGO



En el invierno de 2008, los fuertes temporales provocaron el retroceso de la línea de dunas de la playa de El Puerto (huelva) dejando al descubierto los restos de una embarcación de madera. Tras valorar los riesgos físicos y antrópicos a los que estaba sometido el pecio, se decidió acometer una actuación de urgencia.

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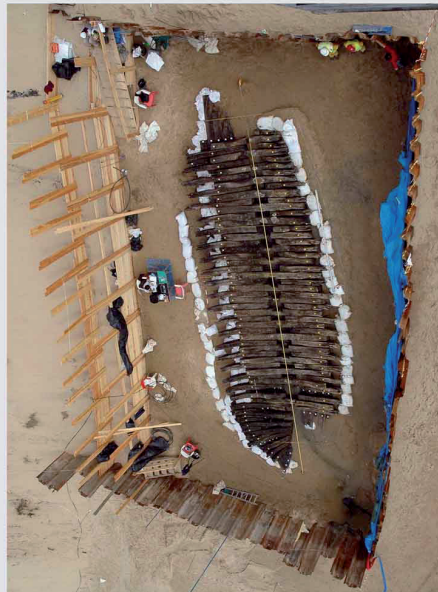


DESCRIPCIÓN DEL PECIO

Los restos del pecio de Matagrana pertenecen a una embarcación que, con una eslora máxima conservada de 16,81 m y una manga de 5,48 m, presentaba la zona del plan de varengas hasta la altura del pantoque en la banda de estribor.

Podríamos describirla como una embarcación de estructura robusta en la que destacan los miembros de grandes dimensiones, mostrando una técnica de construcción que, con un mínimo espaciado de claras, alterna varengas con gonoles siguiendo un sistema de ligazones superpuestas.

El costado de babor, de cara al mar, presentaba un mayor deterioro con respecto al de estribor al haber soportado directamente los envites del oleaje, perdiendo, en este proceso de degradación, la zona de la amura y la aleta. El pecio no conservaba artefactos relacionados con la vida a bordo o posible cargamento.



Cultura eres tú.

MÉTODO DE CONSTRUCCIÓN NAVAL DE TRADICIÓN INGLESA S.XVIII

La construcción naval se ejecuta siguiendo una Técnica de construcción mixta, en la que el barco tiene un crecimiento simultáneo de sus planos transversales y longitudinales.

Según William Sutherland, Maestro Carpintero de la Real Armada Británica en el s. XVIII, el método constructivo a seguir era el siguiente:

- Colocación de la Cuaderna Maestra y las Cuadernas de Molde o Referencia.

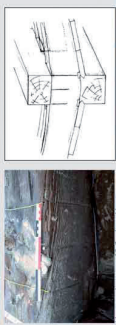
- Se erigía como guía para la colocación de las Cuadernas de Reliño o Intermedias.

- Se procedía al carenado de las varengas y a la instalación de Gonoles flotantes. Y así sucesivamente hasta la finalización del amazon.

- Se utilizaba un encañillado de madera a excepción del encañillado en hierro en la línea de crujía.

PECIO DE MATAGRANA: PAUTAS DE CONSTRUCCIÓN

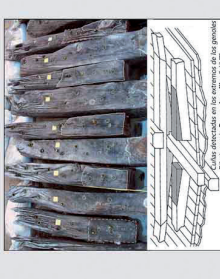
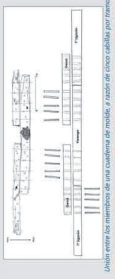
ESTRUCTURA AXIAL



El costado de babor, de cara al mar, presentaba un mayor deterioro con respecto al de estribor al haber soportado directamente los envites del oleaje, perdiendo, en este proceso de degradación, la zona de la amura y la aleta. El pecio no conservaba artefactos relacionados con la vida a bordo o posible cargamento.

ESTRUCTURA TRANSVERSAL

Características:
- Cuadernas de doble espesor, con un espaciado mínimo entre ellas.
- Presencia de cuatro cuadernas de molde, una de ellas la maestra.
- Unión lateral mediante encañillados de madera de las cuadernas de molde.
- Uso de culas en cabezas de varengas y gonoles.



CERRAMIENTO PROA



La proa está constituida por medias cuadernas en disposición radial. Los maderos se han encañillado directamente al casco.

CASCO INTERIOR



No conservado. La falanxía detectada en las cuadernas dentro la presencia original de un suelo que no ha sido conservado. Se observan los restos de la estructura sobre la superficie de las cuadernas de 5,7 m, indicando así el grosor de las tablas que sujetaban.

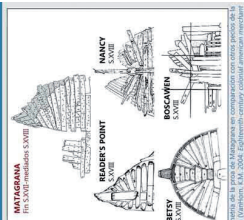
FORRO DE SACRIFICIO



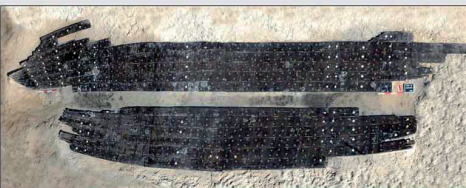
Al igual que ocurre con el casco interior, el forro de sacrificio se encontraba en la zona de la proa, indicando así el grosor de las tablas que sujetaban.

SISTEMA DE ENSAMBLAJE

Se caracteriza por el uso predominante del encañillado de las cuadernas de molde, una de ellas la maestra, en la zona de la proa y, en menor porcentaje, por elementos de clavazón en hierro en la unión de quilla-varenga-sobrequilla y entablados del casco exterior.



CASCO EXTERIOR



Asociación de Amigos de la Historia de la Isla de Cádiz



La construcción naval a la inglesa en España (1749-1763). Pautas para la identificación de detalles constructivos de la tradición inglesa y española

English shipbuilding in Spain (1749-1763). Guidelines for identifying construction details of the English and Spanish tradition

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Resumen: en el siglo XVIII España aún era un Imperio colonial, pero con serios problemas para proteger las colonias de sus competidores, principalmente Gran Bretaña y Francia. El marqués de la Ensenada, ministro de Hacienda, Guerra, Marina e Indias (1743-1754) impulsó la creación de un ejército poderoso y la reorganización de la Marina, construyendo un mayor número de navíos e introduciendo la tecnología inglesa. En el año 1749 se inicia la construcción a la inglesa. Los mejores constructores británicos (Rooth, Bryant y Mullan) asumen la dirección de los arsenales del Ferrol, Cádiz y Cartagena. Hasta que en el año 1763, como consecuencia del Tercer Pacto de Familia, entre Francia y España, François Gautier (1763-1767) toma el control de la Marina española y sus arsenales. Mostramos cuáles fueron las principales diferencias entre los detalles constructivos a la inglesa y a la española para el periodo comprendido entre los años 1749 y 1767.

Palabras clave: España, Inglaterra, construcción naval, siglo XVIII, detalles de construcción.

Abstract: In the 18th century Spain was still a Colonial Empire, but it was unable to protect its colonies from their competitors, mainly Great Britain and France. The Marquis of La Ensenada, Minister of Finance, War, the Navy and the Indies (1743-1754) wanted to create a strong army and reorganize the navy by building a great number of man-of-war and introducing the English technology. In 1749 the English construction is commenced in Spain. The best British shipbuilders (Rooth, Bryant and Mullan) assumed the direction of the Spanish shipyards of Ferrol, Cadis and Cartagena. In 1763, as a consequence of the Third «Pacte de Famille» between the French and the Spanish Bourbons, François Gautier took control of the Spanish Navy and its shipyards. We would like to show you the difference between the Spanish and the English construction details found in the Spanish ships from 1749 to 1767.

Key words: Spain, England, Shipbuilding, 18th century, construction details.

La construcción naval a la inglesa en España (1749-1763)

Pautas para la identificación de detalles constructivos de la tradición inglesa y española



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1. El Marqués de la Ensenada, secretario de Hacienda, Guerra, Marina e Indias (1743-1754)

Impulsa la creación de un ejército fuerte y una armada con un mayor número de navios, mejorando su calidad inspirándose en la tecnología inglesa, confiando en Jorge Juan como la persona que transformará la armada española.

2. La misión de Jorge Juan en Londres (1748-1750)

Es enviado en una misión de espionaje a los arsenales de la Royal Navy en Inglaterra. Real Instrucción Reservada, 27 octubre 1748: "Procurará con maña y secreto adquirir noticias de los constructores de más fama en la fábrica de navios de guerra... tratará la forma de ganar uno o dos de estos constructores para que vengan a Madrid."

En la primavera del 1750 la operación es descubierta, huye de Inglaterra, pero ya son más de 50 los técnicos británicos que han sido trasladados secretamente a los arsenales españoles.

3. La construcción a la inglesa en España (1749-1755)

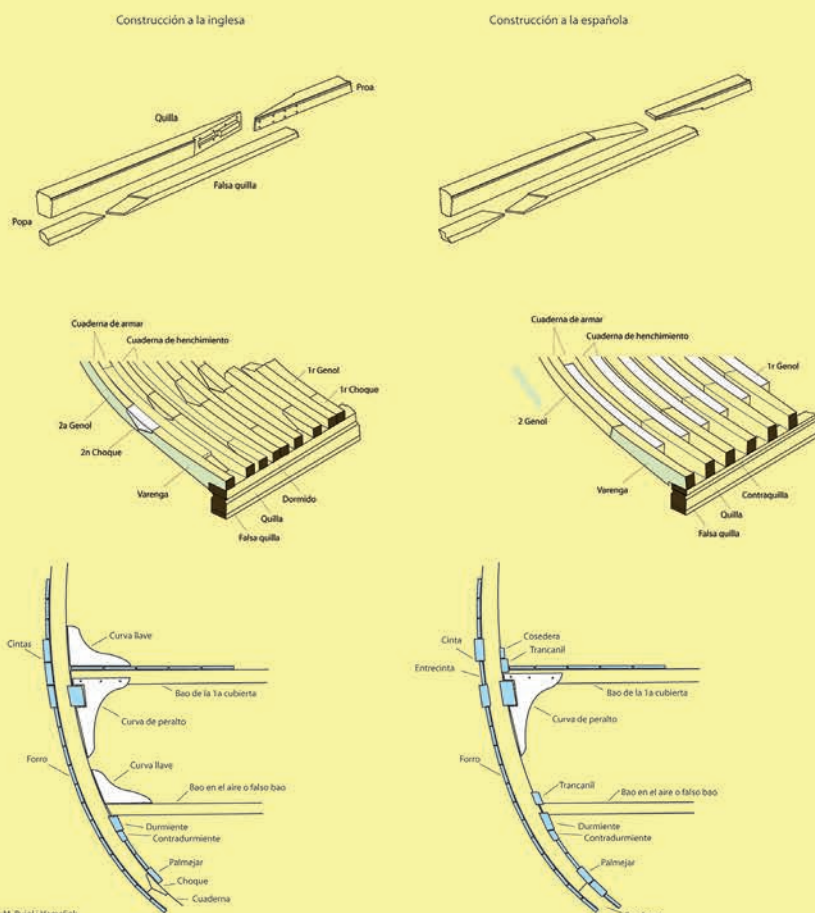
Los constructores ingleses (Rooth, Bryant y Mullan) toman la dirección de las construcciones de los arsenales de Ferrol, Cádiz y Cartagena, además del astillero de Guarnizo. El modelo de navio de 68 cañones de Jorge Juan, y la construcción a la inglesa, es aprobado por la Junta de Construcción de Cádiz de 1752.

4. La Junta de Construcción de Cádiz del 1754. Revisión del sistema y construcción híbrida (1755-1763)

La caída en desgracia de Ensenada permite a los detractores de la construcción a la inglesa una revisión, aprobada por la Junta de Construcción de Cádiz, que vuelve, en parte, al sistema de construcción española. La aplicación de lo acordado por la Junta es la creación de navios híbridos, con elementos propios de la construcción española y otros propiamente ingleses.

5. El Pacto de Familia y la llegada de François Gautier. Fin de la construcción a la inglesa (1763-1767)

La armada francesa y española deben unirse en una de sola, construyéndose a la francesa (de hecho un retorno a la antigua construcción a la española). Es el mandato recibido por Gautier, nuevo director de las construcciones navales de los arsenales españoles.



Constructores Edward Bryant David Howell Matthew Mullan Richard Rooth	Carpinteros de lo blanco Thomas Bowdell Richard Brad John Canon Walter Commons John Cooke Edward Duff James Harris John Harris John Macbride Thomas Marston Stephen Ricards James Shannon John Stafford
Ayudantes Thomas Hule William Richards Almond Hill (y delineante) William Turner Thomas Hewett John Harris John Higgins Jan Hughes Cristophe Watery	Escultores Samuel How Diego Pepper James Pepper
Contramaestros Diego Baxter Thomas Cornet Thomas Williams Henry Jacques John Loughnan Thomas Longham John Sears James Wells	Maestros de jarcia Adams (escocés) William Clark Henry Sawyers Patrick Larhey Jan van Graaf (holandés) Jan van Graaf jr. (holandés)
Carpinteros de ribera Joseph Archibould Joseph Archibould William Ransdell Santiago Bolafios Thomas Brown William Clark John Evans Michael Gormond Francis Hewett James Hewer Patrick Hewett John Hughes Michael Layons James Linch George Mac Donnell James Oliver John Reynolds Richard Reynolds John Wink	Maestros de armar y aparejar William Cabell William Fauler Edward Fenell William Fenell Stephen Gubney Thomas Orams William Towler Edward Whelan
Perforadores David Biggs Francis Mankhouse jr.	Maestros de motoneria Jereimas Gerard Samuel Stringer
Serradores Thomas Bent Diego Conway Santiago Conway Thomas Graugham Diego Muger James Muger Nicholas Ogden Thomas Prieda Thomas Stringer	Oficiales de velas y jarcia Diego Colium Edmund Knight
	Maestros de lonas Florus Timms e hijo (holandeses)
	Caldereros Christian Franklin Francis Mankhouse
	Herreros Raimond Graham Balthasar Parrell
	Intérpretes Thomas Fleming David Lawles
	Criadas (de la mujer de Rooth) Margareth Parrell Leonora Garvey

Español	English
Bao	Beam
Bullacema	Buttock rider
Choque	Chock
Cinta	Wale
Cara	Room
Chavila	Treenail
Clavo	Nail
Codaste	Stem post
Cuaderna	Frame
Curva	Knee
Curva de peralto	Hanging knee
Curva llave	Standard knee
Curva coral	Deadwood knee
Curva valona	Lodging knee
Dormido	Deadwood
Durmiente	Clamp
Empalme	Scarf
Empalme a tope	Butt joint
Empalme de clavo o de lingüete	Keyed hook scarf
Falsa quilla, zapata	False keel
Forno	Planking
Genol	Futtock
Junta de cola de milano	Dovetail joint
Junta de dentellón	Hook scarf
Junta de media madera	Hook and butt scarf
Palmejar	Stringer
Pique	Floor timber, cotche
Quilla	Keel
Remache, henchimiento	Filling frames
Roda	Stem post
Sobreplán	Floor rider
Sobrequilla	Keelson
Sollado	Ceiling
Trancanil	Waterway, gutter
Varenga	Floor plan

Dibujos: M. Pujol i Hamelink

Baía da Horta 3 (Faial Island, Azores, Portugal) – the Cannon Site

Baía da Horta 3 (Isla de Faial, Azores, Portugal) – Yacimiento de cañones

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Abstract: A collection of fourteen iron cannons, amongst other remains, was identified during the archaeological monitoring of dredging works carried out in the scope of the «Rehabilitation and Renewal of the Seafront of Horta» project. Most of the guns were covered with concretions and were transferred to an underwater preserve near the port, where they can be visited. However, three guns were recovered due to partial loss of concretion, which exposed various details of their manufacture. Based upon the design initially proposed by John Armstrong, all of these seem to be English guns, with three different calibers and dating from the second half of the 18th century. The archaeological surveys conducted in the area (BH003) further revealed only a few lead bullets and one elephant tusk, which complicates the interpretation of the context. Nevertheless, the collection could be related to a shipwreck dating from the second half of the 18th or early 19th centuries.

Key words: Portugal, Azores, early modern archaeology, iron cannons, Atlantic.

Resumen: se presenta una colección de catorce cañones de hierro descubiertos durante el seguimiento arqueológico de las obras de dragado del proyecto «Rehabilitación y Renovación del Paseo Marítimo de Horta». La mayoría de ellos estaban cubiertos de concreción y, de cara a su preservación, fueron trasladados a un depósito submarino cerca del puerto, donde se pueden visitar. Sin embargo, tres cañones fueron recuperados debido a la pérdida parcial de la concreción, exponiendo varios detalles de su fabricación. Según el diseño propuesto inicialmente por John Armstrong, estos cañones parecen ser de fabricación inglesa de la segunda mitad del siglo XVIII, y de tres calibres distintos. Además de los cañones, los estudios arqueológicos realizados en la zona BH-003 solo revelaron balas de plomo y un colmillo de elefante, lo que complica la interpretación del contexto, que puede estar relacionado con un naufragio que ocurrió durante la segunda mitad del siglo XVIII o principios del XIX.

Palabras clave: Portugal, Azores, arqueología moderna, cañones de hierro, Atlántico.

Baía da Horta 3 (Faial island, Azores, Portugal): the Cannons Site

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Introduction



Horta bay with the location of the new harbour.

In 2008, the Azores Government decided to launch a project to reorganize the maritime waterfront of Horta, in Faial Island (Azores), which included the construction of a passenger terminal located in the northern area of the existing port.

The project involved the modification of a 170,000 m² submerged area, including the construction of a 300 m long dock and the dredging of a turning and maneuvering basin. Project works began in June 2009 and were preceded by an Environmental Site Assessment (ESA) study that resulted in the definition of several mitigation measures to be implemented before (trial excavation of an 18th-century shipwreck site) and during the construction works (archaeological monitoring of the dredging).

The discovery of four cast iron cannons in August 2009, during the archaeological monitoring of the dredging, led to a temporary interruption of these works and to the implementation of specific mitigation measures on that area (BH-003).



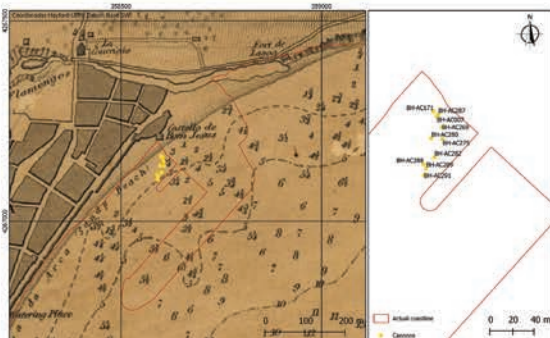
The first cannon, when discovered.

The site

Further assessment of the area has shown that the cannons were recovered under more than 3 m of sediment, in the surf zone of a beach that occupied this coastal area until the mid-20th century. The area was surveyed with a magnetometer, and trial excavations were carried out to verify the results. However, results from this phase were not conclusive, since the area around the cannons was already occupied by the construction works. The restart of dredging in 2011 resulted in the detection of eight more cannons, leading to an interruption of the works and to an assessment by means of a trial excavation.



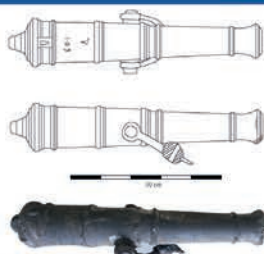
An elephant tusk, lead bullets of diverse calibers (a), a weight (c) and part of a pewter buckle (b) were recovered during the monitoring and the trial excavation. The elephant tusk presents small marks, which are different from the ones recorded at BH-001. The most important site excavated during the intervention in Horta bay. The buckle fragment should be from a 16th century shoe. Parallels can be found, for example, in the artefacts recovered in the HMS *Invisible*, a Royal Navy ship sank in the English Channel in 1756 (Bingeman, 2010: 163).



Left, cannons distribution map, on 1844 cartography. The distribution of the cannons over a wide but confined area suggest that they correspond to the remains of a ship, which possibly ran ashore in front of the fortress of Bom Jesus. The proximity to the coast and the shallow depth explains the lack of well-preserved deposits and indicates that the ship was probably salvaged soon after its loss. Deposited on the exposed surf zone, the remains were gradually eroded, and only the more resistant iron cannons were left in the archaeological record. Still, even they suffered a vertical shift up to the hard substrate.

Most of the cannons were transferred to an underwater deposit located in Entre-os-Montes Bay. They are currently visitable and will be the subject of a monitoring and conservation plan until the end of this year. Nevertheless, the first four cannons (BHAC-BH007.01 to 007.04), along with BHAC-171 and BHAC-287 were transferred to the Portos dos Açores S.A. company facilities. Being a representative part of the collection, these cannons were recorded and are currently in Horta Museum, immersed in alkaline solutions in order to guarantee their preventive conservation.

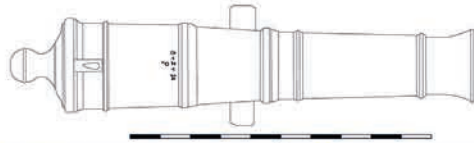
The cannons



BHAC-007.04 is a cast iron cannon with a total length of 84 cm and a 75 cm long gun. The bore is some 4 cm in diameter. This cannon has several interesting features, namely a swivel peg in wrought iron and the beginning of a tiller of the same material at the bottom. Besides, the gun shows an inscription incised on the first reinforce (1:0-9), topped by a P. The first mark should correspond to the English hundredweight - 1(122) × 0 (0) × 9 = 121 lbs. The P corresponds to the English cannon proof mark (Proved).



Cannons BHAC-007.02, 007.3 and BHAC-BHAC-287 are covered with concretions and should have the same characteristics, if we trust the details visible on the mouth, where it is still possible to observe the wood covers that avoided water ingress. This fact may indicate that the guns were still loaded at the time of the wreck.



BHAC-007.01 is also a cast iron cannon, with the original surface exposed. It has much larger dimensions in comparison to the previous artefacts, with a total length of 157 cm and a 139 cm long gun. The bore diameter reaches 8 cm. As the previous cannons, BHAC-007.1 shows English hundredweight incised in the first reinforce - 8 × 2 × R 4 - 8 (112) × 2 (28) × 14 = 956 lbs. This inscription surmounts the P, the proof of a regular fire test. The BHAC-171 cannon, also at the Horta Museum and partially exposed in almost its entire length, features similar measurements and features.

Most cannons in the underwater deposit bear the same dimensions of the two aforementioned groups. Nevertheless, four guns with a total length of more than 2.70 m, measured under water with concretions, correspond to the largest caliber recorded on BH-003 site.

Discussion

At the present stage of research, the cannons discovered during the archaeological monitoring can be divided into three different calibers. The smaller caliber corresponds to ½ pounder swivel guns, mounted on wrought-iron swivel pegs.

The medium-sized cannons are well represented by BHAC 007.01, which corresponds to a 3 pounder gun. Its shape fits the English design that John Armstrong proposed in 1722, later modified, for example, by Charles Fredrick's proposal in 1760. The general form is very similar to the 1760-1780 typology (Roth, 1989: 200). This type was dominant in the British Navy until the early 19th century, and similar artefacts were also found, for example, in the HMS *Colossus*, lost in the Isles of Sicily in 1798, or at the early 19th century *Roses II* shipwreck site (Pujol et al., 2003).

Conclusions

The authors conclude that the BH-003 site probably corresponds to the remains of a British ship lost in Faial Island somewhere between the second half of the 18th and the early 19th centuries.

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El *Fougueux*, Trafalgar (1805). Un navío construido y artillado para la batalla

The *Fougueux*, Trafalgar (1805). A ship built and armed for the battle

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Resumen: el navío de línea francés *Fougueux* se pierde la noche del 22 de octubre de 1805 frente a las costas de Camposoto (Cádiz). Tras combatir en la Batalla de Trafalgar, acontecida el 21 de octubre, desarbolado, sin gobierno y a remolque como presa de un navío inglés, se enfrentará a su última contienda contra los embates de un fuerte temporal que finalmente lo arrasará contra los bajos rocosos de Sancti-Petri, donde naufraga. En 1999 se descubren bajo las aguas los restos de un buque artillado para la batalla en zonas próximas a las que las fuentes

documentales sitúan el naufragio del *Fougueux*. Las investigaciones arqueológicas llevadas a cabo en el yacimiento (2006-2008) trataron de averiguar, a través del análisis de su sistema constructivo y de su armamento, la identidad del buque.

Palabras clave: *Fougueux*, Batalla de Trafalgar, construcción naval, artillería, pecio.

Abstract: The French line ship *Fougueux* was lost in front of the coast of Camposoto (Cádiz) the night of October 22nd, 1805. After fighting in the Battle of Trafalgar, which took place on October 21st, dismasted, without government and being towed as a prisoner of an English ship, he will face his last fight against the stakes of a powerful storm that eventually drag it against the rocky shallows of Sancti -Petri where it shipwrecked. In 1999 the remains of an armed ship for battle are discovered under water in nearby areas where the documentary sources place the wreck of the *Fougueux*. The archaeological investigations conducted at this site (2006-2008) tried to find out, by analyzing their constructive and weapons system, the ship's identity.

Key words: *Fougueux*, Battle of Trafalgar, shipbuilding, artillery, wreck.

INSTITUTO ANDALUZ DEL PATRIMONIO HISTÓRICO:
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EL FOUQUEUX, TRAFALGAR (1805) UN NAVÍO CONSTRUÍDO Y ARTILLADO PARA LA BATALLA



CONSTRUCCIÓN DEL BUQUE

El *Fouqueux*, navío de línea francés de segunda clase, fue construido en L'Orient entre 1783-85, siguiendo las pautas francesas establecidas por el Plan de Saint-Borde en el año 1782.

Pautas del Plan Saint-Borde decretadas en el pecio:

1. Dimensionado de Quilla, uso de Falsa Quilla

2. Cuadernas

- De doble espesor, compuestas por mimbros entesados

- Uso y disposición de varangas y medias varangas

3. Diseño del Casco Interno en zona de bodega

4. Uso de Bulercanas o Sobrelunas

5. Protección del Ferro Externo con planchas de cobre

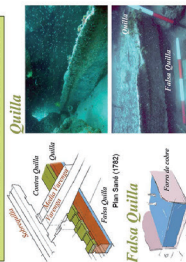
6. Protección externa de Estruex. Longitudinal con planchas de plomo



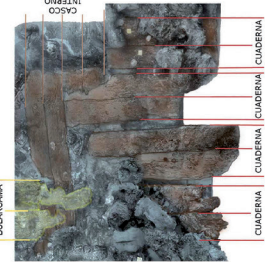
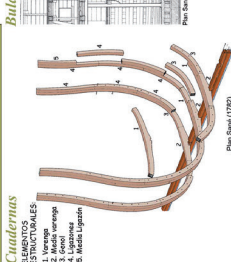
En febrero de 1805, el *Fouqueux* se incorpora a la *Escuadra Combinada franco-española* comandada por Villeneuve, con la que, el 21 de octubre, se enfrenta a la flota inglesa al mando de Nelson en la conocida *Batalla de Trafalgar*. Tras esta, desbarbado y sin gobierno, a remolque como presa de navío inglés *Temeraire* y soportando los envites de un fuerte temporal, naufragó la noche del 22 de octubre en las bajas rocas de Sancti-Petri (San Fernando, Cádiz).

El estado tanto de su sistema constructivo como del armamento y otros objetos asociados con la vida a bordo en el buque, han permitido relacionar los restos localizados en Sancti-Petri con el navío de línea francés *Fouqueux*.

ESTRUCTURA LONGITUDINAL



ESTRUCTURA TRANSVERSAL

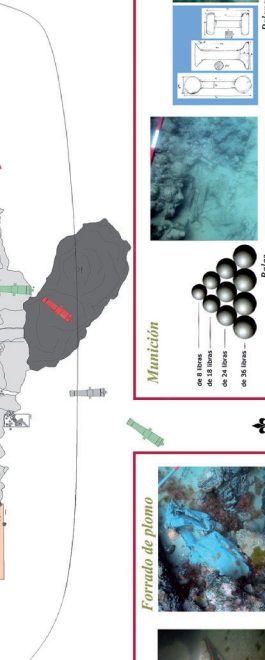
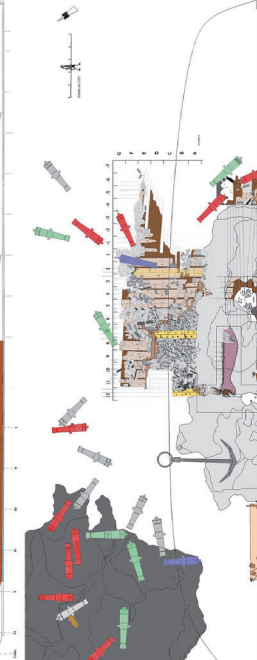
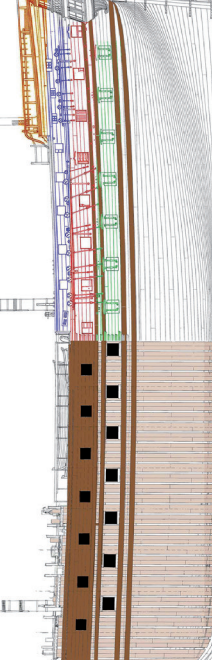


HISTORIA DEL FOUQUEUX EN TRAFALGAR



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ARTILLADO DEL BUQUE

El *Fouqueux*, navío de 74 cañones y en activo desde 1783 a 1805, estaba artillado siguiendo las *Ordenanzas francesas de 1778 y de 1786*.

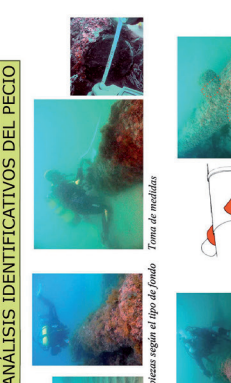
El cañón como elemento tecnológico fundamental para mantener la supremacía en los mares de las potencias del momento, iba evolucionando, modificándose formalmente e incorporando nuevos avances técnicos.

El análisis de la artillería localizada en este pecio, así como de otros elementos relacionados con el artillado, tales como los tipos de munición, mecanismos de disparo, etc., han aportado datos fundamentales sobre los centros de producción de las piezas y su cronología.

Tales datos nos indican que la nacionalidad del artillado es francesa, y su adscripción cronológica de entre finales del s. XVIII e inicios del s. XIX, reforzando la hipótesis de la identificación de los restos de Sancti-Petri como los del navío francés *Fouqueux*.



ELEMENTOS DE ANALISIS IDENTIFICATIVOS DEL PECIO



Cultura eres tú.

