

A MARITIME RESEARCH PROJECT FUNDED BY THE EUROPEAN UNION CULTURE 2000 PROGRAMME

MACHU Report

Nr. 1 www.machuproject.eu

Managing Cultural Heritage Underwater





PHOTO FRONT COVER:

Scientific diver excavating with a water dredge in the investigation trench on a Stone Age Settlement site. PHOTO: RGK

ISBN 978-90-76046-58-7

AMERSFOORT – JANUARY 2008



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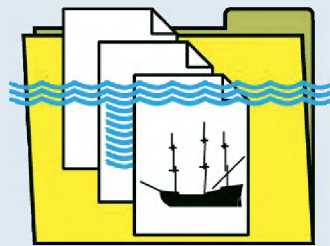
FOREWORD

MARTIJN MANDERS

Here, on behalf of the project team, is the first **MACHU Report** where we present to you information on how the project was started, its current status and what we want to achieve. In addition, the eight partners in the project introduce their contribution.

MACHU: Managing Cultural Heritage Underwater, will publish one report each year, followed by a final publication in 2009 at end of the project. Another way to keep track of the project's progress is to check the website www.machuproject.eu once in a while.

I sincerely hope that the information we present here will be of use to you and of course be fun to read.



WHAT DOES MACHU STAND FOR?

For decades our underwater cultural heritage has been a virtually unknown and unused source of information for the reconstruction of our past. Indeed it has only been in the last decade that international and national institutions have recognised any need for legislative measures to protect and manage this heritage (e.g. UNESCO Convention of Underwater Cultural Heritage, 2001).

Nevertheless, if found, by accident or by intent, sites and objects from the seabed can provide totally new archaeological and historical perspectives on our past. Moreover, they are often spectacular and receive a large amount of public attention, both during excavation and subsequent display (e.g. Vasa, Sweden and the Mary Rose, UK).

The underwater cultural heritage is rich, it has a great variety, and – in many areas in Europe – it is very well preserved. It is also worth remembering that Europe's history is intimately linked with its maritime heritage. This is reflected in the countries involved in the MACHU project (Belgium, Germany, Netherlands, Poland, Portugal, Sweden and United Kingdom) all of which are situated along the coastal maritime routes that have been very important for the development of Europe throughout the centuries.

One of the main reasons why we know so little about our underwater cultural heritage is the fact that it is usually invisible and almost inaccessible. This exclusivity has been beneficial for the submerged remains for many centuries, as wrecks were protected in a

natural way against looting. However, in the present-development of new technologies causes the underwater heritage to become both more accessible and therefore under greater threat. Looting is a serious problem for well-known sites and commercial development projects are also putting pressure on this valuable source of cultural knowledge. Until now, management of the underwater cultural heritage has been done without much planning or coordination, effectively on a site by site basis.

As a result, there is little understanding of the actual processes (both regional and local) that threaten underwater sites. A greater understanding of how sites are formed and changed is also essential as we move nationally and internationally towards a policy of preservation,

conservation or management, *in situ* (ICOMOS Charter, 1996; UNESCO Convention, 2001).

The primary goal of the MACHU project is to make information about our common underwater cultural heritage accessible for academic purposes, policy makers and for the general public. This is going to be achieved through the construction of a GIS-based Decision Support System which will simultaneously act as a database for research, and as a web-based interface for increasing access to our underwater cultural heritage by the general public, the citizens of Europe. The specific benefits to the academic research community will be an improved exchange of data and information that will help to promote research networks between different countries. On a broader European basis information about the condition of sites on the seabed and about research project development will become more available to the academic community. Therefore, duplication in research and management can be avoided. A benefit to policy makers is that this project will help develop good practice for the implementation of European Directives, such as the 1985 EIA2 and 2001 SEA3 Directives.

As a large part of the damage done to underwater sites is invisible to the wider public, it is difficult to obtain support for protective measures. Therefore making site information accessible to the greater public will inevitably engender a greater public understanding of the need to protect sites and promote a

FIGURE 1:
Members of the
MACHU project team
during a meeting



commitment to support that protection. Further, by tackling this issue through a multi-country approach MACHU will inherently promote greater mobility of both data and researchers working in the field of a shared underwater cultural heritage. The project will therefore also contribute to a cultural dialogue between, and mutual knowledge of, the culture and history of the countries involved.

Within MACHU, GIS application, archaeological and historical data from sites and areas will be combined with information on the burial environment (including geophysical, geochemical, sedimentological and oceanographic data) and possible threats to the sites on short term (e.g. erosion, infrastructural works, mining and fishing), and longer term (e.g. increased erosion due to climate change and chemical deterioration). Data will be acquired by both desk-based studies of extant archaeological resources and the acquisition of new data using new technologies and models that, until now, have been only sporadically used in the cultural sector.

Particular emphasis will be paid to the physical controls on site formation and management, including the development of erosion-sedimentation models. These models will be developed on both regional (via the manipulation of the data within the GIS system) and local scale (through calibration of laboratory scale models already developed by the group with *in situ* data). The results from both elements being iteratively fed back into the GIS application throughout the project.

Ultimately, major emphasis will be placed on the final web-based GIS application becoming the basis of a critical tool for the effective management of underwater sites by cultural professionals throughout Europe. This will be achieved through the development of a Decision Support System which will integrate the process-based knowledge with information on the legal and management status of any site, as well as the potential human impact on any site or environment (i.e. a regional as well as a local perspective). With MACHU we will be able to more effectively preserve our past for our future – which is almost by definition of international concern.

More importantly, this will be achieved in a pro-active manner by sharing this information with all countries that have a long maritime history. The project runs from September 2006 until August 2009. ■



FIGURE 2: Due to the Treaty of Valletta [Malta], works executed on land and water are now subject to archeological investigation prior to, as seen here, dredging. PHOTO'S: PETER STASSEN, RACM



HOW MACHU HELPS EUROPEAN PLANNERS, POLICY OFFICERS

The EU-Culture 2000 project MACHU – Managing Cultural Heritage Underwater – aims to address three major groups: the European citizen as well as policy makers, planners and scientists.

MACHU FOR THE PUBLIC

Why does the project want to address the (European) citizen?

For centuries, connections between countries and cultures were made over, and by, water. Many European countries have a rich maritime history and the common maritime heritage that remains underwater reflects this. However a significant problem is that this underwater cultural heritage is not visible for the majority of the people. Once in a while, through archaeological excavation, salvaging, dredging or accidental catch by fishermen, objects from this rich cultural source are lifted out of their remote and anonymous environment. Then suddenly we are excited by the beauty and the mystery of it.

Due to regulations and agreements, the management of underwater cultural heritage is moving towards *in situ* preservation, leaving the sites (usually) untouched on the seabed. But does this mean we are not going to see and experience any of this cultural richness ever again?

Before protecting these sites, it is the aim of the archaeological community to make an inventory of our underwater archive. This means that our specific goal is to get an insight in what we should protect.

The aim of the MACHU project is to make this information available to the wider public, showing the richness of our maritime heritage underwater not only on national, but also on international level; appreciating the

history and the resources of our neighbours as well as our own. To that end, all MACHU information will be presented in an accessible way.

HOW WILL MACHU ACHIEVE THIS?

MACHU's main tool to inform and help the European citizen will be the website

www.machuproject.eu which is structured in such a way that it will lead you to the topics referred to above and answer your questions about them. There will also be an explanation of why we are promoting *in situ* preservation, how we are doing it, and where it will be published.

The different countries involved in MACHU

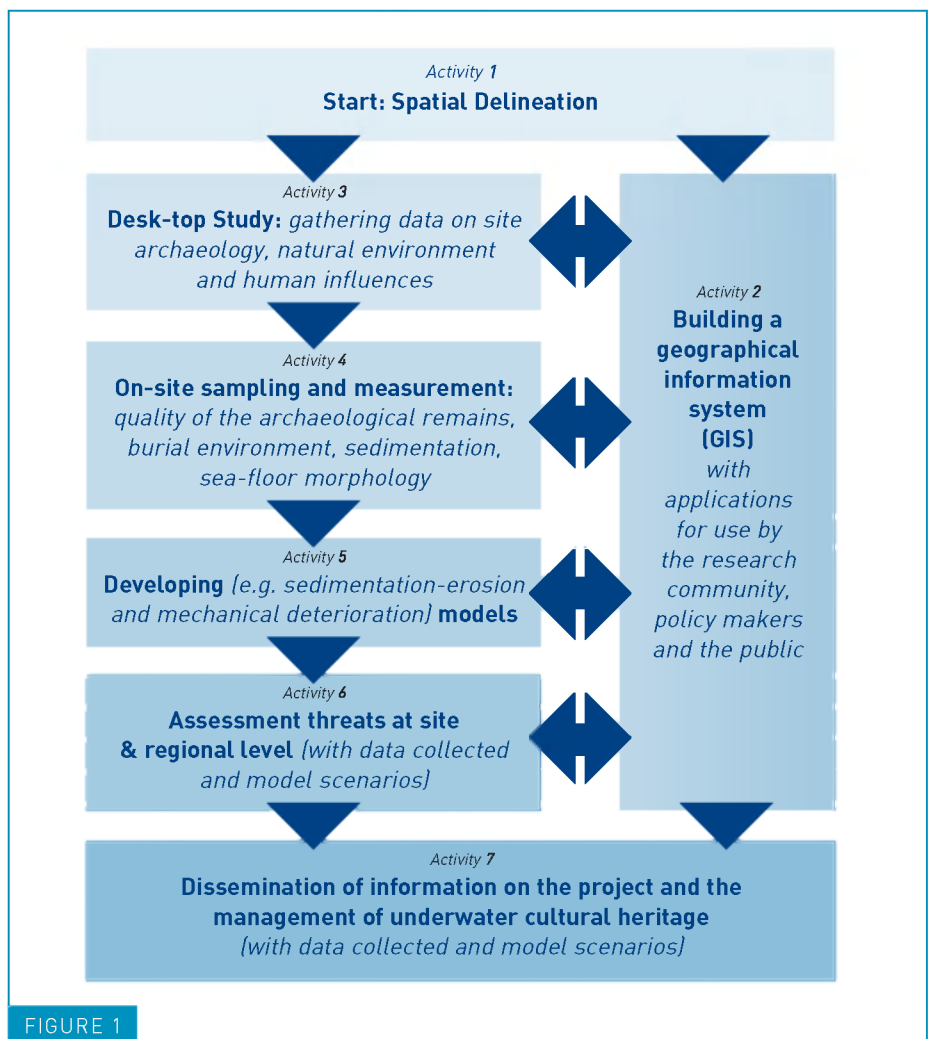
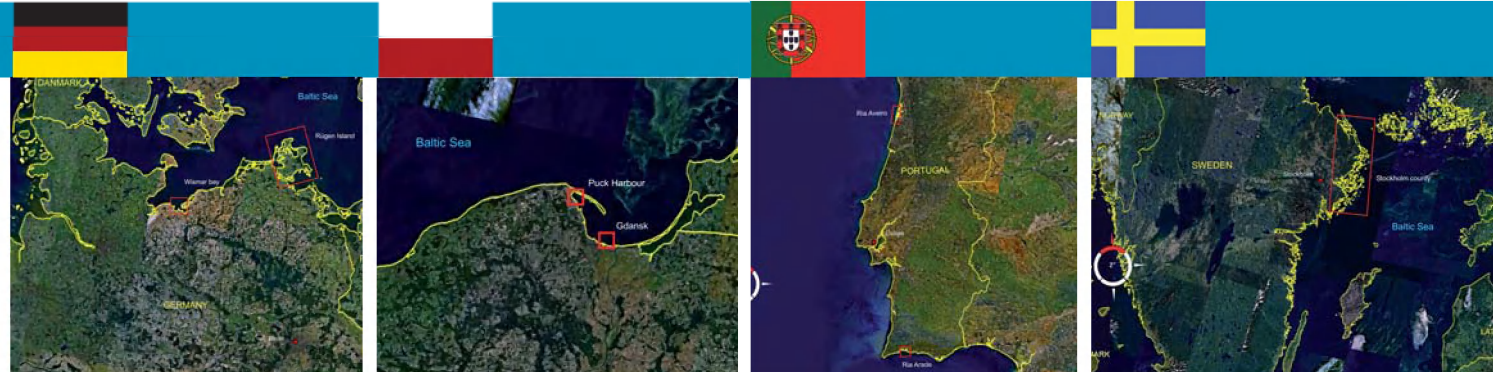


FIGURE 1



N CITIZENS, AND SCIENTISTS

will host examples of their underwater cultural heritage on the website for the public to see. Information about wrecks lying underwater is shown so that the public will get a better insight in what can be found on the seabed and what we can do with such heritage assets.

MACHU FOR THE PLANNERS AND POLICY OFFICERS

Why would we like to inform policy makers, managers and planners in archaeology?

For a long period, the sea and its seabed were a kind of 'Terra Incognita' to many of us. Once in a while infrastructural interventions and commercial developments were planned (e.g. dredging out waterways or extending harbours). Regularly, due to these works, wrecks were exposed and destroyed.

Nowadays we know much more about the seabed. The information is however scattered across several organisations and it is not always accessible to others. How can we use the available information to convince others to be careful with our cultural heritage underwater and make them realise that it is worth protecting? How can we use data that has been recorded by others for the management of this heritage?

And even if the 2001 UNESCO Convention on the Protection of Underwater Cultural Heritage hasn't entered into force and it will take a long time until its ratification by the majority of the Countries of the world, we must be aware of the universal significance of the unanimous decision of countries represented in UNESCO assembly to include in the body text an Annex inspired by the Sofia ICOMOS Charter, 1996, which is the state of the art on UCH management and the reference of MACHU's principles and standards.

How does MACHU address the planners and policy officers?

First of all MACHU will show everyone the overall richness of the underwater heritage as a source of information. Therefore it will be a useful tool for policy makers to emphasise the shared responsibility we have towards our common underwater cultural heritage.

The use and exploitation of the seabed has been regulated in many (EU) Directives, agreements and laws. The Treaty of Valletta (signed by most EU-countries) even obligates us to investigate the seabed before disturbing it.

Much information on the heritage underwater is not yet available for decision-makers or planners. MACHU aims to make this information accessible through a GIS-system (to agreed standards), within a password-protected section of the MACHU website. It consists of bathymetrical data, sediment-erosion models, administrative information, detailed depth information and the existing connected legislation.

The MACHU GIS will be designed in such a way that extra maps (e.g. specific information like fishing or diving activities, the condition of shipwrecks, or threats to specific areas of our underwater cultural heritage) can easily be added.

When MACHU is ready, it will be a useful tool for predicting the archaeological value of areas and the threats to this rich underwater cultural resources.

MACHU FOR THE SCIENTISTS

Why are we addressing the scientists?

Taking a similar approach for a wide range of shipwreck-sites in various areas, and assessing them similarly, a good overview can be produced for the research potential of sites across the different areas of Europe. Would a

European-wide approach to research questions, and the related relevance of specific sites to those questions, not be a useful way forward? Should research funding in each country only be expended on study within its own territory? Would a united European approach to the management of common maritime heritage not be more effective?

This is not necessarily a question of combining budgets, but it is of exchanging knowledge, information and data.

Combining forces and knowledge in this respect is therefore much more than simple co-operation across European borders.

How will we address the scientists in MACHU?

MACHU will provide a central portal for data. It will be the base for a joint management of maritime heritage. Data will be presented through a GIS, making it possible to combine certain information and therefore generate new information on sites and areas.

If we have a well structured system in which wrecks of many countries can be consulted, registered and presented in the same way, it will be in the advantage of scientists through the whole of Europe.

In MACHU, data formats will be developed for the assessment of sites (Management Plans developed in the MoSS project), looking at degradation of sites and describing these processes in the same way. New techniques in management and research of underwater cultural heritage will also be developed and implemented (e.g. dating the sediment of the seabed with OSL (Optical Stimulated Luminescence)). ■

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The National Service for Archaeology, Cultural Landscape and Built Heritage (RACM) is responsible, with others, for managing the Netherlands' heritage both above and below the ground and under water.

From the Middle Palaeolithic, some 350,000 years ago, to the post-war period of reconstruction. Whenever historic, archaeological or cultural landscape values are at stake, the RACM takes the lead in ensuring the conservation, statutory protection, conservation and investigation of the country's heritage.

The keywords are quality and sustainability. In cases where no national or international values are involved, the RACM lobbies other authorities and public and private sector parties to manage our heritage in accordance with universally accepted standards.

As part of the Ministry of Education, Culture and Science the RACM operates under the direct responsibility of the Minister. In our role as a government agency, we maintain an overview of the cultural heritage throughout the country, including the legislation governing it. We tell the stories behind our cultural heritage and advise national, regional and local authorities in their decision-making. We also make a valuable contribution to international cooperation in this field through the exchange of knowledge and information.

The RACM operates at the interface between policy, science and practice. This enables us to renew, enhance and share knowledge. In making knowledge and information accessible, we are led by society's demands regarding

heritage management.

We act as a partner in the design and implementation of land use plans, and help develop policy, conduct research, and issue grants for activities in the field of archaeology, cultural landscape and built heritage management.

We administer a national repository for ship archaeology, a register and database of listed historic buildings and monuments and protected townscapes, and a central archaeological information system.

The heritage is often vulnerable to external influences, and we cannot expect it to be cared for as a matter of course. The RACM is also charged with implementing and enforcing the Monuments and Historic Buildings Act, taking action where necessary when the heritage is threatened.

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MARTIJN MANDERS did a free doctoral study in underwater archaeology and maritime history at the University of Leiden finishing with a study on the casks of a sixteenth century trader excavated on the Texel Roads. He has worked since 1990 for the RACM, first in Alphen aan den Rijn (AAO) then in Lelystad (NISA) and now in Amersfoort (RACM-BMI). Martijn has a special interest in finding ways to execute in

situ-preservation and overall management of underwater cultural heritage. He has worked on sites all over the world. The experiences in European projects he gained in the MoSS project (Monitoring, Safeguarding and Visualizing North-European Shipwreck sites) and the BACPOLES project (Bacterial Decay of Wood).

WILL BROUWERS studied Classical history and Roman provincial archaeology at the Radboud University in Nijmegen.

Finished with a study on the trade and cultural interaction between the Greek colony Selinus (6th and 5th century B.C.) and the Carthaginian emporia on Sicily (1990). After that he excavated with the university and the municipal archaeological service in Nijmegen at the Roman *canabae* near the legionary fortress (Legio XG) in Nijmegen. His special interest goes to the interaction between the tribe of Batavians and the Romans in the *limes* area of Batavia in The Netherlands. Besides this he worked for the Roman Museum in Nijmegen where he is specialised in educational programmes on (Roman) archaeology.

ARJEN ROOS completed an economics programme at the HEAO in Utrecht. He has worked at RACM since May 2000. He started as financial assistant. Nowadays he is financial controller and coordinates procure-

rements. In the MACHU project Arjen is responsible for all the financial affairs and controls the project budget.

PAUL BOEKENOOGEN studied Social Geography at the University of Utrecht. Later he followed a special GIS course at the Van Hall Larenstein institute in Velp. He is now working as specialist in geographical information at the RACM in Amersfoort.

ROBERT OOSTING completed his studies as a naval architect at the HTS of Haarlem in 1979. Since August 1980 Robert was involved, as a naval architect, in the shipwreck excavations in the IJsselmeerpolders. In the period 1992-2000, he was the Head of the Ship Archaeological Division of the Netherlands Institute for Ship and Underwater Archaeology (NISA). From the end of 2000 Robert Oosting worked as a civil servant at the Division of Maritime Heritage at the ROB/NISA (RACM since 2006) and was involved in the physical and legal protection of shipwrecks as well as in several ship archaeological research projects.

ANDREA OTTE studied Archaeology of the Roman era in North Western Europe, (MA) (University of Amsterdam 1992). From 1993-2002 she worked for the National Service for Archaeology, Cultural Landscape and Built heritage in different functions such as adviser on spatial planning and development projects and project leader for the Highway A2. Since 2002 she has worked as (senior) policy adviser on maritime heritage: advising on maritime policy development, national and international, and coordinating major spatial planning projects.

WENDY VAN DER WENSPOLICH studied Art History at the University in Leiden. Finished with a study on 20th century graphic and corporate design in Holland, particularly related to the new image of the Dutch Police in the early nineties. After this study, she started to work with a ship's insurance company. Since 2002 she has worked at RACM. Here, the combination of maritime heritage, archaeology, applied arts and data management, offers her an interesting working environment.



In the Netherlands, two test areas have been chosen. The first one is for the RACM a quite unknown area, named the Banjaard, in the North Sea near the entrance of the Oosterschelde in the southern part of the Netherlands. This area has been chosen for two reasons:

- It is a dynamic area and can give much detailed information for the sedimentation/erosion model;
- Amateur divers are interested in the area and collect a lot of data from different sites.

The second area is the Burgzand Noord in the Waddenzee in the northern part of the country. The Burgzand has been chosen because his long history of research and therefore a lot of information is collected.

THE BANJAARD TEST AREA IN ZEELAND

The Banjaard is a shoal area just west of the island of Schouwen-Duiveland. Banjaard means saloon (kajuit) on a ship. Originally the Banjaard was a part of the island of Schouwen. The area was, from the 9th century until 1580 AD, a stable triangle sandbank of approximately 15 km length. After 1580 AD erosion intensified enormously. Most of the (dramatic) changes in the area were due to human interference. This caused the Oosterschelde to change rapidly from a riverdelta into an estuary (between 1535-1600). The tidal energy intensified which caused the islands bordering the estuary to

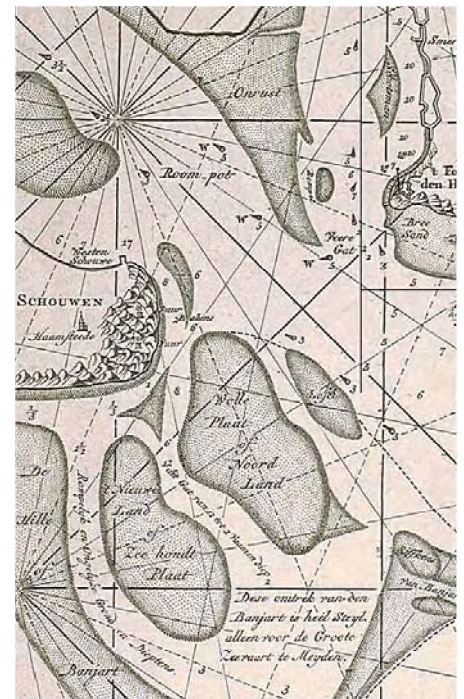


FIGURE 2: The Banjaard area on a map from 1774.

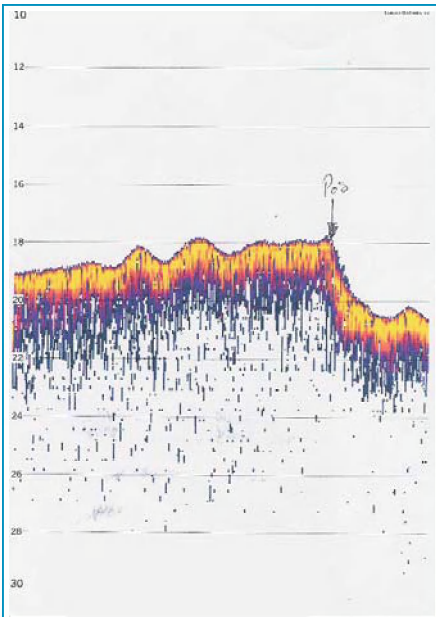


FIGURE 3: Echo sounding survey on 'The Banjaard'.

PHOTO: DUIKGROEP NEHALENNIA



FIGURE 4: Wood with a copper bolt of one of the shipwrecks on the Banjaard.

PHOTO: DUIKGROEP NEHALENNIA

decline. Parts of the islands of Schouwen and Noord Beveland vanished in the sea. More than 100 villages disappeared. (figure 2)

New channels in the Oosterschelde eroded the Banjaard and sliced the area into different parts. At the same time, million tons of sand was transported out of the Oosterschelde to form new sandbanks in the Banjaard area. Until very recently changes in the Oosterschelde and Banjaard area were considerable. The safer searoute to Rotterdam was just west of the Banjaard area. Ships intended to avoid the Banjaard area and yet hundreds of ships got in trouble there. Between 1822 and 1999 more than 300 ships sunk or stranded in the Banjaard area. Although many ships have been reported sunk on the Banjaard few have been identified.

Even today the shoal area can be dangerous. The Provincial 'Zeeland Newspaper' stated that on July the 17th 2007 a Swedish yacht travelling from IJmuiden to Calais run ashore. The reason given was a navigation error. Ship and crew, a couple, were rescued.

THE BURGZAND NOORD TEST AREA

For centuries, the Netherlands have been an

important maritime nation. Amsterdam was a significant market for all kinds of goods within Europe. Grain coming from the Baltic region was traded there, as well as goods from the East and the West Indies.

For a long time however it was impossible for big ships to enter the Amsterdam harbour with their cargo because of the shallow waters in this area, called Pampus.

As a solution, these ships were loaded and unloaded on the Texel Roads, in the Wadden Sea in the North of Holland.

Protected for the North Western winds by the island of Texel, it was a relatively calm area. Relatively, because during centuries thousands of these ships have been wrecked by storms. One example is the storm of Christmas Night 1593. In one night more than forty ships sunk and hundreds of sailors died. One of these unfortunate ships, the Scheurak SOI-wreck, has been excavated by RACM. This is however not the only shipwreck found in the western part of the Wadden Sea.

In a small area of a few square miles about eighty shipwrecks with archaeological potential from between the sixteenth and nineteenth century are located. These wrecks have been found by local fishermen and divers.

Between 1998 and 2006 the diving team of the Netherlands Institute for Ship and underwater Archeology (NISA), nowadays RACM Lelystad, investigated and monitored several of these shipwrecks. Within the BZN test area we can find four wrecks from the seventeenth century:

- The BZN 3 an East Indiaman ship called the 'Rob';
- The BZN 8 and BZN 11 these are unknown armed traders;
- The BZN 10 possible a German trader to the Iberic peninsula.

In order to know how important this area is for our national, but also for our common maritime heritage, it was important to develop a method to give an assessment to these wrecks. The used method formed the basis for the 'master management plan' that was developed within the EU MoSS project and is now again used in MACHU.

The used assessment method was mainly non-intrusive. Only in two cases where key-questions couldn't be answered, and after long consideration, shipwrecks have been partly excavated by digging trenches. The Western Wadden Sea is placed on the Tentative List from the Netherlands for

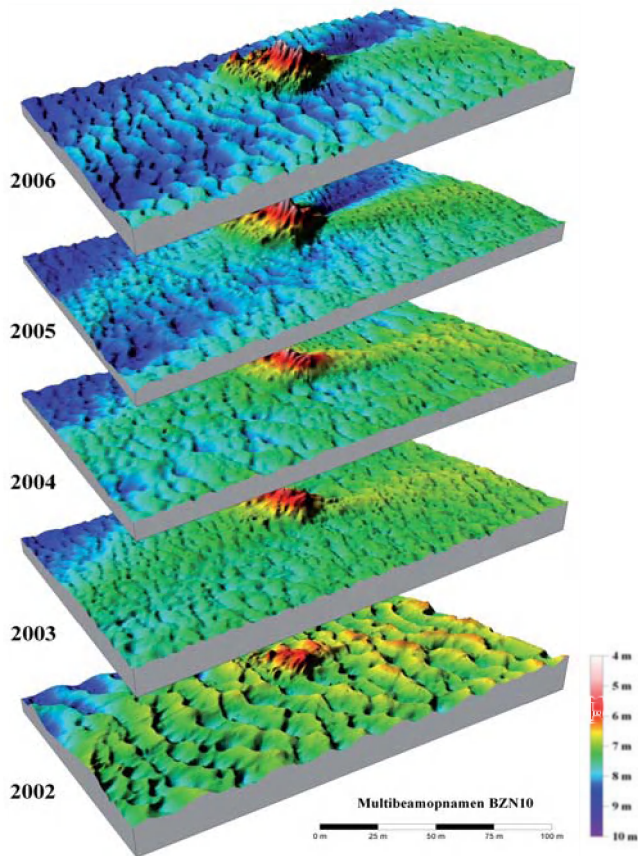


FIGURE 5: Five year sequence of multibeam recording on the BZN 10 wreck



FIGURE 6: Iberian jars on the BZN 10 wreck



FIGURE 7: A complete cask on the BZN 10 wreck

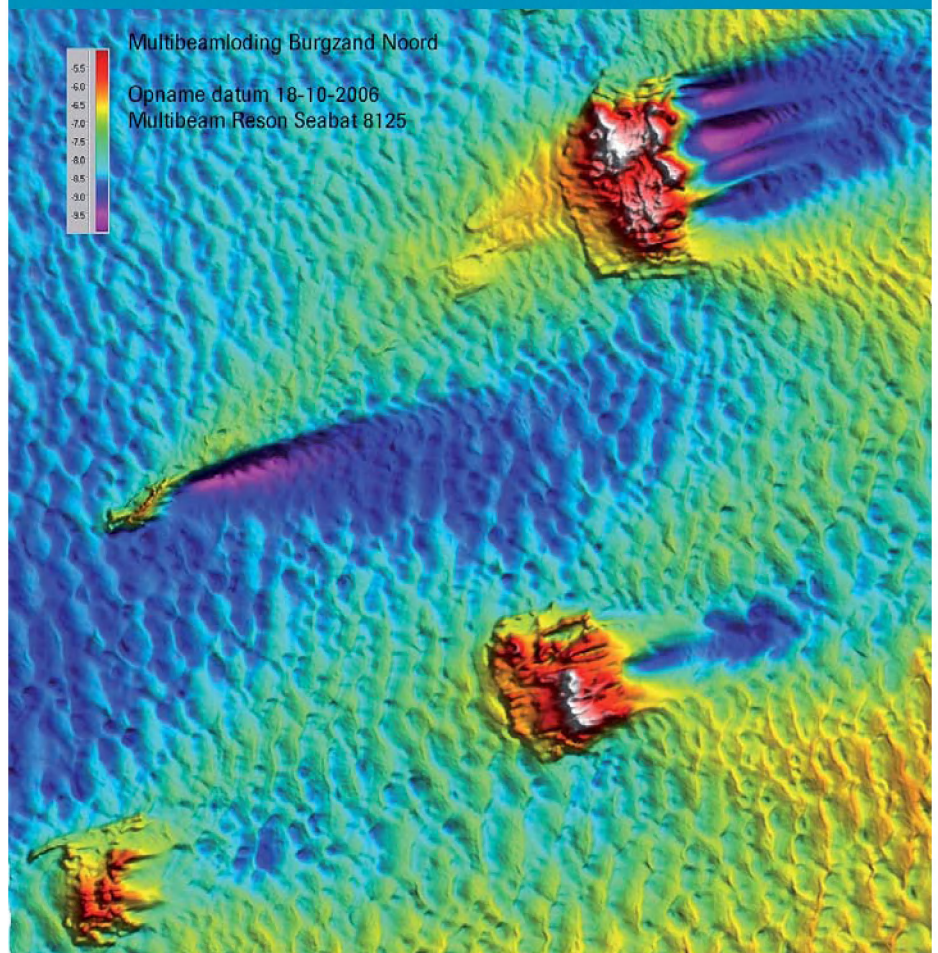
UNESCO World Heritage. One of the aims of the assessments of shipwrecks is to show that there is still a great deal of archaeological evidence surviving in this area. The other aims are the development of methods to carry out assessments and to do research on the degradation of shipwrecks underwater. Until now 12 shipwrecks in the whole Burgzand area have been assessed.

With so many wrecks in Dutch national waters, it is impossible to excavate all of them. The first option is to protect shipwrecks *in situ*. In the MACHU test area the BZN 3, BZN 8 and BZN 10 are physically protected. ■

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FIGURE 8: Multibeam sounding of four wrecks on the Burgzand Noord



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The Flemish Heritage Institute (VIOE) is a scientific Institute of the Flemish Government under the direct authority of the Minister. The Institute was set up in 2004 to carry out research related to heritage and organise presentations of the research results. The policy of the Institute is to approach the legacy of the past as an integrated whole, encompassing not only archaeological sites, but also monuments, landscapes and heritage afloat.

Archaeological finds from the sea have attracted considerable attention for quite some time. The part of the North Sea under Belgian supervision and the rivers not only conceal large numbers of shipwrecks but also a wide variety of 'other maritime archaeological heritage' such as ship cargoes lost or left behind, drowned settlements and skeleton remains of extinct animal species. Maritime archaeological heritage can also be found on

land, including the remains of various structures connected with the sea or rivers, such as sluices, ports, lighthouses, fishermen villages and salt works. A very closely related field of study is represented by ships of historic importance that are still afloat today, the so-called 'heritage afloat'.

Since 2005 these fields of study have been addressed in an integrated way by the Maritime Archaeology And Heritage Afloat Unit of the Flemish Heritage Institute. This unit of 11 people (established in the summer of 2007), has an anchor point by the sea in the Provincial Museum of Walraversijde (Oostende).

In view of the shared competence, the establishment of a co-operation agreement between the Flemish and Federal government on maritime heritage in late 2004 was a first major step. Another important element was the setting-up, and continuous update, of a

database that collects as much information as possible on maritime archaeological archives. Developed by Aaxis-Belgium NV, this database with interactive web applications can be consulted at:

<http://www.maritieme-archeologie.be>.

In co-operation with a large number of partners, including the Province of West Flanders, a variety of initiatives were subsequently set up, ranging from exhibitions with workshops for divers, to an international maritime colloquium in Bruges 'To sea or not to sea'. In addition, the growing collaboration with the diving community has already produced important results.

New and adapted legislation that regulates the issue of ownership of wrecks and provides the legal basis for the protection of historically or archaeologically valuable wrecks was approved in early 2007.

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After participating in the archaeological excavations at the Louvre museum in Paris-France (1989-1991) he joined the scientific staff of the Flemish Heritage Institute in 1992. Since that year, he has directed archaeological research at the late medieval fishing village 'Walraversijde' (Oostende, Belgium) and was awarded in 2002 a Ph.D. at the Free University of Brussels with a dissertation on the material culture of late medieval fishing communities in the southern North Sea area. In July 2003 he was responsible for developing the new research unit devoted to maritime heritage at the Flemish Heritage Institute.

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(1997-2001) at the University of Leuven. She worked as a site assistant (2002-2004) on rescue excavations in Ireland, involving post-medieval and bronze-age sites. In 2005 she joined the scientific staff of the VIOE. As well as archaeological excavations (among which at the medieval fishing village of 'Walraversijde'(2005-2006)), she is responsible for data acquisition and research on the maritime archaeological heritage present in Flanders and in the North Sea. Currently she is working full-time on the MACHU project.



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FIGURE 1

The Belgian section of the North Sea, covering only about 3600 km², is small when compared with neighbouring territorial waters. However, its position close to the English Channel, for centuries an important gateway to the North Sea and the Baltic, and its long-established international trading ports such as Bruges and Antwerp, meant that it was among the busiest shipping zones of the world from the Middle Ages onwards.

In spite of its great potential, study of the maritime heritage of the North Sea has only begun in earnest in Belgium in recent years. An overview of the achievements to date was published in 2007 (Zeebroek et al. 2007). An interactive database of this Belgian maritime archaeological heritage can be consulted at www.maritime-archaeology.be.

As part of the MACHU project two areas of Belgium's North Sea waters were selected for study: the first is centred on the 'Vlakte van de Raan' sandbank, and the second on the 'Buiten Ratel' sandbank. The 'Vlakte van de Raan' is the main sandbank in the Scheldt estuary and appears on maps as early as the 17th century. The 'Buiten Ratel' sandbank is the site of an 18th century wreck which is already the subject of investigation by the VIOE (Vlaams Instituut voor het Onroerend Erfgoed - Flemish Heritage Institute).

VLAKTE VAN DE RAAN

This study area covers some 97 km² in the form of a rectangle measuring 12 km x 9 km apart from a small triangle which is in Dutch Territorial Waters. Twenty archaeological sites have been identified in the 'Vlakte van de Raan' study area to date. Among the 20 is the 'Zeebrugge site' from which numerous artefacts, mainly of copper alloy, have been recovered since 1990 (Vandenberghé 1997, 87-90). Examination of these artefacts has led to an estimated date for the site of the late 15th - early 16th century. The most striking of the objects from the Zeebrugge site is a well-

preserved wrought iron cannon together with its wooden gun-carriage. No remains of the actual vessel have been recorded, but detailed scientific study of the site and the artefacts has yet to be carried out.

Also in the 'Vlakte van de Raan' study area is 't *Vliegent Hart*, a Dutch East Indiaman lost in 1735. A huge number of artefacts were recovered from this wreck between 1981 and 2000 in the course of a joint Anglo-Dutch initiative under the direction of Rex Cowan (Hildred, ed., 2001). A comprehensive report on this project is awaited.

Two wrecks in the 'Vlakte van de Raan' study area have been identified as German World War I submarines (UC-4 and UB-59) (Ter-mote 1999, 157, 159). Two more date from World War II: an American - British landing ship tank, LST-80; and the front section of the 'Samselbu', a British Liberty ship the stern half of which lies some 5,5 km away, outside the study area. As well as vessels connected with the World Wars, other twentieth century wrecks are to be investigated. Only one of these has so far been identified in the study area: Z.442 'André Jeannine', a fishing boat which sank in 1961. The 'André Jeannine' was until a few years ago, discernible by means of multibeam. Its current invisibility by multibeam probably means that it has in large measure been covered by sediment.

Four further shipwrecks are known but have yet to be identified. Nine other sites have been reported by divers or fishermen but await survey.

'BUITEN RATEL'

This second study area covers a square of 225 km² (15 km x 15 km) up against the western boundary of Belgium's territorial waters. It takes its name from the sandbank which is situated in its centre and includes 21 archaeological sites.

The best-known of the sites in the second study area is the 'Buiten Ratel wreck', the most prominent features of which are 3 massive anchors. Since 1996 NATA (North Sea Archaeological Team Aquarius) divers



FIGURE 2: Voluntary divers preparing for their dive with the research vessel 'Zeeleeuw' in the background. ©VIOE



FIGURE 3: Measuring parts of an unidentified UC-boat. PHOTO: STEFAAN MAECKELBERGH ©VIOE

have been carrying out a systematic salvage operation at the site. Among the artefacts recovered is a large collection of clay pipes (Thierens 2006, 23-24). In 2006 the Flemish Heritage Institute (VIOE) initiated a detailed study of the artefacts from the 'Buiten Ratel wreck'. The material has been dated to the mid-18th century, and a significant proportion, including the clay pipes, pewter spoons, and a watch in a gold case, link the wreck to parts of the modern Netherlands. In fact the finds are very similar to the 18th century artefacts known from the 'Hollandia' and the 'Amsterdam'.

In the 'Buiten Ratel' study area the wrecks of 4 World War I torpedo boats have been identified, though spread over 5 sites. Two of the wrecks are of German boats, G-96 and A-19 (the two halves of which lie some 90m apart), while the other two are French, the 'Branlebas' and T-319.

The British ferry 'Gracie Fields', the armed trawler 'St. Achilleus' and the 'Bourrasque' are wrecks from the World War II period in the study area. The 'Bourrasque' is one of the sites which have been chosen for detailed

biological research (www.vliz.be/projects/bewremabi/).

A fishing vessel which sank in 1972, 'Z.577 Sabrina', provides useful information on the preservation, the rate of sedimentation, and the human and biological impact on a wreck which was not affected by bombs or mines. One other wreck, which has yet to be identified, nonetheless appears to be of 19th or 20th century in date. Ten further sites have been recorded but remain to be explored.

FIRST IMPRESSIONS AND WORK IN PROGRESS

In the two test areas 41 archaeological sites have been identified. Of the 41, only three have been shown to predate the 19th century.

The largest group of sites (12 in total) is that of wrecks from the two World Wars. Explosions connected with their foundering mean that many of these ships were severely damaged even before any other deterioration could take place on the seabed. It appears, however, that most of the wrecks in the two

study areas are well buried in the sediment, which probably provides good protection. There is clearly a need for more detailed study of the processes of sedimentation and erosion if informed forecasts regarding the preservation of the sites are to be attempted.

Many of the wrecks with elements protruding from the seabed are being reused, serving as artificial reefs for plant and animal marine life. This biological activity may protect the wreck against erosion but may also accelerate its deterioration – it is anticipated that further study may shed light on this question.

The wrecks at five sites remain unidentified, while seventeen possible sites await investigation. As a result of a cooperative initiative with the Flemish Hydrographic Service (www.vlaamsehydrografie.be), the first half of 2007 has seen the recording of fourteen of the forty-one sites with an EM3002 Multi-beam, and further such scanning is planned. In addition reported positions need more analysis.

Detailed recordings are also soon to be taken of a selection of wrecks using an AUV / Side Scan Sonar (Remus 100). These forms of

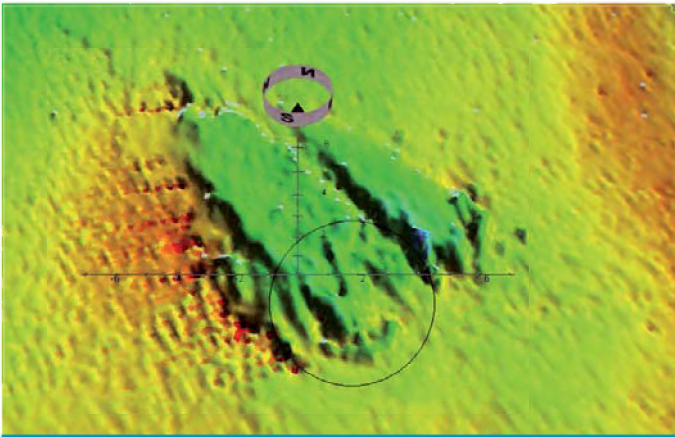


FIGURE 4: Multibeam image of the 'Z. 577 Sabrina'
© FLEMISH HYDROGRAPHIC SERVICE

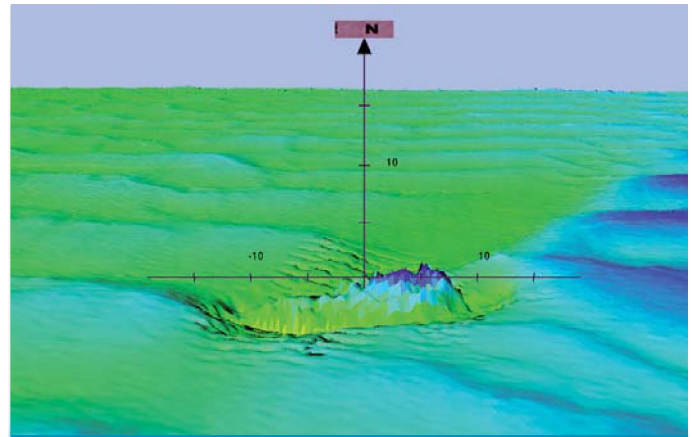


FIGURE 5: Multibeam image of the 'Z. 577 Sabrina'
© FLEMISH HYDROGRAPHIC SERVICE

imaging, using different scanning apparatus, provide a very good basis for further underwater research (fig. 4 & 5).

Divers have now made preliminary surveys of five of the wrecks in the 'Buiten Ratel' study area. These surveys afford an initial impression of the state of each wreck, recording the presence of fishing nets, noting traces of robbery and other damage and identifying the immediacy of threats such as erosion. The appearance and condition of each wreck site is recorded by means of sketches, measurements, techniques which provide information regarding, for example, the survival of structures on the seabed as well as regarding plant and animal life at each site.

Soil samples are taken from inside and outside each wreck for sediment study. The rate of corrosion of different metals under water is being investigated by means of the placing of samples on the 'Buiten Ratel wreck'. In

addition, of course, the 20th century wrecks provide excellent data for the investigation of the deterioration of different materials, particularly as in many cases the exact date upon which the ship sank is known (figure 6).

In summary, there is a varied selection of sites spread between the two study areas. The project holds great potential for research which ought to contribute valuable information towards the formulation of policy and practice in the management of the underwater archaeological heritage. (With special thanks to archaeologist R. Budd (Dublin, Ireland) for revising the text) ■

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FIGURE 6: Example of corrosion on parts of a 19th or 20th century wreck of unknown identity in the 'Buiten Ratel' area. PHOTO ALLAN SOREYN ©VIOE



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The seas and shores around England contain an immense wealth of archaeological sites and remains. As an island country that has experienced successive waves of settlements over many centuries, and as a major mercantile, naval, industrial and imperial power, the history of England and the experience of many of its inhabitants has been inextricably linked to its surrounding seas.

And, of course, it is only within the last 10,000 years or so that we have been an island, so for many more millennia before that we were part of the landmass of North West Europe. Maritime archaeology concerns the investigation of such evidence and we are the Government's advisor on all aspects of the historic environment of England, all the way out to the

Territorial Limit 12 nautical miles off our shores. The English Heritage Maritime Archaeology Team provides maritime and coastal archaeology policy development and strategy, promotes standards, manages grants, produces guidance, and takes forward the physical management of England's Designated Wreck Sites. The Head of Maritime Archaeology Team is Ian Oxley.

Early evaluation of how development might impact on the marine historic environment is a key consideration in assessing the overall viability of a project, or in the preparation of future planning proposals. In our provision of advice to UK Government regulators for off-shore developments we encourage a proactive

approach promoting early discussion so that any survey work to examine the seabed is made available for wider benefit and use. Knowledge of the presence of previously unknown and potentially significant archaeological sites will improve decision-making and promote effective development planning.

We also work to ensure that the historic environment receives appropriate recognition and inclusion within the development of European maritime policy. In support of this objective, we have participated in the formulation of the European Marine Strategy to ensure our interests are integral to the action taken to deliver a sustainable marine environment.

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IAN OXLEY started his archaeological career as a digger in the late Seventies, learnt to dive and joined the Mary Rose project as diving Finds Assistant. Following the excavation and recovery of the Tudor warship he specialised in shipwreck environmental archaeology, progressing to become the Mary Rose Trust's Archaeological Scientist. He has held many voluntary offices in societies such as the Institute of Field Archaeologists and helped develop the Nautical Archaeology Society Training Programme. Moving to St Andrews in 1988 to spend ten years with the Archaeological Diving Unit he set up and directed the voluntary Maritime Fife project. After embarking on research into the management of historic shipwreck sites in Scotland at Heriot-Watt University, he joined Historic Scotland as an Assistant Inspector of Ancient Monuments before moving to English Heritage as Head of Maritime Archaeology in 2002.

CHRIS PATER is Marine Planner and he provides the main contact point for the MACHU project. Chris Pater joined the English Heritage Maritime Archaeology Team in 2005 after having spent seven years in the Maritime Team of English Nature, another UK public body responsible for nature and geological conservation in England.



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Introduction to the English test areas

EASTERN ENGLISH CHANNEL AND THE GOODWIN SANDS



The contribution that English Heritage brings to this project is work supported by the Aggregates Levy Sustainability Fund introduced by the UK Government to provide funds to help address the environmental impacts of marine aggregate extraction. English Heritage is a major distributor of the fund and supports projects that examine the implications of marine sand and gravel extraction on the marine historic environment.

Research projects have been targeted to meet both the Fund priorities and the strategic agenda for England's maritime archaeology. Through its involvement in the Fund English Heritage has supported a range of initiatives, providing new insights into mitigation, assessment, evaluation and potential of the marine historic environment through remote survey and field investigation. It is in reference to a particular set of projects, supported by the fund that will provide the basis for our participation in the MACHU project undertaken by the Justin Dix and David Lambkin of the University of Southampton.

EASTERN ENGLISH CHANNEL

One of the seabed modelling test sites is the wreck of a First World War submarine broken in two at a depth of approximately 41 m in the middle of the central vessel separation zone of the eastern English Channel (approximately 20 nm SSW of Hastings (East Sussex)). The vessel when intact measured 57 m LOA with 5.2 m beam and now stands 4.5 m proud of the seabed and represents the remains of a German mine-laying submarine (figure 2).

The initial investigation concluded that the site represented the remains of UC65 sunk 90 years ago on 3rd November 1917 after being torpedoed by a British submarine with the loss of 22 out of 27 lives. She was home-ward-bound via rapid surface run when she was sighted by HM Submarine C16, which dived, firing two torpedoes. UC 65 avoided the first but was struck amidships by the second. Kapitanleutnant Lafrenz was among five survivors captured. However, the location given for this attack on UC65 was that she was torpedoed off Dartmouth (Devon), although a record also exists that the attack on this submarine was by HMS MC-15, commanded by Lieut. E Dolphin. So what of the identity of the U-boat 20 nm SSW of Hastings? Peter Longstaff-Tyrrell of the Sussex Military History Society is quoted as suggesting a provenance for a 'rare World

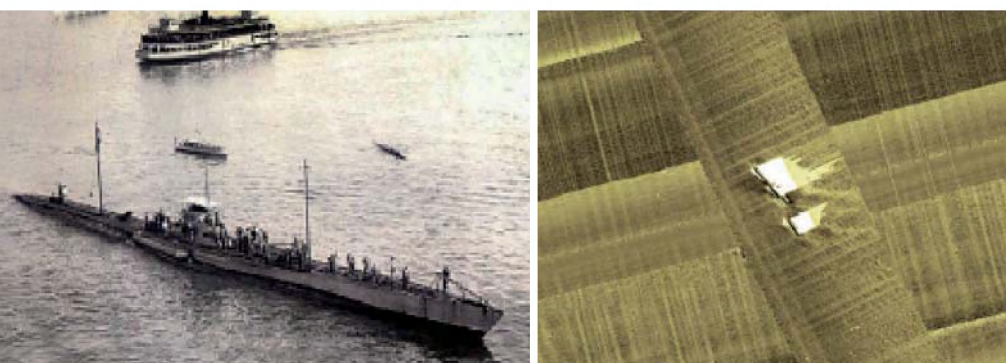


FIGURE 2: A World War One U-boat types and sidescan survey of wreck believed to be UC65



FIGURE 3: the 'Great Storm' of 1703 IMAGE: SEADIVE, NATIONAL MARITIME MUSEUM

War I U-boat gun' recovered from the sea by divers off Newhaven, and presented to the Newhaven Local and Maritime Museum. He suggests that it came from either U8 or UC65. It is described as 16 ft long and weighing two tons, with parts still in working order. So does the vessel subject to our study still have its gun? The initial investigation of the site by ROV suggested that a gun was present on the seabed adjacent to the wreck – so is this the wreck of U8 or UC65 and who really attacked it?

EASTERN ENGLISH CHANNEL: HASTINGS SHINGLE BANK THE UNKNOWN WRECK

The Hastings Shingle lies at a depth of 20 metres in the form of a broad flat sedimentary feature 5 km² in area. The 'unknown' wreck lies 13 km south of Hastings on the south coast of England and lies 200 m from an active dredging area. It is included on the UK Hydrographic Office database and was first recorded in 1918, but no further information is available concerning its history or the circumstances of its loss other than in 1959 the site was subject to a 'clearance sweep' which reduced the height of the wreck above the seabed from over 8 m with further clearance in 1962 which reduced the height above seabed to a maximum of 4.6 m. Recent sonar and swath survey of the site indicated that the vessel was 70 m in length

with 15 m beam and lies almost horizontal on the seabed (Dix et al., 2007).

EASTERN ENGLISH CHANNEL: THE OWERS BANK THE WRECK OF THE ARIEL

The wreck of the Ariel was chosen as a further field study site as its physical shape and orientation is different to that of the 'unknown wreck' on Hastings Shingle Bank. It lies at 30 m depth in close proximity (approximately 1 km) to an active dredge area. The wreck is recorded on the UK Hydrographic Office database as a British steamship built in 1885 by Earles Co. Ltd. of Hull 91.4 m in length with beam of 12.8 m and 6.1 m draft; powered by two boilers driving a triple expansion engine giving 300hp through a single propeller shaft. At the time of her loss she was transporting a cargo of wheat from Varna (Bulgaria) to Hamburg and was operating under the ownership of Edward Leatham of Hull. Her loss on the 18th October 1896 was caused by a collision with SS Lancashire in conditions of light winds and fog without any loss of life.

Until 1935 the wreck lay intact and it was reported that here masts reached to within 3 m of the sea surface; the wreck was then dispersed using a wire drag to give 18 m of clearance which should have left approximately 9 m of the wreck remaining above the seabed. Subsequent echo sounder trails in

1977/1979 indicated wreckage 6-7 m high with measurements in 2001 reporting wreck height of 5-6 m. The most recent seabed survey of the wreck using sonar and swath show the vessel to be partly resting on its port side, but with central sections lying horizontal and reduced to seabed level, but with large, broken sections of bow, stern and aft superstructure remaining standing up to 5 m above the seabed (Dix et al. 2007).

GOODWIN SANDS - 'SHIP-SWALLOWER'

The Goodwin Sands are a shallow relatively fine grained sand bank system located off the east coast of Kent rising 25 m above the underlying seabed geology and drying in part at low tide.

Naturally, this location has presented a hazard to safe navigation and since at least the mid 1500s the Sands been referred to as the 'ship-swallower' in the belief that an entire vessel, if trapped on the Sands, may become completely buried. It is certainly the case that the complex geomorphology of the sand bank system is not understood beyond observed seasonal changes as revealed by routine survey work conducted for safety of navigation. This location is therefore one where we have keen interest in developing the site specific wreck hydrodynamic studies conducted to date to address regional scale sedimentary dynamics. In particular attention will be directed at the shipwreck sites designated



under our national legislation (the Protection of Wreck Act 1973):

■ *The Stirling Castle*, a ‘third rate ship of the line’ was lost while at anchor on the Goodwin Sands during what became known as the ‘Great Storm’ of 27th November 1703 (figure 3). The wreck of the *Stirling Castle* was first reported in 1979, but shortly afterwards was re-engulfed by sand and was not reported again until 1998 and presently lies at a depth of 12 m in a shallow gully. The effect of tidal flow around the exposed wreck and sand wave movement led to substantial exposure, but reports since 2003 indicate that sand-wave migration is, once more, covering the wreck. (figure 4)

■ *The Northumberland*, also a ‘third rate’ was lost with all hands in the same storm as the *Stirling Castle*. The wreck was first reported in 1980 with the site described as a low mound, but it is thought that the wreck remains are vulnerable to dynamic seabed conditions as noted in dive investigations conducted under the Government’s contract for Archaeological Services in the 1990s.

■ *The Restoration*, was a further ‘third rate’ naval vessel lost in the Great Storm of 1703 and recent dive investigations have revealed the wreck, thought to lie in two sections, to be almost entirely buried;

■ *The Rooswijk* was recorded as a vessel of the *Verenigde Oostindische Compagnie* (Dutch East Company) and was lost on the

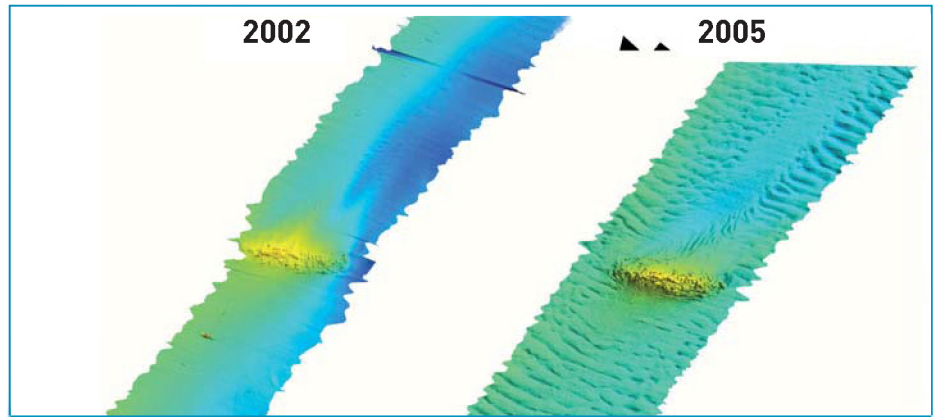


FIGURE 4: Multibeam surveys of the *Stirling Castle* conducted as part of the Wrecks on the Seabed ALSF project.

Goodwin Sands in 1793. The wreck is believed to lie in two sections with reports indicating that exposed sections of hull and internal structure are in good condition with substantial sections presently buried.

■ *The Admiral Gardner* was an English East Indiaman vessel on passage to India when she was wrecked on the Goodwin Sands in January 1809 during a storm. She was discovered in 1983 and subject to salvage with the site designated finally in 1990. Recent site investigation has revealed the recorded position of the wreck to be entirely covered by a sandbank.

It is therefore crucial to inform how we manage these sites that we commission further work to understand seabed dynamics as

it is the change in relative seabed level and degree of exposure to tidal flow that has the greatest influence on determining the longevity of the remaining wreck structure. ■

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FIGURE 5/6/7: Artefacts recovered from *The Rooswijk* PHOTO'S: MARTIJN MANDERS, RACM

The Roman-Germanic Commission (RGK) in cooperation with the Authority for Culture and Protection of Monuments in Mecklenburg-Vorpommern

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The Baltic Sea has developed after the last Ice Age as a marginal sea of the Atlantic Ocean with minimal tidal variation and with limited water exchange through only small connecting channels to the Danish straits. The developing stages were characterized by different freshwater, brackish and marine conditions and the coastlines were changing because of the rising sea level. Today the Baltic Sea is comparatively brackish with low salinity. At the southern and western Baltic region bays, fjords, cliffs, spits and lagoons form the coastline.

In the Stone Age hunters, fishermen and gatherers were living at the Baltic coast. Traces of their existence are still preserved on the sea floor. Later on the Baltic Sea connected the medieval towns of the Hanseatic League in Central-, East- and North-Europe. The trade

ways on the water also connect to the North Sea and the first large ships, mainly made for transportation of goods, advanced the development of European markets. But the Baltic Sea was also a location for several wars and many war ships have been sunk over the years. Although the Baltic Sea can be deemed a quiet and safe sea, many ships and their crews have also been wrecked or stranded along these constantly changing energetic coasts.

All these sunken traces of human history build up our cultural heritage that can be investigated and is protected by mandate. In Germany the Federal States have the cultural sovereignty. For that reason the State Authority of Culture and Protection of Monuments in Mecklenburg-Vorpommern is responsible for the archaeological heritage underwater and on land. All

coastal and offshore underwater sites of the Federal State are recorded at that agency. This compilation is essential for protecting and preserving the Cultural heritage.

The Roman-Germanic Commission (RGK), founded by the German Archaeological Institute in 1902, participates as a partner in the MACHU project on the development of a GIS based database for archaeological underwater sites based on European standards. With these tools we can better achieve protection and management of the underwater cultural heritage on a national and European scale. The RGK is committed to promote and carry out research on prehistoric and early historic sites mainly in Europe and to publish the results. In this case the RGK cooperates closely with universities, museums and monument protection organizations.

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Middle Neolithic Cultures in the Middle Elbe-Saale Region. After his work as Head of the Department of Archaeological Heritage of the Archaeological State Museum of Hamburg he became in 1992 the director of the State Authority for Culture and Protection of Monuments and of the Archaeological Museum of Mecklenburg-Vorpommern.

He is involved in political discussion about protecting the underwater cultural heritage and is delegated in several political committees, for example the progress of the UNESCO Convention on the Protection of the Underwater Cultural Heritage.

HARALD LÜBKE studied prehistory, geology/palaeontology and soil sciences at the University of Hamburg. After his work at the Archaeological District Museum of Dithmarschen and at the Archaeological State Museum of Schleswig-Holstein he finished his PhD about Early Northern Neolithic flint technology and ergology in Schleswig Holstein at the University of Kiel in 1997. He worked from 1997-2006 for

the Department Of Underwater Archaeology of the State Authority for Culture and Protection of Monuments in Mecklenburg-Vorpommern and was specifically responsible for investigations of submerged prehistoric sites. Since 2007 he is an employee of the Roman-Germanic commission. Scientific diver since 1995, he is a member of the German Commission for Scientific Diving and since 2007 associated dive instructor of the Scientific Dive Centre of the University of Rostock.

STEFANIE KLOOB completed her studies in prehistory, botany and geology at the University of Kiel in 2002. Now she is working on her PhD thesis about Stone Age wooden finds from the south-western Baltic coast. In 2000 Stefanie trained as a Scientific Diver and has worked since then on different underwater excavations and prospecting surveys. Her special interest is research concerning economy and ecology of man and nature in the past.



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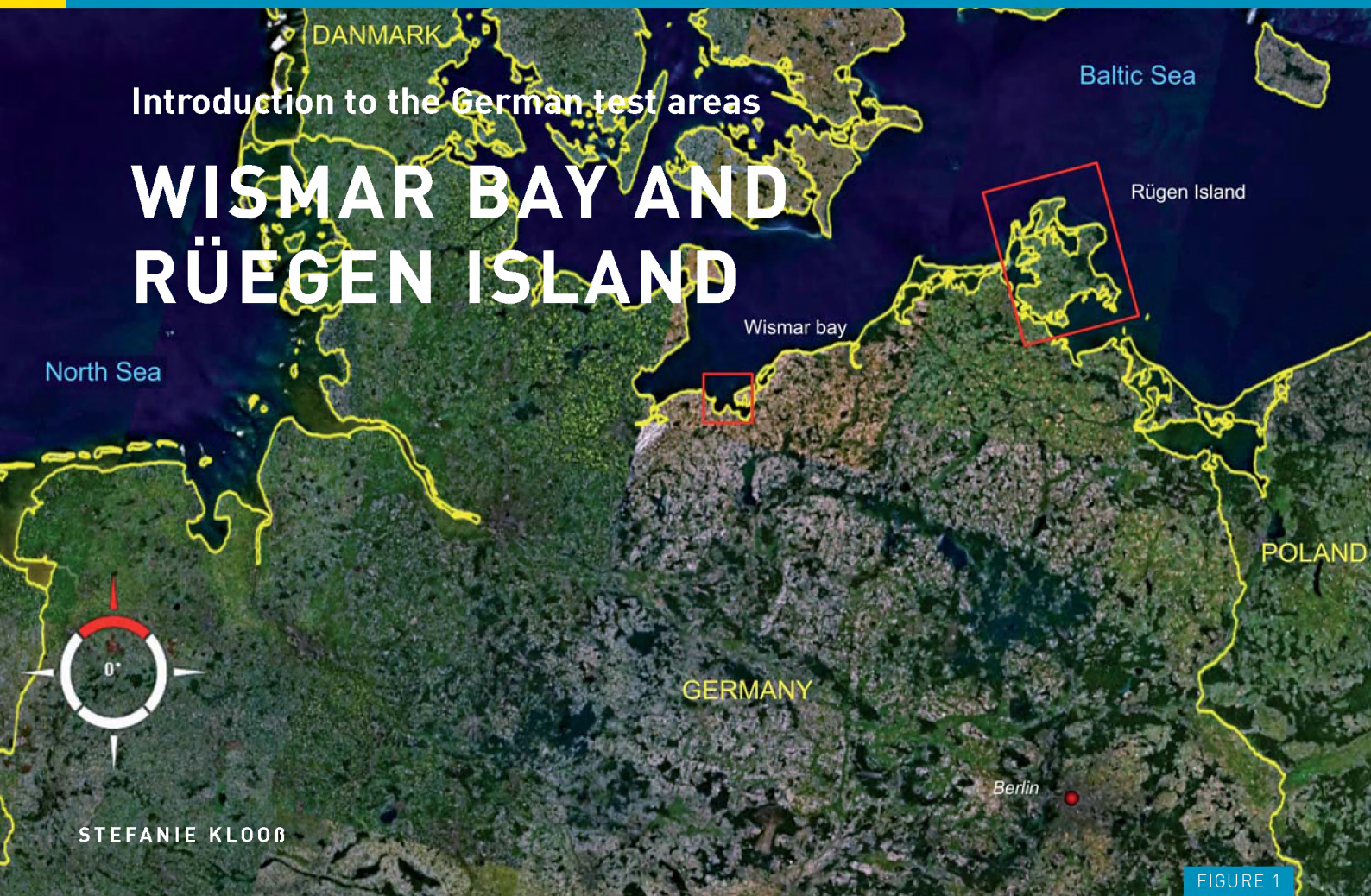


FIGURE 1

The Baltic coast of the state Mecklenburg-Vorpommern extends from about the city of Luebeck in the inner Mecklenburgian Bay to Usedom Island at the border with Poland. On the entire coastline numerous wrecks were found by aerial photography and geophysical survey methods. Circa 200 wrecks were surveyed and partly documented by divers. But 560 wreck positions are known and 1400 notices of ship losses were collected from historic records. Moreover Stone Age settlement traces, also lying today beneath the sea level, were detected and investigated. More than 50 new sites were surveyed by divers in the last 8 years. For the MACHU project two well documented areas were chosen:

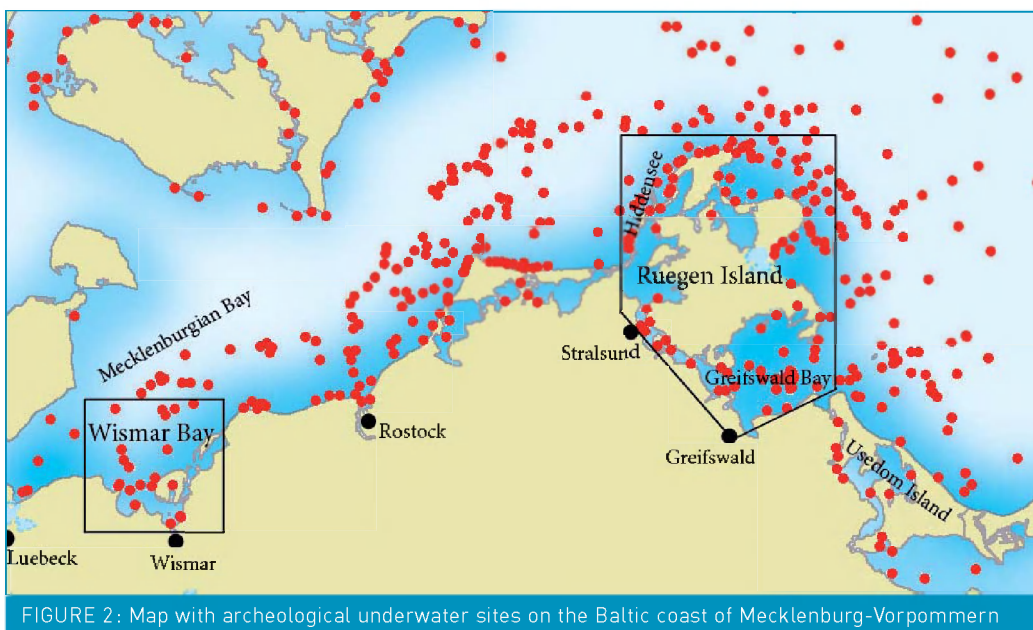


FIGURE 2: Map with archeological underwater sites on the Baltic coast of Mecklenburg-Vorpommern

WISMAR BAY

Wismar Bay, in the western part of the state, is situated in a flat hilly moraine landscape and is dominated by Poel Island. The harbour town Wismar is situated in the south of the bay. It is a town of the Hanseatic League with a well preserved medieval city that was accepted by UNESCO in 2002 as part of the World Cultural Heritage list. Inside the Wismar Bay over 100 underwater sites of archaeological interest were found. Two fields of research were pursued in more detail. One is the investigation of the Middle Stone Age settlement around the former Wismar Bay, which was heavily dependant upon marine



FIGURE 3/4: Photo and drawing of truncated blade with well preserved wooden handle and artful binding from mesolithic site Timmendorf-Nordmole in Wismar Bay.

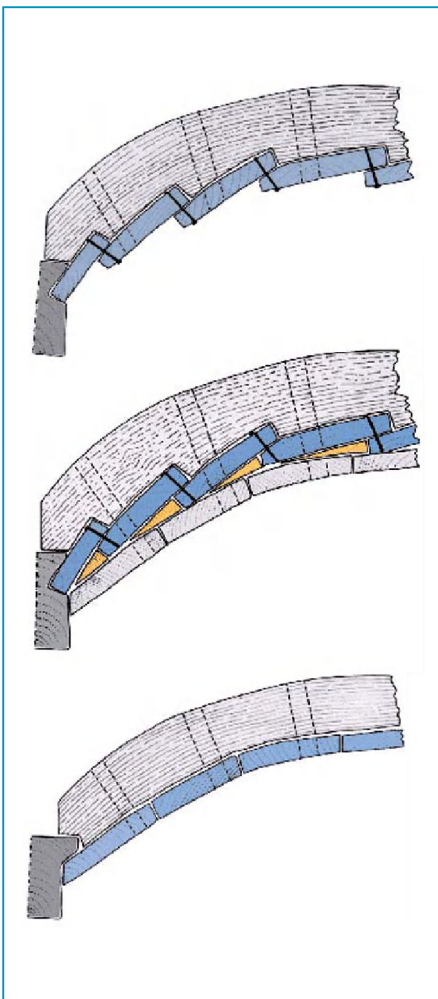


FIGURE 5: Different kinds of plank construction: above: clinker, joining of planks by iron nails middle: clinker with second hull of planks in carvel technique below: carvel, joining of planks to the frame by wooden nails.

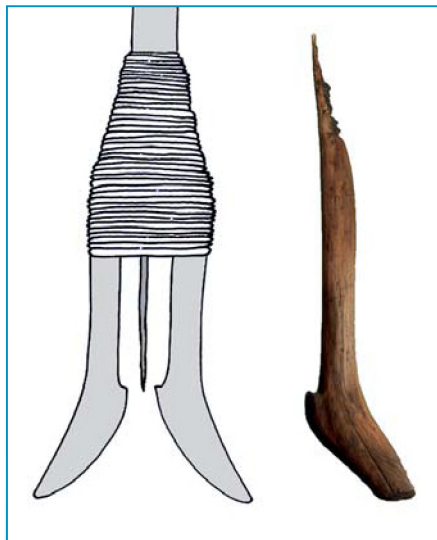


FIGURE 6: Reconstruction of Mesolithic fishing spear, an eel catcher, and finding of wooden leister prong with remains of the binding of bast fibres (length of leister: 25 cm).

food resources. During the Middle Stone Age smaller groups of hunters and gatherers were living here in dense deciduous forests, who knew how to use the nearby sea coast for fishing and sealing. But the sea-level rose continuously and people had to leave their hunting camps and place them on the higher and dryer land. New results about the sea-level rise, the changing of the coastal landscape and the subsistence of the people before 7.000 years were found out in the last years (Hartz/Lübke 2006; Lampe et al. 2005; Lüth et al. 2004).

Similarly the ship wrecks, harbours and fortifications in the Wismar Bay were topics of research. These remains of a maritime cultural landscape evidence the intensive sea trade, the strategic importance and the role of the Baltic Sea as a seaway in medieval times and Early Modern Times. The harbour of Wismar was in medieval times and in Early Modern Times a flourishing transfer point for the goods of the Hanseatic League. As a result of shipwreck investigations, the development of the first big trade ships of the Hanseatic League, the so called cogs, the techniques of ship building and the way of live on board could be researched. The harbour was protected with rows of piles, remains of which are still preserved under water and also illustrated in an historic painting. During the 'Thirty Years' War, at the little island 'Walfisch' (Whale) in the harbour entrance, a fortification was constructed and even in the Nordic War it had strategic importance (Lüth et al. 2004).

RUEGEN ISLAND

Ruegen Island and the Greifswald Bay are part of the heavily structured 'Bodden' at the southern Baltic region. The salinity here is much less than in the western Baltic Sea. Because of that wooden wrecks are not attacked by shipworms so far east of the Ruegen Island. Many ships were stranded around Ruegen Island and the Island of Hiddensee in consequence of the not easily navigable waters.

The so called Gellen wreck from the west coast of Hiddensee, a cog find from the 14th



FIGURE 7: Two scientific divers carefully excavating the wood rich find layer of a Mesolithic coastal settlement.

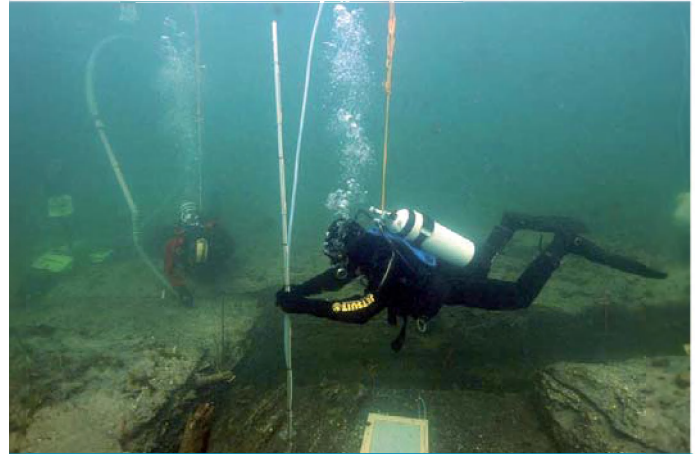


FIGURE 8: Scientific diver documenting the excavated finds by drawing and measuring.

century, and the wreck of the Frigate 'Mynden' from the 17th century were exemplary investigations. The Gellen wreck was documented in 1997 and has to be rescued completely because of heavy shipworm attack. The remains belong to a trade ship, built around 1378, with a trade of limestone from the Island of Oeland, Sweden. It was on the way to Stralsund and stranded on a sandbank near a navigational light at the southern point of the Island of Hiddensee. The ship was made out of pine wood from the southern Baltic region. It was 28 m long and 8 m wide. Typically for cogs it was clinker built, planks joined with twice-bent iron nails and had a narrow distance between the frames of 30 cm. The special constructive detail was the second hull over the clinker planks that was nailed with wooden nails in carvel technique (www.uwa-mv/projekte/gellen.html).

The wreck of the frigate 'Mynden', armed with a minimum of 11 guns, foundered at the chalk reef of Arkona at the north-east point of Rügen. It was clearly identified by archive investigation in Copenhagen. The documents give information about the crew, the outfitting and the ship's history and enable a reconstruction of the chain of events causing the accident and the trials of salvage. The frigate was lost on November 18th, 1718. Dendro-chronological examination of a piece of burned wood from the galley concurred with this historical fact (Auer 2004).

According to historical records a ship barrage between the Islands of Rügen and Usedom was built by the Swedish army during the time of the Nordic War (1700-1721) between Sweden – to which amongst others belonged Pommerania since the Thirty Years' War –

and the allied Danes, Poles, Russians and later Prussians. A number of wreck sites nearby in a line were discovered in 1996 by aerial photography and geophysical survey on the sill at the entrance to the Greifswald Bay. Up to now 17 of the scuttled ships have been located. The examination of nine wrecks by divers provides the evidence of both clinker built and carvel constructed ships. Hence at the ship barrage the investigation of different building traditions of the 17th and 18th century is possible (Förster et al. 2002).

Stone Age settlement sites were also found by diving surveys in the sheltered intercoastal 'Bodden' of Rügen Island. Test excavations show distinct differences to the conditions in the Wismar Bay. Because of different isostatic and neotectonic movements the sea level at

Rügen Island reached a higher level considerably earlier, so that sites of the same age are located in shallower water than in Wismar Bay (Lampe et al. 2005). ■

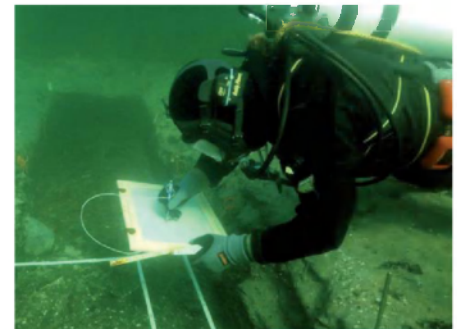


FIGURE 9: Scientific diver documenting the excavated finds.

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The Polish Maritime Museum in Gdańsk (www.cmm.pl) is under the Ministry of Culture and as a national institution it is the largest of its kind in Poland, documenting and promoting Poland's maritime traditions as well as the evolution of her present-day maritime policies, economics, technology and culture.

The Museum has had its own Department of Underwater Archaeology since 1970, involved in the exploration of the archaeological sites in Polish marine waters. The Museum is also

responsible for the excavation, preservation, display, interpretation and management of shipwrecks and historic vessels. Within the space of the last ten years, the Museum has co-operated successfully with the Ministry of Culture and Marine Administration to create an effective system of sustainable preservation of underwater cultural heritage.

Underwater Archaeology Department

On 30 September 2005 the voivod for the Pomeranian Voivodship and CMM's Director

signed an agreement which established that the Polish Maritime Museum shall be in charge of underwater archaeology in the region. The responsible person in the CMM is Ma Iwona Pomian. The Department is responsible for:

- agreeing with the Maritime Authorities underwater archaeological work and research in the area which previously the Voivodship Conservator was in charge of;
- carrying out research and recording tasks concerning objects listed as cultural heritage in the voivodship.

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The Polish Geological Institute is the largest scientific and research geological institution in Poland. It was founded by the Polish Parliament in May 1919, just half a year after the Act of Independence. It is also one of the oldest scientific institutes in Poland.

The PGI manages multi-disciplinary scientific research on the geological structure of Poland in order to use the knowledge for purposes of domestic economy and environmental protection. Besides scientific research in all fields of modern geology, the Institute fulfils the role

of a geological and hydrogeological survey of Poland, securing economic stability to the country in areas of both mineral and ground-water resources management, and environmental monitoring.

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Since 2006, she has been responsible for the protection of marine archaeological heritage in the Pomeranian Province.

excavations on the wrecks located in the Gdańsk Bay. The most important for him is a wreck called 'W-27', the 18th century Dutch merchant ship.

Furthermore since 2007 he is a lecturer of the 'museology of underwater archaeology' at the University of Toruń. His special interest is 17th and 18th century Baltic trade and connections between Gdańsk and other harbours.



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Researcher (PGI)

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In the period 1974-1979 and 1981-2003 she was a specialist and adjunct at Gdańsk University, Department of Geomorphology and Quaternary Geology. Since 2003, she has been a senior scientist in the Marine Geology Branch of the Polish Geological Institute. Experiences in palaeoecological and palaeoclimate reconstructions. Head of many research projects concerning palaeogeographical reconstructions of the Late Glacial and Holocene of the Pomeranian Lakeland and Southern Baltic area.



FIGURE 1

During the last few centuries the coast-line in the Vistula estuary area was changing. The river itself being the main factor of this changes. In the 16th century three different routes were used for sailing, depending on the conditions: so-called east depth, north depth and west depth. Changeability of sailing conditions caused numerous catastrophes around the entrance to the Gdańsk Port. The proper regulation of the Vistula estuary area became the most important problem for the Gdańsk authorities.

In the years 1673-1675 the decision was made to execute a number of hydrotechnical works at the west depth in order to turn it into a permanent entrance channel to the port.

GDAŃSK (figure 2)

In the 1840 the Vistula broke its bank at Górki Wschodnie and made the second estuary. Furthermore in the years 1890-1895 the Vistula cutting was dug at Świbno area. In this way the Vistula river gained its third estuary. Through centuries one could observe gradual 'land grow' at the Vistula estuary and shift of the Gdańsk Bay coastal line in this area to the north and north-east direction.

Trade connections and exchange between Poland and The Netherlands are confirmed by the wreck of a merchant ship, built in The Netherlands, marked as 'W-27'. The vessel sank at the end of the 18th century and the archeologists from The Polish Maritime Museum have been conducting its excavations since the year 1985.

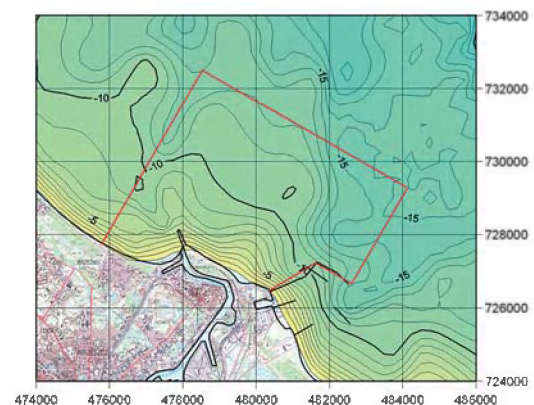


FIGURE 2: Test area in Gdańsk



FIGURE 3: Medieval harbour in Puck Lagoon



FIGURE 4: Wreck W23, Gdańsk Bay

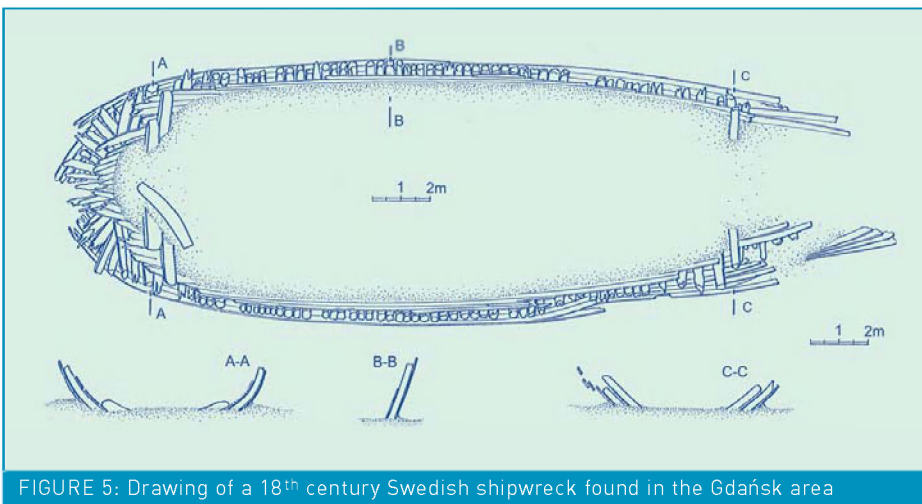


FIGURE 5: Drawing of a 18th century Swedish shipwreck found in the Gdańsk area

MEDIEVAL HARBOUR IN PUCK LAGOON (fig. 3)

NATURAL CONDITIONS

Relics of the Puck medieval harbour are located at the estuary of the Płutnica River, about 150 m from the present coastline of the western Puck Transgression, in the inner part of the Puck Bay. The site covers over 12 hectares of the sea bottom. Today, the water depth oscillates between 1,5 and 2,5 m.

RESEARCH HISTORY

The site was discovered in 1977 by three amateur scuba divers. Preliminary research was initiated in 1978. Ordered by the Regional Museum in Puck the research was directed by W. Stępień, who focused on the creation of a site plan.

Between 1978 and 1985 stone-ground and timber construction remains covering over 12 hectares were localised. Between the constructions three plank boat wrecks and one log boat, classified by W. Stępień as a buoy boat have been found (Stępień 1982). In 1985 timber sampling for dendrochronological analysis was initiated.

Because most of the documents created by Stępień have been lost, the Central Maritime

Museum and the Institute of Archaeology and Ethnology UMK, which in 1990 decided to continue the research at the Puck site, were forced to start the inventory from the very beginning. During the research one more wreck of a plank boat has been found. Since 1994 the research has been continued by the Central Maritime Museum team alone.

CHRONOLOGY DATING

Looking at the chronological arrangement of the site, slowly created on the basis of obtained dendrochronological analysis results, and supplemented with a radiological research, it should be assumed that the northern strip of the structure in the hectare 10G is a continuation of the quay strengthening construction, the origin of the harbour pier.

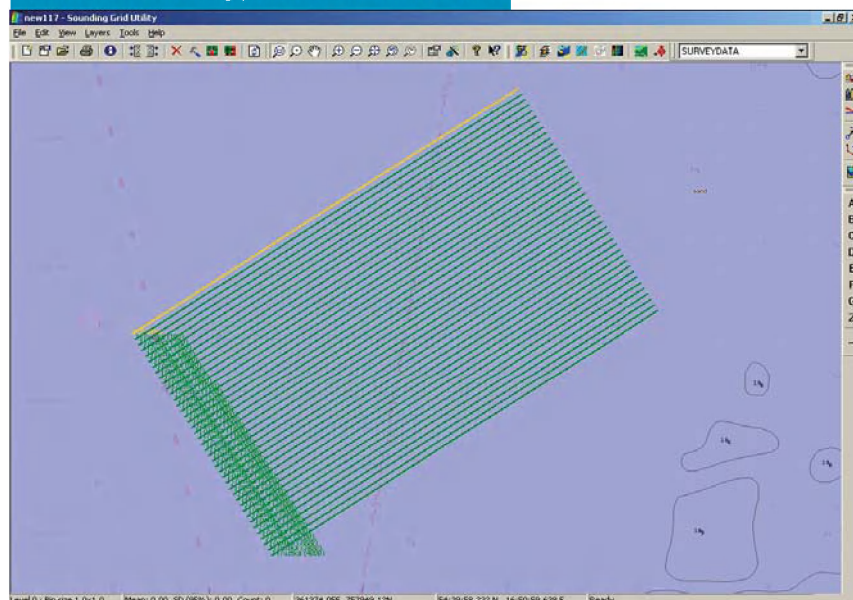
It is probably an earlier, or even the earliest stage in the development of the Puck harbour. It is not, however, a part of the pier, coast protection constructions or mooring piles associated with the cribs, located in the central and southern part of the hectare 10G, as suggested by Zbierski. On the basis of the latest dendrochronological results it should be assumed that the northern line of the strengthening was constructed in the first half of the tenth century. Six of the samples are dated between year 927 + 1/-1 and 943 + 8/-6, however all the samples from the construction situated south from the specified above are dated on the twelfth century turn of the thirteenth, or even first half of the fourteenth century.

HARBOUR

The site consists of a set of timber structure remains located on the ground strengthened with fascine, stones and matted straw. Between the structure wrecks of the four plank boats and a hollowed canoe have been found.

In the northern part of the site the remains of the two earliest piers together with a strengthened quay of the earliest shoreline have been found. The piles have been driven into the bottom in two rows, in clusters, two or three piles in a cluster, in the section 25 m

FIGURE 6: Recording plan of the Ustka test area



long. The width of the pier does not exceed 5 m. Also the sea bottom bathymetry in the area indicates two separate spheres: a deeper one – seaward, where today the depths oscillate within the limits of 200-250 cm, and a shallower one – associated with the shore strengthening constructions, of the depth decreasing even to 160 cm. A lot of fascine and ceramics appear especially in the area of the pier's root. There is also a lot of fragments of basically processed trunks and branches deprived of bark in the area. Also scarce fragments of oak logs with yoke openings have been found laying dispersed between the piles. Some evidence to aid the reconstruction of their arrangement comes from the mooring piles which have characteristic rectangular cross-section, and are still located in the sea bottom.

FUNCTION

Undoubtedly the Puck harbour had a couple of functions. It was a place of trade exchange and a fishing port. Sea fishery was in these times very important. It was based on fishing stations. Documents from the XIIIth century mention for example a fishing station in Trzęsawisko, located probably at the Płutnica estuary. Artificial pond digging is associated with the fishery. A note mentioning such an artificial pond in Puck comes from 1297. It might have been located close to the mill, situated at the later castle.

Location at the estuary of the Płutnica River, which at that time together with Czarna Woda (Black Water) gave a passage to the open Baltic Sea, was also of a great significance for Puck in the terms of defence.

USTKA (SŁUPSK BANK) (fig. 5)

The site of Late Glacial and Early Holocene peat and limnic sediments at eastern part of Słupsk Bank were investigated by seismoacoustic profiling as well as lithological, pollen, molluscs analyses and ¹⁴C datings of 3 sediments cores. There is evidence that from the last deglaciation to the period ca. 6500-5500 years BP, the Słupsk Bank was a land area,



FIGURE 7: Research vessel IMOR



FIGURE 8: Stump of a pine tree found in the Ustka test area (Słupsk Bank)

and the maximum water level of the Baltic Ice Lake, Yoldia Sea, Ancylus Lake, up to the beginning of Middle Holocene (Littorina) transgression was lower than ca. 20 m below the present sea level.

The most important conclusion from the presented documentation material is that from the deglaciation to the transgression of the sea at the Atlantic period, the Słupsk Bank was a terrestrial area. In view of geological data, one can say that during neither the maximum reach of the Baltic Ice Lake (ca. 10.300 years BP) nor the Ancylus Lake (ca. 9.200 years BP), the waters of these reservoirs in the Southern Baltic did not reach higher

than ca. 24-25 m below the present level.

The conclusion then is that Słupsk Bank existed as an island for a long time in the Middle Holocene, and finally was sinked ca. 6500-5500 years ago. It is of vital importance for the reconstruction of the paleo-environmental conditions, especially those related to the magnitude of the level variation of the Southern Baltic in the Late Glacial, Early and Middle Holocene. It is also important for research of the remains of Mesolithic cultures artefacts on the recent sea bed of the southern Baltic area. ■



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DANS (ex-CNANS) is the Portuguese Centre for Underwater and Nautical Archaeology, integrated in the IPA – Portuguese Institute of Archaeology, which was founded in 1997 with the aim of superintending and supporting archaeological research and salvage activities.

DANS researchers work in very diversified areas, namely non intrusive surveying,

archaeological field works, conservation (its laboratory is specialized in the treatment of underwater artefacts), wooden ship building analysis, Portuguese database management, archaeological collections management, scientific publications and basic training in underwater archaeology (using the Nautical Archaeology Society training programme).

DANS researchers are active in all the

previously described tasks, providing a multi-disciplinary platform that can interact with all the other partners, namely contributing to the methodological problematic of archaeological site approach, chronological identification and integration of historical background, dating procedures, conservation know-how, recollection of testing samples and interface with the general public.

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he was also a member of the Commission for the Underwater Cultural Heritage. In 1996, he was invited, as specialist in underwater heritage, to work for the DG X of European Community. In 1997, he represented the Ministry of Culture on the Inter-ministerial Work Group for the Redefinition, Restructuring and Reformulation of the System of Maritime Authority. In 1997, he was part of the Portuguese delegation to the 29th General Conference of UNESCO. He is currently member of ICOMOS's Committee for Underwater Cultural Heritage (ICUCH) and Professor of underwater archaeology at the Universidade Nova de Lisboa, Faculdade de Ciências Sociais e Humanas.

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HELDER HERMOSILHA



VANESSA LOUREIRO

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Introduction to the Portuguese test areas

THE RIVER ARADE

(ALGARVE, SOUTH OF PORTUGAL)

Located in the south of Portugal, the Arade river was one of the most important ways of reaching the hinterland of the Algarve from Pre-History to the start of the 20th century. Regular and well defined, this river runs from Portimão until Silves, 15 km to the north, occupying a surface about 870 km².

Historical records show that the river, mainly its mouth, suffered important changes during the centuries. A description from the 12th century reports a less wide estuary than the one that actually can be observed. On the contrary, a 17th century atlas presents a large estuary in the mouth of which several sand banks caused the river waters to flow into the sea through three narrow channels. The earthquake that struck Portugal on November 1755 (and a subsequent series of tidal waves) seems responsible for these channels' disappearing and for the change of the river's course. In the 19th century, it was still possible to reach Silves by the river, however, its progressive silting was already becoming an issue.

The first dredging works, carried out in 1970, called the attention of scientists and general public to the archaeological potential of the Arade river. Beachcombers started collecting artefacts left within the sands deposit in the beaches and five shipwrecks were exposed by the dredges. The non-existence of an official entity responsible for the nautical and underwater cultural heritage allowed the destruction and disappearance of important artefacts and ship remains. After the creation of CNANS (National Centre for Nautical and Underwater Archaeology) in 1997, special attention has been given to the protection and study of Arade's underwater heritage.

The construction of two jetties in the mouth of the river and the continuous dredging contributed to transform the river into a very unstable context, with depths varying widely even during the year according to weather and sea conditions. These complex processes, allied to the natural microbiology of the Arade' waters, make it extremely difficult to protect the archaeological sites (known) in the river.

VANESSA LOUREIRO AND
JOÃO GACHET ALVES



FIGURE 1: The Arade river test area and archaeological sites GRAPH: J.G.ALVES

The 70's dredging works revealed a 16th century shipwreck, named Arade 1, which was only studied and excavated from 2001 on. This medium-size wooden ship, preserved from the stem until the amidship region, was dismantled as its protection from teredo navalis was almost impossible to accomplish. Just a small part of this vessel is still *in situ*, buried into the sand.

Near Arade 1, it is possible to dive on the Arade 23 shipwreck. Dated from the 17th century, it is a tumulus of rocks under which can be found some wooden frame. On the tumulus and around the surrounding area some tackle pieces can be observed.

Still in the mouth of the river, a small region, known as B1, includes iron and nautical pieces, as cannons, anchors and wooden frames, not having been identified until now



with any relationship between them.

One kilometre away from the river mouth rests the GEO 5 shipwreck. It is probably a 18th century vessel. Visible are several wooden frames with cooper nails. The shipwreck extent is not known as the site was never excavated for heritage reasons.

Furthermore, on the river-bed all types of archaeological artefacts (ceramics from the Roman Period until the 19th century, tackle pieces, prehistoric artefacts) or isolated nautical wooden pieces can be found. This is due to the river dynamics, characterized by strong tides and complex silting processes. Both the historical importance of the Arade river and its hydrodynamic conditions justify the attention given in recent years to this area. In the attempt to understand the river silting in order to better preserved the ship remains *in situ* 'portraits' of the sea-bed by sonar and magnetometer are regularly taken. Nevertheless, the Arade river's mouth, being an important port in the south of Portugal and infrastructural improvements (marinas, bridges, cargo areas, constructions) are a constant threat for the underwater remains of the area. ■

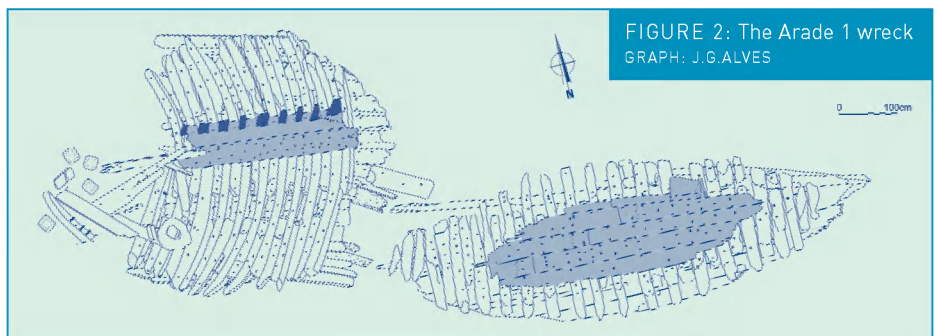


FIGURE 2: The Arade 1 wreck GRAPH: J.G.ALVES

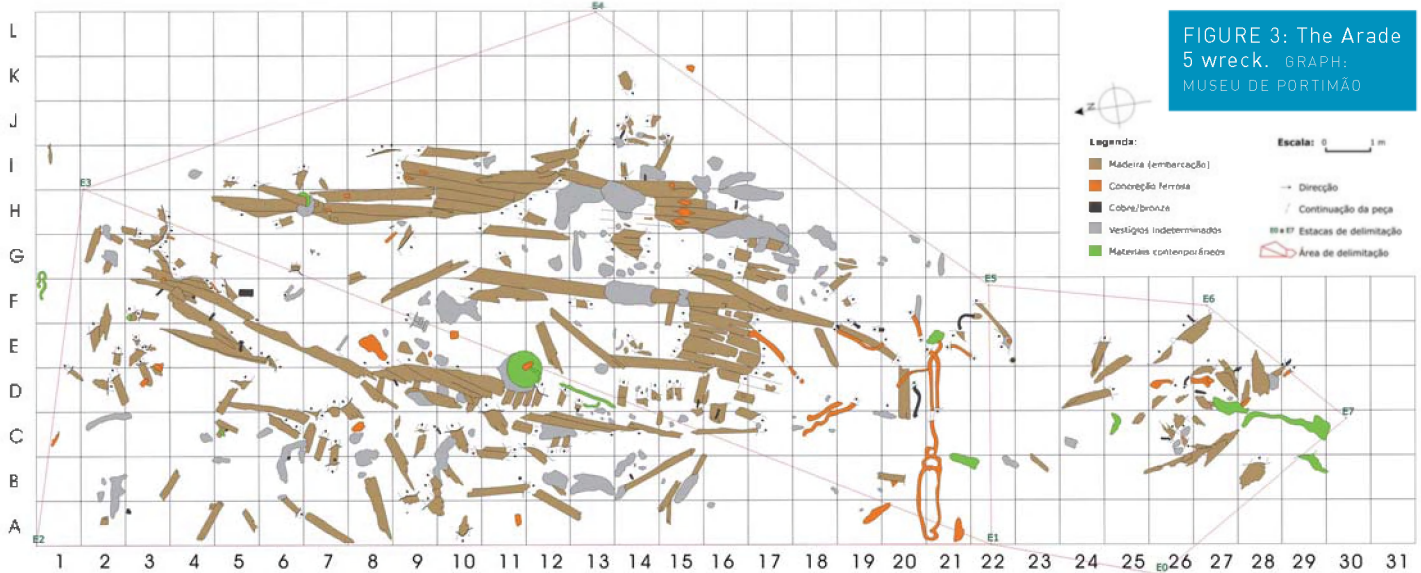


FIGURE 3: The Arade 5 wreck. GRAPH: MUSEU DE PORTIMÃO

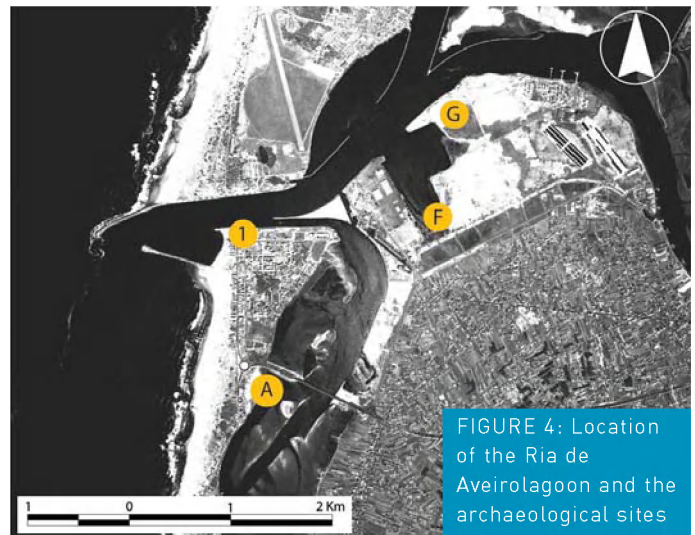
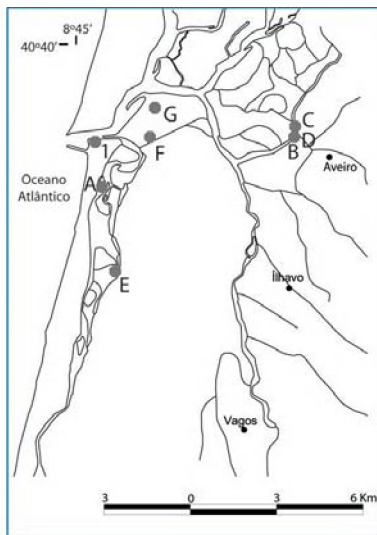


FIGURE 4: Location of the Ria de Aveiro lagoon and the archaeological sites

The Aveiro Lagoon System (AVEIRO, NORTH OF PORTUGAL)

JOSÉ BETTENCOURT AND PATRÍCIA CARVALHO

Ria de Aveiro is a shallow estuary-coastal lagoon system located in north-western Portugal. Its formation is relatively recent and started less than 1000 years ago when a littoral sandy spit grew and isolated the estuary of river Vouga from the Atlantic Ocean. The available historical records report an open coast in the 10th century corresponding to an estuary system related to the Vouga river mouth.

After this time, a coastal spit developed in the Ovar region, from north to south, in the direction of the longshore transport and increased continually until found the continent near Mira in the 17th century. Actually, the lagoon covers an area of approximately 50 km² and extends parallel to the coast, forming several tidal channels and communicating with the Atlantic Ocean through a 500 m

wide channel open in 1804.

Its environmental aspects depend mainly on the water exchanges with the coastal ocean but the lagoon environment is of the transition type, where both fluvial and marine effects may be observed.

Conditioned by this geomorphological setting, during all the Medieval Age and the Modern

period, the economic regional strategies were based essentially on the exploration of marine resources (fishing, salt production and naval shipbuilding).

In the last few decades, several discoveries documented this historical background. Between them six ships dated from the last Middle Age to post-medieval periods were found. These remains were mostly exposed during harbour constructions that allowed their study, through rescue excavations. Other discoveries occurred due to natural dynamics of the system that, despite the human intervention, is responsible for complex processes of erosion and accumulation in the channels.

The first identified site was discovered in 1970, during the construction of a hotel in the vicinity of the Farol da Barra (Barra lighthouse) where the remains of a wooden ship were found.

In 1992 a shipwreck was accidentally discovered at Ria de Aveiro, dated from the mid-15th century by radiocarbon analysis. It is located in the intertidal zone on the west shore of the Mira waterway, in a very dynamic natural area. The excavations revealed the starboard stern portion of a medium sized wooden ship, surrounded by a continuous artefact distribution pattern along the starboard side.

Subsequently, other ships remains were discovered and documented during dredging works and on preventive archaeological surveys. Ria de Aveiro E, dated also from the 15th century is characterized by the presence of a ballast mound identified after the find of a small fragment of a floor timber.

In 2002, parts of a wooden ship, identified as Ria de Aveiro F, were recovered during dredging works carried out inside Aveiro's commercial harbour. The excavation uncovered little more than the stern part of the hull surrounded by the dredged elements. Radiocarbon analysis and a preliminary assemblage evaluation suggested that the ship might have been built between the 15th and 16th centuries.

In 2004, near the Ria de Aveiro F wreck, other shipwreck remains were discovered. This one, Ria de Aveiro G, corresponded to the scattered remains of a clinker ship. Radiocarbon analysis indicated a building chronology dating from 14th to 15th centuries and preliminary analyses of construction

features pointed to a shell-first building.

The Ria de Aveiro B/C site, located in a waterway passing by Aveiro historical centre, shows an extensive, scattered artefact assemblage that suggests an archaeological record related to harbour activities and possible shipwrecks dated from the 15th century to the present.

The location and geoarchaeological context of these remains also document the rapid changes in the morpho-sedimentary system. For example, the geographic position of Ria de Aveiro F, discovered in an actual interior lagoon dune system, corresponded to an old channel represented in 18th century cartography and the archaeological remains of Ria de Aveiro G corresponded to a different position or width of the São Jacinto channel. They also confirm that the geological and geomorphological setting of the lagoon, although unstable, outline a particularly susceptible location for the preservation of shipwreck remains.

In this context, the management of the archaeological heritage known or to be discovered in this area represents a difficult task. The development of the GIS system and of the sedimentation/erosion models in the scope of the MACHU project will contribute

significantly for a better management of the commercial, economic and cultural activities or of the natural processes influencing the *in situ* preservation of those remains. ■

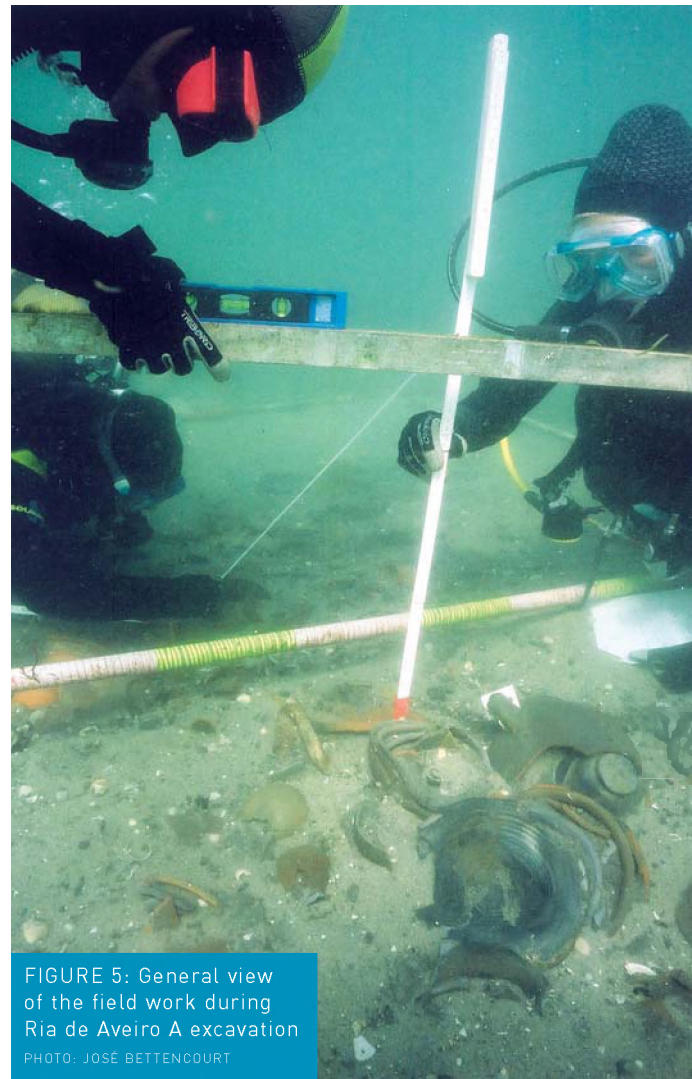


FIGURE 5: General view of the field work during Ria de Aveiro A excavation
PHOTO: JOSÉ BETTENCOURT

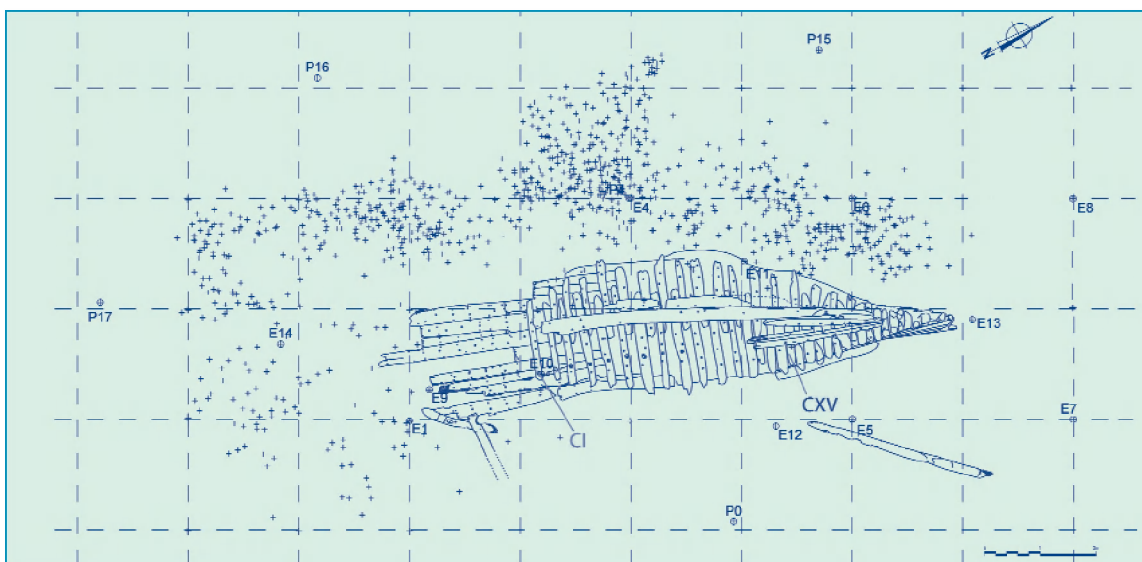


FIGURE 6: General plan of the Ria de Aveiro A wreck with the artefacts distribution

The National Maritime Museums

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The Swedish National Maritime Museums work to preserve and promote the Swedish maritime cultural heritage. It is our ambition to develop a meeting place for organizations, associations, and individuals who work in our field. Within SMM functions concerning the underwater cultural heritage (UCH) are handled by the Department for Cultural Heritage.

The National Maritime Museums conduct research in archaeology that is focused primarily on our cultural heritage under water and in coastal environments.

As a public authority we participate in several national and international projects with an aim to protect and enhance knowledge about our maritime cultural heritage. We have a broad

range of expertise to do archaeological studies in conjunction with physical exploitation of land and under water. Many of the relics that are studied are from shipwrecks. The conditions in the cold and brackish waters of the Baltic Sea are exceptionally good, especially because there are no shipworms.

Vasa Museum, Maritime Museum in Stockholm and the Naval Museum in Karlskrona

Representatives of the MACHU project at the National Maritime Museums:



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BJÖRN VARENIUS has a Ph. doctor's degree in Archaeology at the University of Stockholm. In 1992 he delivered the doctoral thesis *The Nordic Ship – a Study in Technology and Social Strategy in Viking Age and the Middle Ages*. Björn has been involved in many archaeological excavations in Sweden as a field archaeologist during 1979-1983. During the nineties he worked as an antiquarian at the National Heritage Board and also as a researcher and teacher at the University at Umeå. In the period 1999-2001 he was Head of the Field Research Unit at the National Heritage Board. Björn is the director of the Department of Cultural Heritage at the National Maritime Museums of Sweden and have had this position since 2002.

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Introduction to the Swedish test areas

THE STOCKHOLM ARCHIPELAGO



FIGURE 1

The Swedish test area has been defined as the Stockholm archipelago. It extends over 150 kilometres of the Swedish coastline and stretches from Stockholm, the capital of Sweden, to about 80 kilometres to the east. Although the waters in general are relatively shallow, the maximum depth of the test area is no less than 460 meters.

The archipelago comprises about 30,000 islands, islets and rocks. The landscape has been shaped – and is still being shaped – by land elevation. The islands rise by about five millimetres each year, which means an elevation of five meters since the Viking Age, when the archipelago began to assume its present day contours.

Throughout history, the scattered landscape of the archipelago has offered sheltered waters and lots of natural harbours. On the other hand, the many skerries and shoals have made navigation difficult for those not familiar with the waters. Storms, mist, ice and darkness also made ships run aground and caused many losses.

SEAFARING AND NAVIGATION

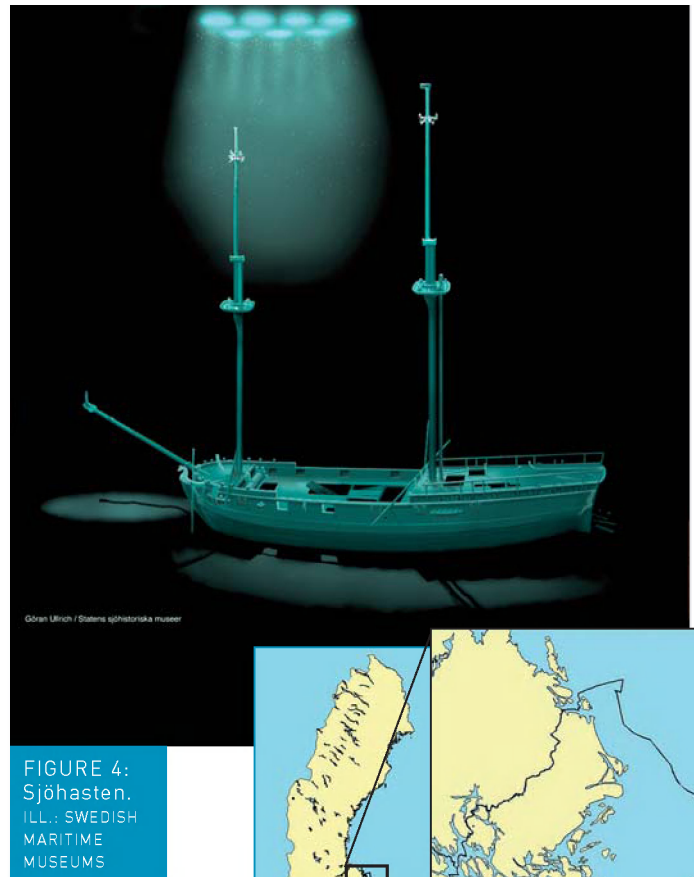
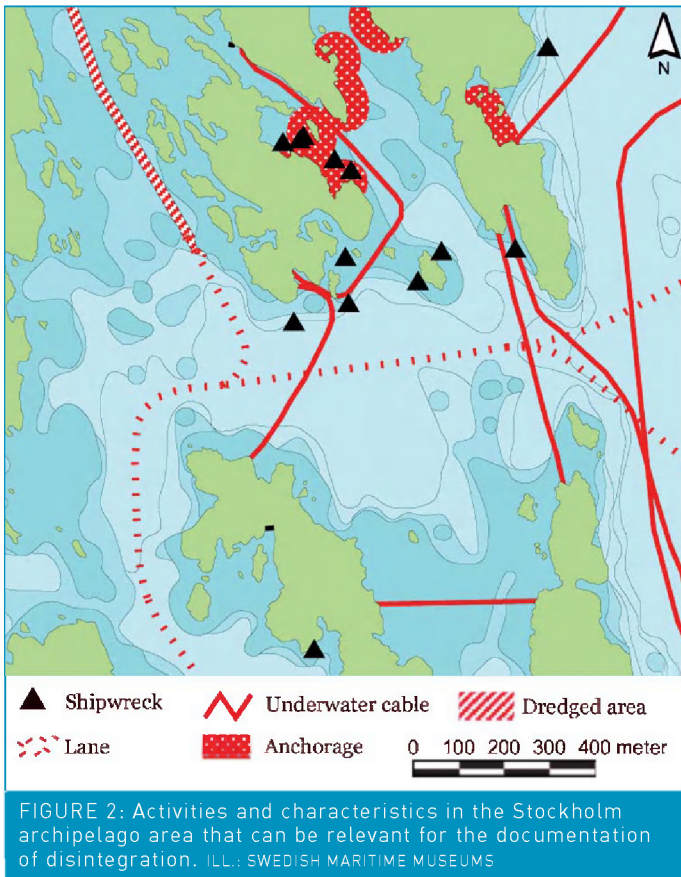
The Stockholm archipelago has been populated at least from the Bronze Age and forward. Although not much is known about the prehistoric and medieval harbours and fairways, there is a preserved description of a sailing route from the 13th century, often called ‘the Fairway of King Valdemar’. The fairway stretches from the east coast of Southern Sweden, passing Stockholm archipelago, to Estonia. An interesting aspect of the document is that it lists several place names, interpreted by some as pilot stations.

The city of Stockholm was founded in the middle ages, strategically located on islands

sited between the Baltic and Lake Mälaren. Goods from the Mälär Valley, the mining industries and the mills of the inland and northern Sweden, were often reloaded in Stockholm before being shipped to its final destinations. Stockholm was a staple market not only for domestic goods, but for wares from all over Europe. Great amounts of iron and wood were exported to foreign countries, while grain, coal, cloths, drinks, pottery and other products were imported.

There was also an intense trade with the population of the archipelago. In order to support the growing capital, goods and supplies such as sand, fish, firewood, down, bricks and lime were shipped from the islands and traded for grain and manufactured products. By time, many of the islanders joined to invest in bigger sailing ships, which managed to take part in foreign trade.

However, much of the seafaring in the region was due to ships passing through the



Stockholm archipelago on voyage between other countries by the Baltic or the West Atlantic coast.

THE CULTURAL HERITAGE UNDER WATER

History is present everywhere in the Stockholm archipelago. The Swedish Maritime Museums has knowledge about 500 discovered wrecks and other monuments in the area. Furthermore, there are at least 300 reports of wrecked ships from the 18th- and 19th centuries. Due to the fact that the Baltic Sea is composed of brackish water, an environment in which wood destructive worms cannot exist, the preservation conditions for organic material, and especially wood, are exceptional. The absence of strong currents, tide and sand banks leads to a low impact of

sedimentation and erosion. As a result many wooden ships have remained more or less intact from the moment of sinking until the present, often well exposed on the bottom.

Despite a great number of well preserved monuments the knowledge of the cultural heritage in the test area is generally poor. Although some of the wrecks have been monitored and investigated by archaeologists, most of the remains are only known by locals or by divers, and some of them have not been paid attention to for many years. At present, it is not known how many of the wrecks that are more than 100 years old and thus protected by the Heritage Conservation Act. The possible scope of the archaeological evidence and the status of preservation, as well as the process and causes of decomposition, has not been assessed.

The situation in the Stockholm archipelago has changed a lot during the last century. In the beginning of the 18th century, the area had an estimated population of almost 3,000, consisting mostly of fishermen. Today the archipelago is a popular holiday destination with about 50,000 summer cottages and 2 million visitors a year. Boating is an extremely popular activity, and in summertime the exploitation of fairways, shores and natural harbours is intense. Situated close to the capital,

there are also a lot of ferries, industries and shipping as well as a need for construction work with jetties, pipes and dredging. All these activities are likely to affect the underwater environment and the cultural heritage.

Another question to be raised is the matter of diving in the area. Since diving became more common in the 1960's, the Stockholm archipelago has been highly appreciated among wreck divers, mostly from the Stockholm area. Thanks to the natural conditions and the history of the region, there are a unique number of spectacular historical sites to be enjoyed under water. Most of the wrecks are possible to experience with a common sports diver certificate, but the number of advanced divers, who can reach a depth of up to 100 meters, increases. As technical equipment such as side scan sonar and advanced echo sounders is becoming more accessible, the search for new dive sites escalates and turns out more successful. There are no fact on how many dives that are performed in the Stockholm archipelago each year, which sites that are preferred and the possible consequences on the wrecks.



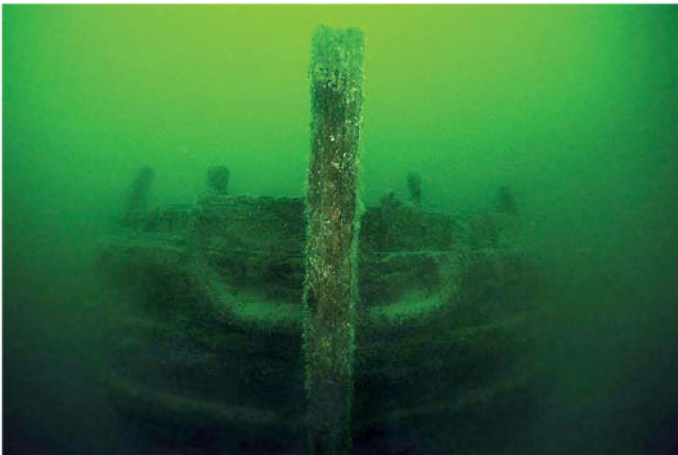


FIGURE 6: Älvsnabben, Concordia PHOTO: ANDERS BOUVIN

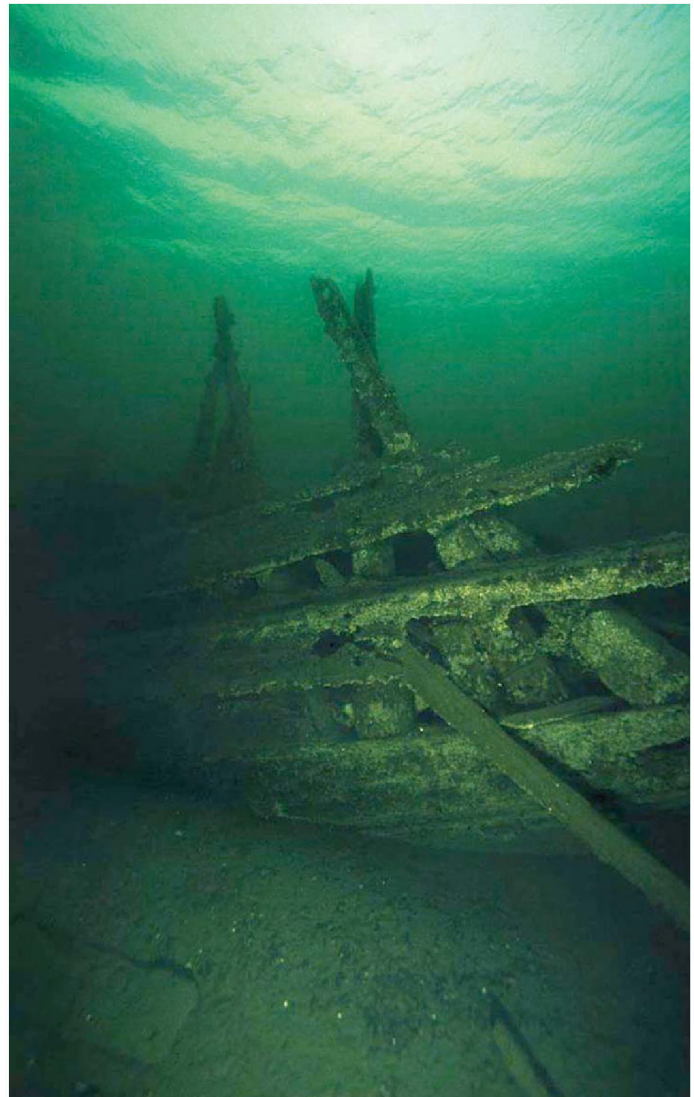


FIGURE 8: Björns vrak PHOTO: ANDERS BOUVIN

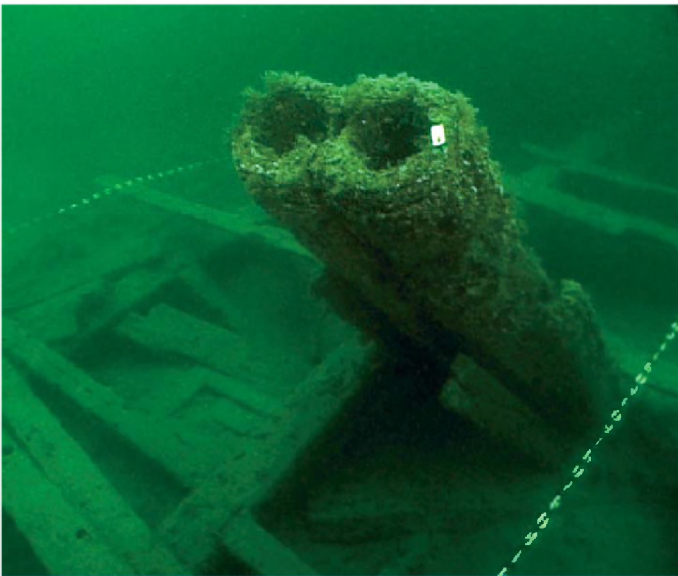


FIGURE 7: Trubbnos/Severn PHOTO: SWEDISH MARITIME MUSEUMS

It is urgent to get a grip on the impact of the way we are affecting the cultural heritage and to develop methods of assessment concerning preservation and degradation. The Swedish test area will hopefully contribute to more knowledge on these issues.

PURPOSE WITH THE SWEDISH PROJECT

The direct purpose with the Swedish project is, within the frame of its geographical delimitations, to map the frequency of diving and its effects on the underwater cultural heritage. This is done by using GIS as a method to identify vulnerable underwater monuments and sites with scuba diving used as the main indicator. The project will also gather geographical digital data on other factors that can be of importance for the preservation and decomposition of the underwater cultural heritage. The project will hopefully illustrate both today's threatened objects as well as future areas where efforts will be needed for protection of the Underwater Cultural Heritage. ■



FIGURE 9: Tegelvraket PHOTO: ANDERS BOUVIN

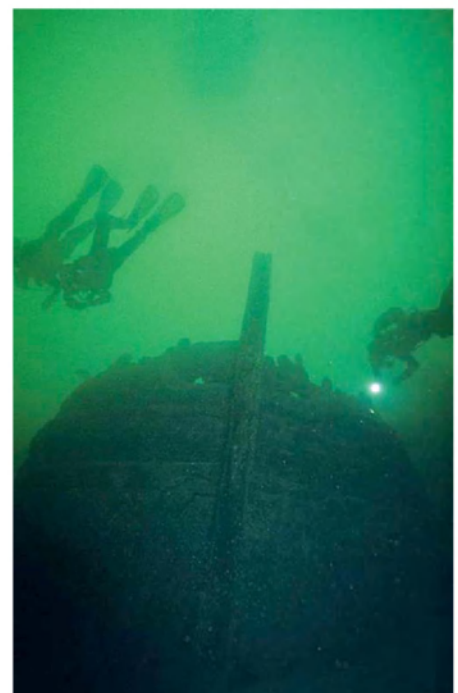


FIGURE 10: Älvsnabben, Concordia PHOTO: ANDERS BOUVIN

Directorate IJsselmeer Region (Rijkswaterstaat (RWS) IJsselmeergebied)

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The Directorate IJsselmeer Region ('Rijkswaterstaat IJsselmeergebied') is a regional service of the Ministry of Transport, Public Works and Water Management that manages national waters, roads and waterways in the IJsselmeer region. From 2001 till 2003, the service was involved in a research-project (IMAGO) on methods to detect wooden objects submerged and buried. The project

demonstrated the added value of combining the results of different data sources in a GIS (Geographic Information System). Bringing different data together and combining them with additional historic, geologic and other information, better interpretations of the measurements became possible, and with that better interpretation of wreck-locations and their surroundings.

On a national scale, the service has within the last few years become more experienced in the use of GIS-web services and the implementation of standards as those that will be applied in the MACHU-project. This is why 'Rijkswaterstaat' has been asked to direct the development of the MACHU GIS-system.

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WIM DIJKMAN studied Environmental Science at the 'Hogeschool IJssel' in Deventer and Geo-Information at the 'van Hall Institute' in Groningen.

He works as Surveyor Hydrography for several companies. Since 2006 he works for the Directorate-General of Public works and Watermanagement, Directorate IJsselmeer Region, Survey and Information Department.

As advisor/specialist Hydrography he is project manager of several projects including building a GIS for the MACHU project.

HERMAN HOOTSEN studied garden and landscape development at the 'International Agrarische Hogeschool Larenstein' in Boskoop. After finishing his study at Larenstein, he attended several colleges and courses on Geographic Information Systems (GIS). Herman worked as GIS specialist for several public organizations. Since 1999 he works as GIS specialist for the Directorate-General of Public works and Watermanagement Rijkswaterstaat, first in Limburg by the Meuse project, and nowadays for the Survey and Information Department in of the Directorate IJsselmeer Region in Lelystad. In the MACHU project he supports the development of the GIS application and database.

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BUILDING THE GIS SYSTEM

HERMAN HOOTSEN

MACHU is about managing cultural heritage underwater. Using a GIS will make it possible to manage, depict and combine relevant spatial information on this subject area. For this purpose, information will be gathered by the partners and presented in separate layers within the GIS.

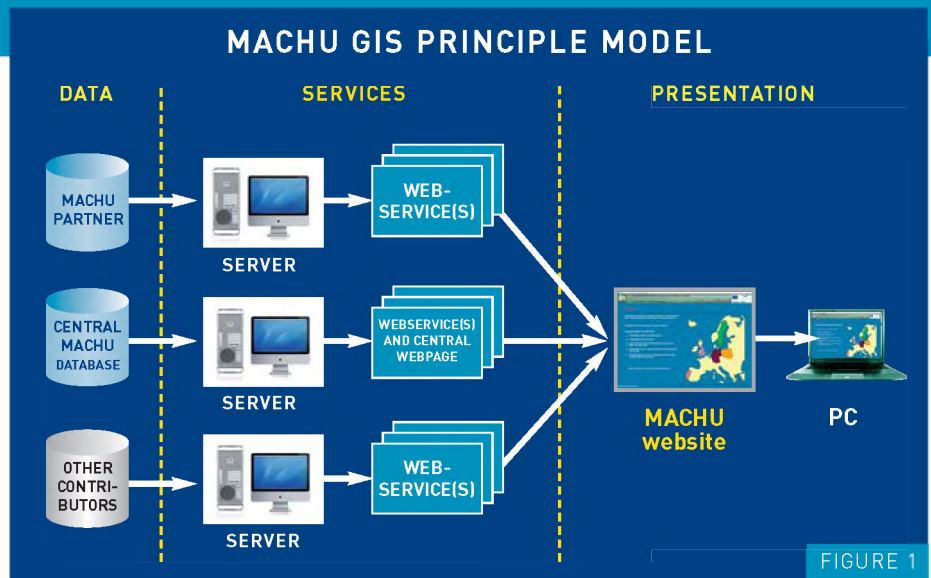
Main layers will concern known wreck-sites, research-areas, information on measurements (e.g. depth) and relevant legislation. In addition, outputs from sediment erosion models, to be developed during this project, will be added. By combining the information in a GIS, insights will be produced into the archaeological richness of an area, the different qualities of sites, and the possibilities and threats to specific sites and their surroundings.

For each site, relevant information shown in the GIS, will also be added to a management plan, according to the guidelines of the MoSS (Monitoring, Safeguarding and Visualizing North-European Shipwreck Sites) Management plan. During the development of the GIS the possibility will be kept open to add more relevant management information to the GIS and/or to establish direct links between management-information and the GIS.

Once accessible, the GIS will contribute to the exchange of management information between partners. The combination of management plans and GIS-system will help policy makers with their decisions concerning the management of sites, and information presented in the GIS can be used as a source for informing the public

on underwater management.

Because part of the information in the GIS will be confidential, direct access to the GIS



will be restricted to scientists and other parties concerned.

FUNCTIONS

The GIS will provide the user with several research-functions. For example, it will be possible to create charts by combining layers on different issues. Data can be searched (geographically or by content), selected, and inquiries on the content can be made. For finding information on data or data sources, a metadata catalogue will be added. With this, the user should be able to find information on ownership of data, date of creation, geographical location, sources, process steps, restrictions on use, etc. Data management will be kept at the owner of the data (see 'Development principles'), so no edit-functions on the data will be applied.

DEVELOPMENT PRINCIPLES

When developing the GIS, the attempt will be made to fit in with the European guidelines for geographical information, as presented by the INSPIRE directive (Infrastructure for Spatial Information in Europe).

One of the principles the INSPIRE directive proposes is to manage data on a single location (at the source). For this, the GIS will be constructed in a way that makes it possible to access data from different sources, by using web services. At the starting point of the development, all test data will be gathered in a single central database. When a contributor of data (one of the MACHU-partners) is technically able to provide its data by web service, this will be added to the GIS as a new source. At that stage, the contributor has again main control of the information it wants to contribute to the GIS.

Another INSPIRE principle is that information must be easy to find and therefore well documented. When developing the GIS, there will

be much attention on the documentation of data, called metadata. This metadata forms an important lead for finding information on, for example, measurements.

The INSPIRE guidelines for implementations on web services, data and metadata, are based on existing standards of the OGC (Open Geospatial Consortium) en ISO (International Organization for standardization). This reveals itself for example in the use of WMS (Web Map Services) or WFS (Web Feature Services) for building up the layers in the GIS and by using the Dutch metadata standard for geography (as it is based on the European metadata standard guidelines).

Finally, the GIS will be developed using Open Source software, improving the possibilities for future extension without the limitations of licence restrictions, as often is the case with commercial software. ■

RELEVANT WEBSITES

- Ministry of Transport, Public Works and Water Management: www.verkeerenwaterstaat.nl
- Monitoring, Safeguarding and Visualizing North-European Shipwreck Sites (MoSS): www.nba.fi/INTERNAT/MoSS
- Infrastructure for Spatial Information in Europe (INSPIRE): www.ec-gis.org/inspire
- Open Geospatial Consortium (OGC): www.opengeospatial.org
- Directorate-General for Public Works and Watermanagement: www.rijkswaterstaat.nl
- Geonovum (National Spatial Data Infrastructure (NSDI) executive committee in the Netherlands): www.geonovum.nl



JUSTIN DIX AND
DAVID LAMBKIN

UNIVERSITY OF SOUTHAMPTON*

It has long been a primary research aim of marine archaeologists to have an understanding of the dynamics of underwater archaeological sites. From the moment that a wrecked ship comes to rest on the seabed, it begins to interact with the tidal currents and waves; the sediments (sands, gravels, muds or some mixture of these) of the site are disturbed and over time form complex patterns of scour (sediment removal) and accumulation which may selectively expose or protectively cover parts of the wreck.

Individual sites tend to reach an equilibrium condition where the many controlling factors are in balance. However, variation in any of the factors can upset this balance, changing the equilibrium and modifying the depth or distribution of sediment cover around the wreck.



FIGURE 2: Instantaneous flow field in the eastern English Channel and southern North Sea.

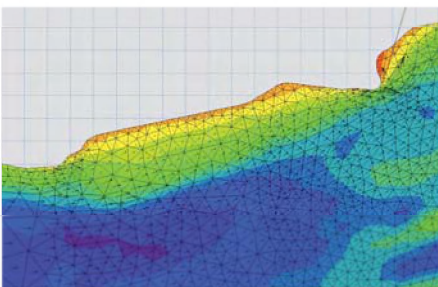


FIGURE 3: Predicted vectors of instantaneous sediment transport in the region of Hastings Bank, UK.

MODELLING SEDIMENT MOBILITY TO SUPPORT THE MANAGEMENT OF SUBMERGED ARCHAEOLOGICAL SITES

FIGURE 1: Patterns of sediment scour and accumulation around the 'Unknown Wreck' on the Hastings Shingle Bank, south coast, UK (DIX ET AL. 2007)

Once a wreck is identified as being of archaeological importance, managers ideally like to maintain any existing sediment cover or even promote additional cover as doing so removes the material of the wreck from the main agents of erosion, decomposition and dispersal. If the amount of sediment cover cannot be artificially controlled, then it would be useful to have an understanding of what the natural variability in sediment cover might be. Factors such as variability in currents, wave action and sediment input must be accounted for over long time periods; it is unlikely that such information can be collected locally and predictions are needed in order to allow for different future environmental conditions.

Numerical modelling using computers provides a means to estimate the variability in these factors over large areas and over long time periods without the need for extensive field monitoring. The model is provided with basic parameters of coastlines, water depth, seabed characteristics and some tidal information. Wind and waves can also be added to simulate storms and other more complex phenomena with a known statistical distribution.

Using the basic laws of physics, the tidal wave is allowed to move through the model domain, thus predicting the flow of the tide at all locations. The output from this flow model can then be used to estimate the direction and magnitude of sediment trans-

port over the same area. By analysing the predicted net transport of water and sediment, the risk of net sediment accumulation or removal in certain areas can be calculated. We are currently calibrating a model of the eastern English Channel and southern North Sea which will provide us with an overview of this large area. We will then be moving on to more detailed 'nested' models of smaller sub-regions to test the importance of model scale and resolution on the risk information. One of the study sub-regions will be the Goodwin Sands, a large sand bank system located off the south east coast of UK which contains a high concentration of shipwrecks. ■

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THE MACHU WEBSITE: GATEWAY TO THE EUROPEAN UNDERWATER CULTURAL HERITAGE

WILL BROUWERS

The World Wide Web has – in recent years – become the digital encyclopaedia (and much more) for much of the citizens in the European community. There even is a new verb to describe just that: to google. Many European citizens use the search engine Google as a first step to find information on... about any subject.

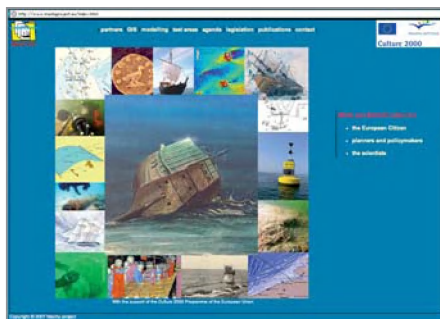


FIGURE 1: Home page



FIGURE 2: Test areas accessible through the map

From holiday to Holocaust everything is to be found on the internet. With it the cultural heritage is more and more digital accessible for the 'common' European citizen.

Research indicates that the people who visit the actual museums and other cultural heritage facilities are also the people who search for cultural heritage on the internet (Klik naar het verleden, Den Haag 2006).

So the good news is: people can be reached through the internet. And that makes the web also very important for the MACHU project. There is one problem; how is the MACHU project to be seen among the vast quantity of digital information concerning cultural heritage? To provide the world with information is one thing but to actually be heard is another. The solution is to link the MACHU site to as many related and not related sites as possible. Starting with the sites of the MACHU partner involved. (Figure 1)

The MACHU website serves two categories of public:

- The scientific community. The development of a GIS Decision Support System and database will be (partly) accessible through the MACHU website. All relevant data (archaeological, legal and research) about the specified test areas, wrecks and sites will be on the MACHU website. An part of the information will be restricted to the (relevant) scientific community.

- The European citizen can find on the MACHU site everything one always wanted to know about cultural heritage underwater – in the GIS application and in articles and other means. So MACHU will be also very helpful for decision makers and municipality

politicians.

As the MACHU website becomes the most important means of communication to the whole of the EU citizens, navigation is kept fairly simple. The home page (Figure 1) gives general information about the project. What is MACHU? For whom? Which countries are involved in the project?

What is an GIS Decision Support System? How can we protect underwater cultural heritage? On all these questions the website will provide an answer. (Figure 2 and 3)

When you goes to the test area part (in the main menu), the map will show the MACHU partners. Click on a given country and you will have access to the information about: test area, wrecks and sites in that country's waters. Sometimes, at the moment, little may be known of an area and sometimes information is abundant. That depends on the level of research carried out in an area. So for every citizen – lay or professional – the site gives worth-while information. Even individual (archaeological) management plans can be found on the site.

Data gathered within the MACHU project will, in this way, form the core of the great hidden maritime (hi)story of Europe. (Figure 4) And it will be, first and foremost, stories that will stimulate the enthusiasm of the public that will eventually lead to better understanding and involvement (commitment) towards our shared underwater cultural heritage. Commitment leads to protection and isn't that what MACHU is all about?

You will find the MACHU website on:
www.machuproject.eu ■



FIGURE 3: The testarea Burgzand Noord

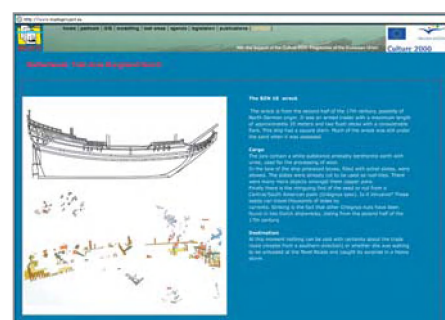


FIGURE 4: The 17th century wreck Burgzand Noord 10

REFERENCE

- *Klik naar het verleden, Een onderzoek naar gebruikers van digitaal erfgoed: hun profiel en zoekstrategieën.* (Den Haag 2006) Uitgave van Sociaal en Cultureel Planbureau

MACHU MEETINGS

ANDREA OTTE

The MACHU Project Group holds meetings twice a year to coordinate internal business. We use these project meetings to monitor the progress of the project, to exchange project-related information and to make collective decisions on future actions. During the meetings, all partners will present the results of their work from the foregoing period. The minutes, and all decisions and action items can be found on the MACHU website.

Our first meeting was held on October 4th to October 7th 2006, organised by the Lead partner, RACM, in Amersfoort (The Netherlands).

The days were used for introductions, deciding on practical matters and discussing the project outline in further detail. At the end of the three days an excursion was organised to the national research centre and depository for historic shipfinds, situated in a typical Dutch reclaimed land area.



FIGURE 1: MACHU meeting in Lisbon, February 2007

On February 12th and 13th the second meeting took place in the beautiful city of Lisbon, hosted by the Division of Underwater Archeology of Portugal (DANS). This meeting happily coincided with the Maritime Heritage week, organised in celebration of Portugal signing the Unesco Convention for the Protection of Underwater Cultural Heritage.

Besides all the hard work, the MACHU meetings give ample opportunity to get acquainted with each other, especially

during a good lunch or dinner.

The network of maritime heritage and other professionals that is created in this way will without any doubt benefit the international cooperation in underwater cultural heritage management beyond the boundaries of the MACHU Project. ■

PROGRESS OF THE PROJECT

MARTIJN MANDERS

The desktop studies are well on their way, the first fieldwork has been done and the website is in the electronic 'ether'. The GIS is now being made on the basis of the formats that have been developed within the project. At the end of this year a GIS will be tested with real information from the test locations. We are looking forward to that. If all goes well, then we will add more layers and areas in the GIS. So, keep yourself informed about the MACHU project and watch the website

The MACHU project is now one year old. Did we manage to do all the work according to the plan? In most of our aims, yes indeed we managed to do so. Some other parts are taking a bit longer than scheduled. However, none of the delays have effected the overall planning of the project.

once in a while. If you have any comments or questions: through the website you can contact the MACHU project group.

1. A definition of underwater cultural heritage is provided in the 2001 UNESCO Convention on the Protection of Underwater Cultural Heritage (article 1): *'...all traces of human existence having a cultural, historical and archaeological character which have been partially or totally under water, periodically or continuously...'*

2. Council Directive of 27 June 1985 on the assessment of the effects of certain public and private projects on the environment (85/337/EEC).

3. Council Directive on the assessment of the effects of certain plans and programmes on the environment (2001/42/EC). ■



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PHOTO BACK COVER:

**A scientific diver installs a
so called 'data logger' on a
wrecksite.** PHOTO: R. OBST



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