Pegaso Project
People for Ecosystem based Governance in Assessing Sustainable development of Ocean and coast

Funded by the European Union under FP7 – ENV.2009.2.2.1.4 Integrated Coastal Zone Management

Specific Programme FP7
Collaborative Projects
Large scale integrating Project

Grant agreement nº: 244170

D5.2B

Guidelines for Maritime Spatial Planning in response to policy options

Dissemination Level*	✔ PU	PP	RE	CO
Project Acronym / number	PEGASO	244170		
Project title	People for Ecosystem based Governance in Assessing Sustainable development of Ocean and coast.			

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Authorisation

Prepared by	IOC/UNESCO (Editor)
Aproved for released by	Françoise Breton
Date	28/03/2014

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The research leading to these results has received funding from the [European Union] Seventh Framework Programme ([FP7/2007- 2013][FP7/2007-2011]) under grant agreement n° [244170].

Project coordination
Universitat Autònoma de Barcelona
UAB / Spain

www.pegasoproject.eu

pegasoproject.eu

Document Information			
Project			
Project Acronym	PEGASO	Grant agreement nº	244170
Project full title	People for Ecosystem based Governance in Assessing Sustainable development of Ocean and coast		
Funding scheme	Collaborative large-scale integrating project		
Project start date	February 1, 2010	Project duration	48 months
Call topic	ENV.2009.2.2.1.4 Integrated Coastal Zone Management		
Web site	www.pegasoproject.eu		

Document					
Deliverable number	5.2B	Due date	31/03/2014	Submission date	27/03/2014
Deliverable title	Guidelines on Maritime Spatial Planning in response to policy options				
Authors	Francesca Santoro, Julian Barbière (IOC) Megan Nowell (UAB) Marco Tonino (UNIVE)				
Reviewers					
Work Package	WP5 Collaborative applications at various scales and Integrated Regional Assessment for Mediterranean and Black Sea basins				
Work Package Leader	Stefano Soriani (UNIVE)				
Lead beneficiary	IOC-UNESCO				
Dissemination level	PU				
Nature	Report				
Nº of pages (incl. cover)	41				

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Acronyms

ABNJ	Areas Beyond National Jurisdiction
CBD	Convention for Biological Diversity
CIM	Cumulative Impact Mapping
DG MARE	EC Directorate-General for Maritime Affairs and Fisheries
EBSA	Ecologically or Biologically Significant Marine Area
EcAp	Ecosystems Approach (acronym in IUCN and MAP context; see also EsA)
EEZ	Exclusive Economic Zone
EU	European Union
GDP	Gross Domestic Product
GFCM	General Fisheries Commission for the Mediterranean
GIS	Geographic Information System
ICZM	Integrated Coastal Zone Management
IMP	Integrated Maritime Policy
IOC	Intergovernmental Oceanographic Commission of UNESCO
IUCN	International Union for Conservation of Nature
LEAC	Land and Ecosystem Accounting
MAP	Mediterranean Action Plan
MPA	Marine Protected Areas
MSP	Marine Spatial Planning
MSSD	Mediterranean Strategy for Sustainable Development
OSPAR	Oslo/Paris convention for the Protection of the Marine Environment of the North-East Atlantic
PAP	Priority Actions Programme
PCA	Principal Components Analysis
PEGASO	People for Ecosystem based Governance in Assessing Sustainable development of Ocean and coast
RAC	Regional Activity Centre
SCI	Site of Community Importance
SDI	Spatial Data Infrastructure (SDI)
SPA	Special Protected Area
SPAMI	Specially Protected Areas of Mediterranean Importance

UNCLOS	United Nations Convention on the Law Of the Sea
UN DOALOS	United Nations Office of Legal Affairs/ Division for Ocean Affairs
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational Scientific and Cultural Organization
WCMC	World Conservation Monitoring Centre

Introduction

Marine ecosystems provide important economic and social benefits to citizens (food, employment, carbon storage, coastal hazard protection amongst others). The global ocean economic activity, often called the 'Blue economy' includes a wide range of ocean industries (e.g. fishing, shipping, tourism, marine renewable energy, sub-marine cabling) essential to both current and future economic development and estimated at between USD 3-6 trillion/year. However, the capacity of the ocean to provide those benefits is increasingly hampered by the degradation of the marine environment. In addition, the increasing demand for marine space to conduct these economic activities creates conflicts amongst users. In order to mitigate this degradation, restore and sustain its critical monetary and social/cultural ecosystem services, a framework for the integrated governance of maritime activities is necessary. Two main tools are essential for the success of such approach, the establishment of a participatory planning process (using the Marine Spatial Planning approach); and the existence of a comprehensive and accessible data and information source (Shared information systems) to support the formulation of sound policies and ensure the engagement of concerned stakeholders.

Due to the increasing utilization of the sea and the threats caused by climate change, it became critical to manage the seas effectively and in a coordinated fashion. This implies the need for adopting a more place-based holistic approach whereby objectives of individual sectors are balanced along the cumulative pressure on the ecosystem from combined human use, to ensure that any development is achieved sustainably. This is the essence of Marine Spatial Planning[1] (MSP). The Intergovernmental Oceanographic Commission of UNESCO has been a leading force in the development of ecosystem-based MSP throughout the world. Since 2005, the IOC has promoted this approach, and provided international guidance through collection and sharing of good practices, and capacity building activities becoming a worldwide acknowledged reference for it.

In 2008 the European Union published a road map for Maritime Spatial Planning: Achieving Common Principles in the EU. This and the 2011 Communication on Maritime Spatial

[1] Elher Charles, and Fanny Douvere. Visions for a Sea Change. Report of the First International Workshop on Marine Spatial Planning. Intergovernmental Oceanographic Commission and Man and Biosphere Programme. IOC Manual and Guides No.48, IOCAM Dossier no.4. Paris: UNESCO, 2007 (http://www.unesco-ioc-marinesp.be/marine_spatial_planning_msp)

Planning in the EU: Achievements and Future Developments, paved the way for the recently proposed Framework Directive on Maritime Spatial Planning and Integrated Coastal Management. Aware of the great opportunities offered by the maritime sector for innovation, growth and employment the 'aim is to identify the most efficient and sustainable current and future utilization of the maritime space' on Europe's way towards a Blue Economy.

It is clear that blue growth can only be s ustainable if the appropriate management frameworks are in place. This requires a shift from the usual sectoral management to integrated ecosystem based management.

We need to move

- From looking at individual species to looking at the entire ecosystem;
- From examining only small spatial scales to examining multiple scales;
- From the short-term perspective to a long-term perspective
- From considering humans as bei ng independent from marine ecosystems to recognizing humans as being an integral part of them
- From having management divorced from research to using an adaptive case by case approach, informed by robust science
- And from managing commodities to focusing on s ustaining production potential for both goods and services

Over the past 10-12 years MSP has become the preferred approach of many coastal countries to manage increasing conflicts among the multiple uses of their exclusive economic zones (EEZ), whilst providing an operational process that can lead eventually to ecosystem-based management of marine areas.

At least six countries (Belgium, The Netherlands, Germany, Norway, Australia, and China, and three American states (Massachusetts, Rhode Island, and Oregon) have implemented spatial plans for their marine jurisdictions. In two cases, Norway and The Netherlands, MSP is already in its second or third generation. Three other countries (England, Portugal, and Sweden) will implement marine spatial plans for their marine waters over the next few years. Over the next decade over 30 countries will have produced about 60-70 marine spatial plans at the national (EEZ), sub-national (territorial sea), and state/provincial levels. MSP can help in developing long-term adaptive economic and business models for offshore economy under the given uncertainty.

The benefits are clear, and policy relevant

- Reduce conflicts among uses
- Increased predictability and certainty
- Facilitate compatible uses
- Preserve critical ecosystem services

In practice, however, the implementation of marine spatial plans faces some important challenges when defining the most appropriate strategies which will be able to balance the demands for economic development, the need to protect marine ecosystems, and the social and economic objectives. First of all, when developing their blue economy and maritime activities coastal nations need to address three compounding levels of uncertainty:

- uncertainty over the underlying marine physical or ecological processes,
- uncertainty over the socio-economic impacts of offshore activities and related environmental change,
- and uncertainty over technological changes that might ameliorate economic impacts and/or reduce the environmental damage in the first place.

Being added to the equation, climate change-driven alterations in marine ecosystem and human access and use may make additional dynamism and require adaptability in place-based marine governance. Climate change will certainly influence the location of important biological and ecological areas and species over the next 30–100 years, while technological change (and climate change) will considerably alter the exploitation of previously inaccessible marine areas such the high seas. Goals and objectives of MSP, and management plans and measures will inevitably have to be modified to respond to those changes—or plans quickly become ineffective, uneconomic, infeasible, and ultimately—irrelevant.

One of the other missing pieces to this complex puzzle, concerns the identification and valuation of ecosystem services provided by the coastal and marine ecosystems. These are an essential element to consider when defining management objectives for a specific area, leading to the allocation of space and uses in the marine environment.

Ecosystem services provide an important basis for monitoring impacts of ecosystem change and can be used to identify needs for interventions in management of coastal and marine areas. As the ocean with its ecosystem services is a source of economic and social wealth, the degradation of coastal ecosystems leads to substantial socio-economic impacts and poses a risk to citizens by threatening their livelihood, health or general well-being. Thus, it is essential that decision makers in charge of developing MSP understand the value of marine ecosystem services, their implication and links to human well-being and as well as take appropriate measures to manage this relationship. Another important source of information for sustaining MSP is to quantify the value of the marine sectors, their contribution to the GDP of an economy, and the cost on those sectors towards the unsustainable environmental use.

Nevertheless, monitoring only quantitative ecological or biological information is insufficient—social, political, and cultural information and qualitative data help provide a more complete understanding of what is happening in a marine region. The recognition that monitoring should go beyond quantitative biological or ecological information reflects the fact that MSP takes place in a complex context influenced by human populations. It is important to understand the strengths and weaknesses of quantitative and qualitative methods and measures and to know when it is appropriate to use either of them. Practitioners should be clear about their information needs and gather the minimum amount of information required to meet those needs and given the available resources

Past experiences in the implementation of MSP have proven useful in identifying the key to success. Marine planning supports regional actions and decision-making and addresses regionally determined priorities. Therefore, robust stakeholder engagement and public participation is a foundation of marine planning

MSP is a proactive planning process that gathers information and identifies issues before decisions have to be made, therefore important factors are:

•Fair and Open Process for All Stakeholders

•Make Decisions Based on the Best Available Science

•Respect the Unique Character of each Region

The PEGASO work can offer a number of tested approaches, methods and tools to respond to the needs of a successful MSP process. This report presents the potential application of PEGASO toolbox MSP in the Mediterranean region.

Chapter 1 Maritime Spatial Planning in the Mediterranean

Santoro F., Tonino M.

1.1 Maritime activities in the Mediterranean and the need for MSP

In Limassol in November 2012, the European Union ministers agreed unanimously to support the Blue Economy in Europe, recognizing that the sea provides opportunities for growth and new jobs. Moreover, it has been agreed that a new way to manage the sea should be proposed. This is the Integrated Marine Policy. Policy areas such as the energy, transport, environment, fisheries, and research should be managed in an integrated manner with a view also to adapt those policies to the specificities of each sea basin.

The Mediterranean Sea is a vast area covering twenty-two states from three continents. The Mediterranean coast is home to more than 150 million inhabitants. This number doubles during the tourist season. The ports of the Mediterranean welcome each year one million cruise tourists. The Mediterranean is also an important transit corridor for shipping with 30% of the world seaborne trade channeled through it, including 20% of the world's seaborne oil traffic. Half of EU's fleet is active in the Mediterranean, mostly small-sized and artisanal, together with an increasing aquaculture production. The Mediterranean is also confronted with serious risks and threats in the field of maritime security such as illegal immigration, trans-national crime, drug trafficking, illegal fishing activities. The Mediterranean ecosystems also face serious environmental issues, and they are influenced by the high pressure that they have from developing economic activities and multiple sources of pollution from both land and sea.

The maritime sector, or the blue economy, is composed of several activities or components. Shipping, passenger ferry services, fisheries, aquaculture, coastal protection, marine renewable energies, coastal, cruise and maritime tourism, yachting and marinas, offshore oil and gas, blue biotechnology, desalination, marine mineral mining. Moreover, these individual sectors are interdependent and rely on common skills and shared infrastructure, making the need for an integrated and synergetic approach to the development of the blue economy all the more relevant. Furthermore, this economy development in the marine space of the Mediterranean could exert pressure on the spatial and environmental limits that the sea area can handle.

It is for this reason that an increasing number of stakeholders in countries around the Mediterranean have become aware of the urgency to find the right balance between economic benefits and the environmental protection.

MSP has been proposed also in the Mediterranean as the way to promote a balanced use of the marine space. A number of studies and publications have been produced in order to analyse the potential for MSP in the Mediterranean as well as the obstacles and the challenges to face.

In particular in the study 'Exploring the potential for Maritime Spatial Planning in the Mediterranean Sea', carried out on behalf of the European Commission Directorate-General for Maritime Affairs and Fisheries (DG MARE), and executed by the Policy Research Corporation, a series of recommendations have been presented:

- The most urgent need for MSP in the Mediterranean exists in coastal areas which are extensively used by a variety of maritime activities which compete with each other and with the environment for the space;
- The feasibility of MSP in the Mediterranean depends on a range of factors that vary significantly throughout the Mediterranean and between countries and regions;
- Important elements for success in the Mediterranean are:
    - **stakeholder involvement**,

- there are some examples of countries that facilitate stakeholder involvement at the level of national government through inter-ministerial committee

- **a well-functioning institutional and legal framework**,

  - With regards in particular to the institutional and legal framework most countries in the Mediterranean have not yet developed legislation that accommodates MSP. Most countries have not yet established the Economic Exclusive Zone (EEZ), which would enable them to manage associated sea space under national jurisdiction

- **cross-border cooperation**,

  - in the Mediterranean cross-border initiatives exist in the form of platforms, networks and international research and m anagement projects as documented in the PEGASO Integrated Regional Assessment

- **the presence of strong data and knowledge base**,

  - In the Mediterranean many countries have research institutes on fisheries, while some have a wider scope

- **coherence of MSP with terrestrial spatial planning and sound management and control of the seas**

  - the existence of the Integrated Coastal Zone Management (ICZM) Protocol should ensure this coherence for the land-sea interface

1.2. Ocean governance in the Mediterranean

The issues related to ocean governance and MSP are of particular importance in the case of the Mediterranean. The rights of coastal States to claim and enforce maritime zones in the Mediterranean, as elsewhere in the world, derive from the law of the sea. The law of the sea is the branch of international law that is concerned with all uses and resources of the sea. The cornerstone of the law of the sea is the United Nations Convention on the Law of the Sea (hereafter referred to as 'UNCLOS') and its two implementation agreements, the Agreement relating to the Implementation of Part XI of the United Nations Convention on the Law of the Sea of 10 December 1982[6] and the Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks (the 'UN Fish Stocks Agreement').

Customary international law continues to play an important role in the Mediterranean as a number of countries are not party to UNCLOS. However, most of the provisions of UNCLOS related to maritime zones are generally to be considered declaratory of customary international law.

As at 20 September 2011, there were 165 parties to UNCLOS, including the EU. All of the Mediterranean coastal States are party to UNCLOS with the exception of Libya, Israel, Syria and Turkey. Syria, Turkey and Israel have neither signed nor ratified UNCLOS while although Libya signed the convention on 3 December 1984 ratification has yet to take place.
Article 310 of UNCLOS allows States and entities to make declarations or statements regarding the application of the convention at the time of signing, ratifying or acceding to it provided these do not purport to exclude or modify the legal effect of the provisions of the convention. A number of Mediterranean coastal States have made such declarations.

In the case of the Mediterranean is very important to make reference to Part IX of UNCLOS which contains specific provisions on 'enclosed or semi-enclosed seas'.

Article 122 defines an ‘enclosed or semi-enclosed sea’ to mean a gulf, basin or sea surrounded by two or more States and connected to another sea or the ocean by a narrow outlet or channel consisting entirely or primarily of the territorial seas and exclusive economic zones of two or more coastal States’. The Mediterranean Sea falls within this definition, as does the Adriatic Sea.

Article 123 of UNCLOS provides that States bordering an enclosed or semi-enclosed sea should cooperate with each other in the exercise of their rights and in the performance of their duties under the convention. It goes on to provide that such States must endeavour, directly or through an appropriate regional organization:

- to coordinate the management, conservation, exploration and exploitation of the living resources of the sea;
- to coordinate the implementation of their rights and duties with respect to the protection and preservation of the marine environment;
- to coordinate their scientific research policies and undertake where appropriate joint programmes of scientific research in the area; and
- to invite, as appropriate, other interested States or international organization

While UNCLOS is of global application, at the regional level three particular agreements inform the law of the sea in the Mediterranean. These are:

- the Convention for the Protection of the Marine Environment and Coastal Regions of the Mediterranean (the ‘Barcelona Convention’),
- the Agreement for the establishment of the General Fisheries Commission for the Mediterranean (the ‘GFCM Agreement’) and
- the International Convention for the Conservation of Atlantic Tunas (the ‘ICCAT Convention’).

1.2.3 Maritime zones under UNCLOS

UNCLOS recognizes the sovereignty, sovereign rights, freedom, rights, jurisdiction and obligations of States within several maritime zones namely internal waters, archipelagic waters, the territorial sea, the contiguous zone, the EEZ, the continental shelf, the high seas, and the seabed beneath the high seas which is defined as the 'area'.

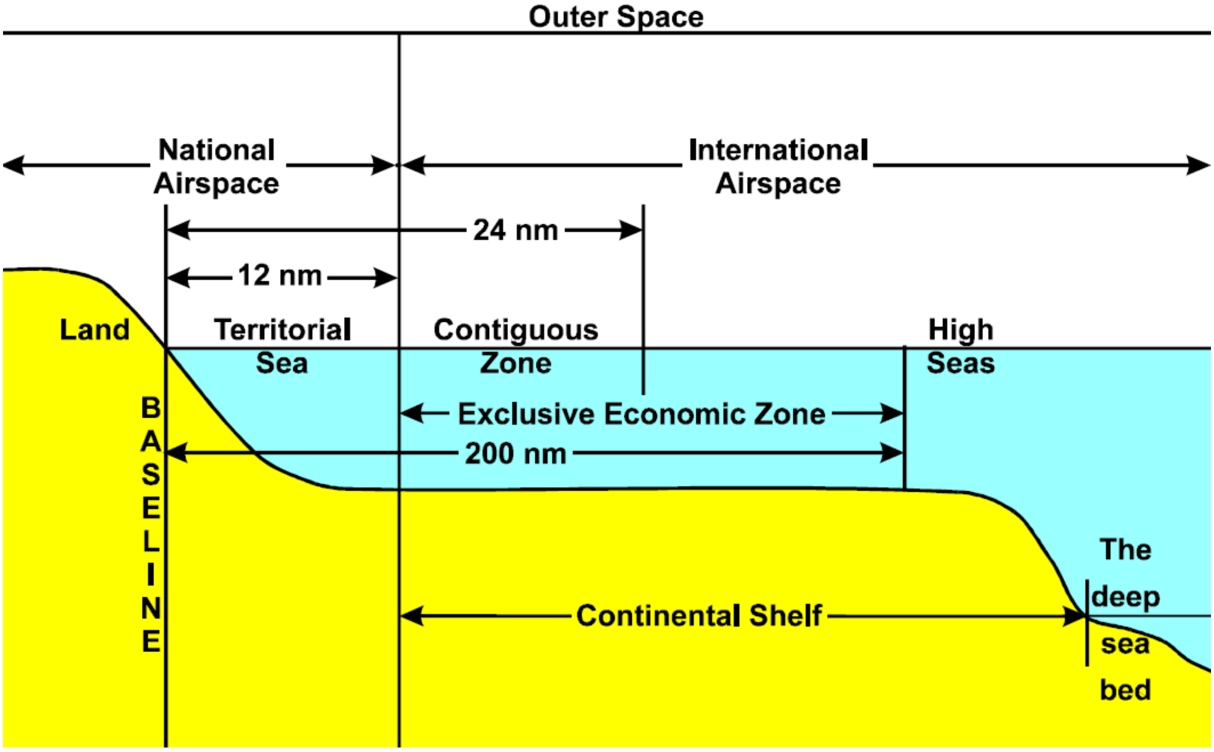

Figure 1 Maritime zones under UNCLOS

The starting point for the measurement of the seaward extent of all the maritime zones of a coastal State are the 'baselines', which are to be determined in accordance with UNCLOS.

Straight baseline in the Mediterranean are provided for in the legislation of Albania, Algeria, Croatia, Cyprus, Egypt, France, Italy, Malta, Morocco, Slovenia, Spain and Tunisia.

The sovereignty of a coastal State extends beyond its land territory and internal waters to an adjacent belt of sea described as the territorial sea. The maximum breadth of the territorial sea is twelve nautical miles (nm) measured from the baselines. Within the territorial sea the authority of the coastal State is in principle absolute except as restricted by UNCLOS and other rules of international law. The most important restriction included in UNCLOS is the right of ‘innocent passage’ through the territorial sea. This right is enjoyed by ships of all States.

Beyond its territorial sea a coastal State may claim an EEZ that may extend up to 200 nm from the baseline. In contrast to the territorial sea, in respect of which a coastal State has sovereignty, a more limited set of “sovereign rights” are conferred by UNCLOS on coastal States in respect of EEZs claimed.

More specifically, within its EEZ a coastal State has sovereign rights relating to living and non-living resources and with regard to other activities for the economic exploitation and exploration of its EEZ, such as the production of energy. Article 56 states that:

> *(a) In the exclusive economic zone, a coastal State has: (a) sovereign rights for the purpose of exploring and exploiting, conserving and managing the natural resources, whether living or non-living, of the waters superjacent to the seabed and of the seabed and its subsoil, and with regard to other activities for the economic exploitation and exploration of the zone, such as the production of energy from the water, currents and winds;*

A coastal State also has the necessary jurisdiction related to these sovereign rights as well as jurisdiction for the establishment and use of artificial islands, installations and structures, marine scientific research and the protection and preservation of the marine environment.

These sovereign rights and jurisdiction conferred upon the coastal State imply the power to regulate the terms of use relating to those activities. On the other hand the coastal State does not enjoy sovereignty in the fullest sense. Article 56 of UNCLOS states:

> *In exercising its rights and performing its duties under this Convention in the exclusive economic zone, the coastal State shall have due regard to the rights and duties of other States and shall act in a manner compatible with the provisions of this Convention.*

In other words coastal State regulatory competence in the EEZ is not plenary, but confined to the matters expressly indicated in UNCLOS in respect of which sovereign rights or jurisdictional powers are granted to a coastal State. Moreover UNCLOS subjects the exercise of this competence to various conditions and obligations explicitly foreseen, such as the right of any State to lay submarine pipelines and cables, and the freedom of navigation of other States' vessels.

A range of maritime zones have been established to date in the Mediterranean. UNCLOS provides the background against which all of these zones have been established but the

UNCLOS zoning regime is complemented by a number of other instruments adopted under international law that provide for the establishment of a range of different types of maritime area.

The picture that emerges is of a patchwork of different maritime zones and areas.

As regards the establishment of maritime zones, certain Mediterranean States have taken steps to claim all that they are entitled to under UNCLOS. Some indeed, have arguably claimed more than that to which they are entitled. Other States have taken preliminary measures such as the adoption of primary legislation that has yet to be fully implemented.

Others have taken minimal measures in terms of establishing maritime zones beyond their continental shelf and territorial sea entitlements. The objective of this section is to describe and analyse the current situation as regards the establishment of maritime zones and maritime areas in the Mediterranean Sea.

As the existence of the territorial sea arises by operation of law it is not necessary for a coastal State to formally claim a territorial sea per se although they have some discretion as to its breadth up to a maximum limit of 12 nm. More specifically a coastal State needs to specify the breadth of its territorial sea. In this connection most States have claimed the maximum entitlement i.e. 12 nm.

In the Mediterranean to date only Algeria, Cyprus, Egypt, France, Italy, Malta, Monaco, Morocco, Spain, Syria and Tunisia have claimed a contiguous zone. In each case this extends to 24 nm.

The process of analysing the current situation with regard to the establishment of EEZs and derivative zones in the Mediterranean is complicated by reason of the procedures whereby maritime zones are claimed. The first stage is usually the adoption by the coastal State in question of legislation that provides inter alia for the establishment of an EEZ or derivative zone. In fact a majority of Mediterranean coastal States have such legislation in place. In the cases of Albania, Algeria, Croatia, Cyprus, Italy, Lebanon, Libya, Malta, Monaco, Montenegro, Slovenia, Syria and Tunisia geography dictates that such legislation can only be a precursor to the establishment of an EEZ or derivative zone in the Mediterranean given that these countries do not have land access to any other seas. In the cases of countries which also have non - Mediterranean coastlines, France, Israel, Morocco and Spain also have legislation in place that provides for the establishment of EEZs or derivatives zones although as will be seen below not all of these countries have sought to establish full EEZs in the Mediterranean. France has also put in place the relevant legislation to establish a full EEZ in the Mediterranean Sea (Law No. 76 - 665 of 16 July 1976) and declared in August 2009 (and officially to the UN in August 2010) its intention to create an EEZ in the Mediterranean (the "décret" to delimit the area is understood to be in the process of being developed). As regards Spain, Law No. 15/1978 on the Economic Zone is expressed to apply only to Spain's Atlantic coasts although powers are conferred on the Government to extend its provisions to other coasts of Spain. Egypt can also be included under this category of country (i.e. with both a Mediterranean and non-Mediterranean coast) although the legal mechanism whereby the Egyptian EEZ claim is made is not entirely clear, the only documents available at the UN DOALOS website.

In this respect are Egypt's declarations on signature and ratification as to the country's intention to claim an EEZ. Nevertheless Cyprus and Egypt have reached a formal agreement on the delimitation of their EEZ boundaries. Finally mention can be made of Turkey which has not only adopted legislation for the establishment of an EEZ in the Black Sea (but not the

Mediterranean) but also has taken steps to implement an EEZ there including as regards boundary delimitation.

1.3 Priority issue: preserving natural capital in the Mediterranean, and the role of Marine Protected Areas

The Mediterranean basin represents one of the most important eco-regions worldwide. Although it represents only 0.82% of the total ocean surface, it hosts between 4 and 18% of the global marine biodiversity (Coll et al., 2010).

Mediterranean marine waters and coastal zones are increasingly threatened by pressure both land based like industrial pollution, urban sprawl, coastal artificialisation and tourism as well as marine based like overfishing, cruise shipping and alien species invasion. Concerning climate change, the Mediterranean is considered an hotspot at global scale (The MerMex Group, 2011; Giorgi e Lionello, 2008). In particular, more than other seas, the Mediterranean region is expected to be exposed to acidification processes and biodiversity loss (Lejeusne et al., 2009), a decrease of wetlands and an increasing of extreme events (Magnan et al., 2009) leading to an worsening of coastal erosion. Despite its limited extension, waters of *Mare Nostrum* receive about the 30% of the global boat traffic at global level (UNEP/MAP, 2009).

The need of conservation and preservation of natural species and ecosystems has lead Mediterranean countries to collaborate together in order to cope with the threats for biodiversity in the basin. Since 1975, Mediterranean countries have embarked, through the Barcelona Convention and its related Protocols, on a series of cooperation and coordination processes aimed at protecting Mediterranean natural resources, conserve biological diversity and combat pollution (Romani, 2013).

Two protocols of the Barcelona Convention are particularly relevant for the protection and conservation of biodiversity, especially for what concern the identification, establishment and management of coastal and marine areas to be protected: these are the Protocol on ICZM in the Mediterranean and the SPA/BD protocol.

The **SPA/BD protocol** provides for the designation by the Mediterranean riparian countries of Specially Protected Areas of Mediterranean Importance (SPAMIs). According to SPA/RAC[2], in order to be designated as SPAMI, a coastal and/or marine area should:

- be of importance for conserving the components of biological diversity in the Mediterranean;
- contain ecosystems specific to the Mediterranean area or the habitats of endangered species;
- be of special interest at the scientific, aesthetic, cultural or educational levels.

SPAMIs can also be designated in areas beyond national jurisdiction (ABNJ). Very often national jurisdiction is limited within 12 nm from the coast; to date, only Algeria, Cyprus, Egypt, France, Italy Malta, Monaco, Morocco, Spain, Syria and Tunisia have claimed up a contiguous zone extended to 24 nm (MRAG et al., 2013). Mediterranean countries are still in a early stage of defining their EEZ due to the need of agreements between adjacent or opposite countries. However, if all coastal countries would proclaim an exclusive economic zone, the high seas would disappear in the Mediterranean, as no point in this semi-enclosed sea is located more than 200 nm from the nearest land or island (Scovazzi, 2011).
As highlighted in the "Mediterranean Integrated Marine Policy Communication", 'the large proportion of marine space made up of high seas makes it difficult for coastal States to plan, organize and regulate activities that directly affect their territorial seas and coasts'[3] , including the transboundary issue of environmental protection.
The establishment of EEZs and its subcategories [4] - with consequent disappear of high seas in the Mediterranean- would have significant positive impacts as far as environmental protection measures are concerned, particularly as regards the establishment of MPAs; the

[2] The Regional Activity Center for Specially Protected Areas (http://www.rac-spa.org/spami)

[3] COM(2009) 466 final, Brussels, 11.9.2009

[4] fishery zones', 'fisheries protection zones', 'ecological protection zones' and 'ecological and fishery protection zones' are all subcategories of Exclusive Economic Zones with a focus on the protection of specific resources.

limitations due to the need to rely only on flag State enforcement are indeed obviated if MPAs, including SPAMIs, are established within EEZs or its subcategories (MRAG et al., 2013).

By 2012 there were 32 SPAMIs in the Mediterranean, of which just the Pelagos Sanctuary for the conservation of marine mammals includes high sea waters and is managed at transboundary scale.

At the moment the existing SPAMIs do not function as a network: they are not synergistic, not ecologically connected nor they achieve representativeness of the full range of ecosystems within the Mediterranean, or replication of ecological features (Portman et al.,2013). Moreover due to the lack of monitoring systems for these protected areas, little is known whether the established SPAMIs are achieving their designated level of protection (Portman et al.,2012).

This is not a problem just related to SPAMIs: even considering all the 677 MPAs[5] in the Mediterranean (some of which are also recognized as SPAMIs) mapped by SPA/RAC in 2012 (i.e. MPAs with a legal national and/or international designation, including Pelagos Sanctuary and Natura 2000) the 4.56% of the Mediterranean emerge to be under a protected status, and the percentage goes down to 1.08% excluding Pelagos. MPAs distribution is uneven in the basin: without considering Natura 2000 sites, the 84% of MPAs are located in the northern basin; MPAs are all distributed in the coastal zone (only Pelagos extends offshore), and large portions of the South-eastern coast of the Mediterranean have no MPAs. Moreover habitats are not adequately represented, especially concerning deep sea benthic habitats. More specifically, only Posidonia oceanica meadows -and only in the Western Mediterranean- is adequately represented among MPAs. Finally the results of the SPA/RAC analysis shows that generally the MPAs connectivity is not sufficient among MPAs.

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[5] According to a study conducted by RAC/SPA in 2012 (Gabrié et al., 2012)

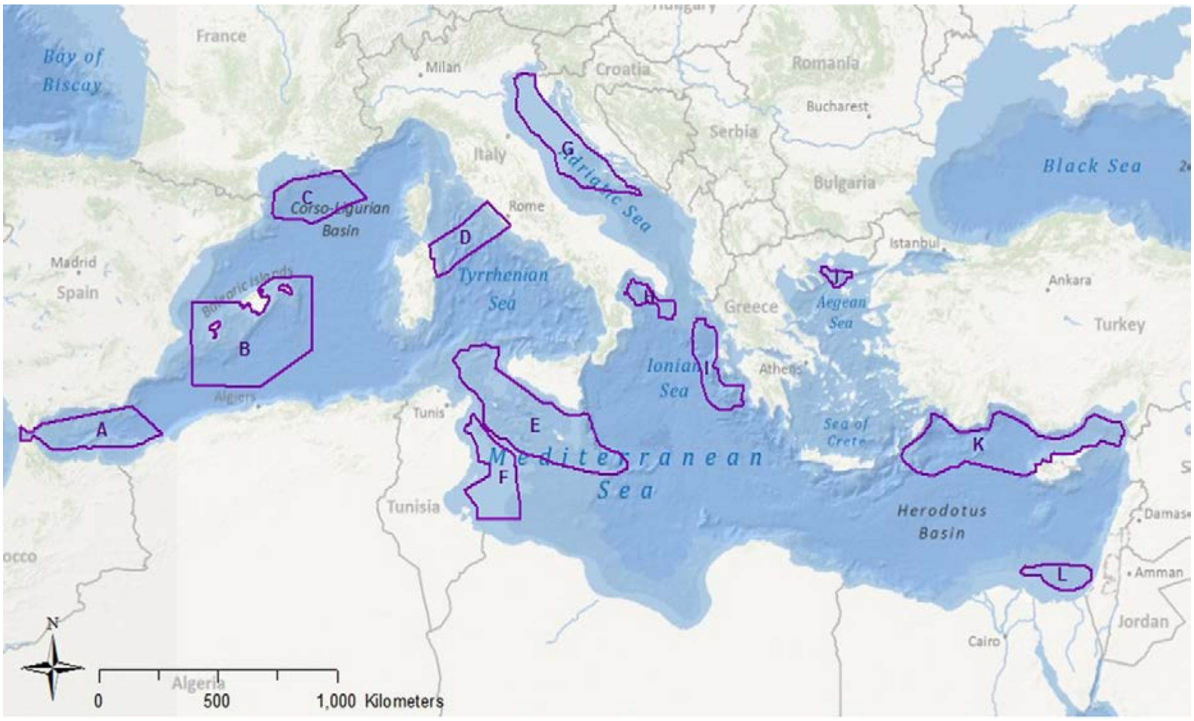

Figure 2 The 11 Priority conservation areas in the open seas, including the deep sea, containing sites that could be candidates for the SPAMI list (from Portman, 2013). A, Alborán Seamounts; B, Southern Balearic; C, Gulf of Lions shelf and slope; Central Tyrrhen

In order to overcome the lack of a proper ecologically representative network of MPAs especially in the water beyond national jurisdiction (i.e. beyond 12 nm) in the Mediterranean, the United Nations Environment Programme's Mediterranean Action Plan (UNEP/MAP) started a process in 2009 in cooperation with the European Commission. The effort consisted of a three-stage hierarchical planning approach that led to the identification of a set of large Ecologically or Biologically Significant marine Areas (EBSAs) distributed throughout the basin (Notabartolo di Sciara and Agardy, 2010). First the waters of the Mediterranean were ideally divided in 8 sub regions[6]. In a second stage, a group of expert oceanographers, marine biologists and ecologists identified EBSAs within each sub-region using the criteria provided by the Convention of Biological Diversity (CBD). A parallel process involved

[6] Mediterranean sub-regions as proposed in Notarbartolo di Sciara and Agardy (2010): Alborán Sea,Algero-Provencal Basin, Tyrrhenian Sea, Tunisian Plateau/ Gulf of Sidra, Adriatic Sea, Ionian Sea, Aegean Sea, Levantine Sea.

maximizing overlaying between thematic polygons (e.g. habitat for threatened species, feeding areas, nursery areas) for each subregion. The results, as shown in Figure 2, are 11 areas identified around the Mediterranean basin.
The third stage of the process, currently under implementation, aims to identify new SPAMIs within each identified EBSAs and the socio-economic, legal, administrative and political actions necessary for the formal establishment of the MPAs (Portman, 2013).

As described, SPAMIs, both within and beyond national jurisdictions, are regulated by the SPAMI/BD protocol. However, MPAs alone cannot cope with those impacts coming from outside its territory (Agardy et al., 2011). The management of protected areas requires a set of management and planning tools and approaches able to consider the interactions between the designed protected areas and the other activities and economic sectors that regard the surrounding marine and coastal areas.

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Therefore in order to guarantee that MPAs can meet the biodiversity conservation objects management and planning tools such as zoning, Marine Spatial Planning (MSP) and ICZM are needed. As suggested by the CBD Programme of Work for the protection of marine biodiversity, at national level, a network of MPAs should be composed by three levels of spatial planning for MPAs within a country (UNEP-WCMC, 2008):

- A core system of No Take Areas within a large MPA.
- A larger system of multiple-use MPAs, including fishery management areas.
- A national MPA system planned within a national integrated coastal management programme and overall management framework for the EEZ.

Marine Spatial Planning and Marine Protected Areas are therefore strictly related: this planning tool was indeed first applied to improve the management of MPAs: one of the best known example is the Great Barrier Reef Marine Park in Australia. Spatial planning and zoning in the protected area is needed to permit multiple human activities such fishery and tourism while ensuring an high protection of the area. Even in small marine protected areas, zoning is a fundamental tool to provide different ranges of protection in the areas.

At the same time MSP is necessary also as a framework wherein identify one or more MPAs in order to adopt ecosystem based criteria and to harmonize all the other uses of the sea by the other economic sectors. MSP is essential to guarantee ecological connectivity among MPAs especially at large scale. While ICZM is often applied considering both inner land and coastal seas (usually within the 12 nm), MSP is often applied within the national jurisdiction of the Exclusive Economic Zone (200 nm from coastline). As yet, the application of MSP in the high seas is still at an early stage (OSPAR areas beyond national jurisdiction set up in 2012 in the North-East Atlantic are the first example at global level).

Chapter 2 PEGASO toolbox in support of MSP in the Mediterranean

Santoro F., Nowell M.

2.1 The MSP process and the PEGASO toolbox

As previously expresses in this report important elements for success of MSP in the Mediterranean are:

- stakeholder involvement,
- a well-functioning institutional and legal framework,
- cross-border cooperation,
- the presence of strong data and knowledge base,
- coherence of MSP with terrestrial spatial planning and sound management and control of the seas

It appears evident that the approach, the outcomes, the tools and the methods developed in PEGASO can provide a useful support for the implementation of MSP in the Mediterranean.

The ICZM Platform, with its human component could provide the ideal space for stakeholder involvement and engagement, and with its technical component, the Spatial Data Infrastructure (SDI), the mechanism for sharing data and knowledge.

In the course of the work undertaken in the PEGASO project it was clear that the ICZM Protocol could provide the necessary legal basis not only for the promotion of a sustainable management of coastal areas but also of the land-sea interface. Being inspired by the ecosystem approach (EsA) the ICZM Protocol is promoting an integrated and coherent management of coastal and the marine spaces.

In its concrete implementation MSP needs data, products and tools. These for example include ways to assess:

- ecosystem functions, uses and services

- societal goals for specific areas
- implications of alternate ocean use scenarios
- the effects of environmental change

The following image shows the iterative process of MSP that learns and adapts over time. The development and implementation of MSP involves a number of steps, including:

Identifying need and establishing authority

1. Obtaining financial support
2. Organising the process through pre-planning
3. Organising stakeholder participation
4. Defining and analysing existing conditions
5. Defining and analysing future conditions
6. Preparing and approving the spatial management plan
7. Implementing and enforcing the spatial management plan
8. Monitoring and evaluating performance
9. Adapting the marine spatial management process

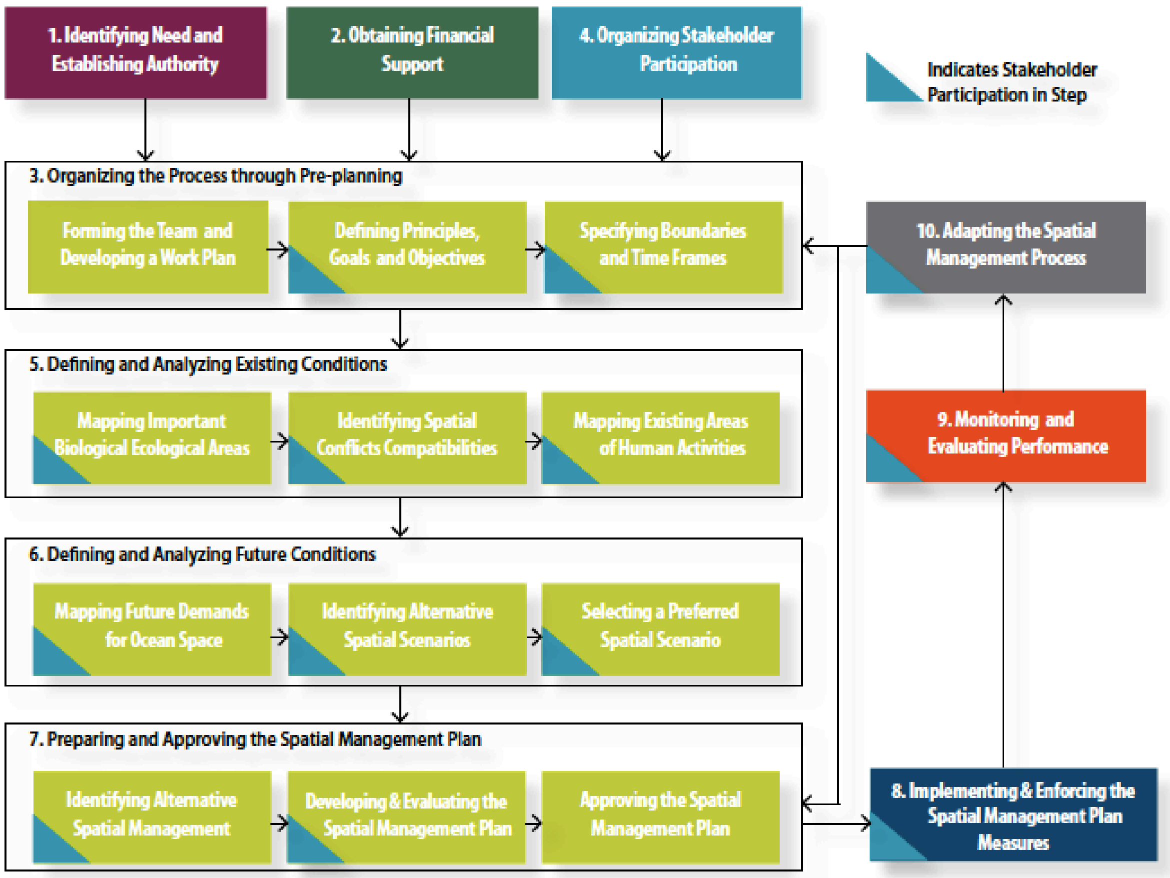

Figure 3 MSP a step-by-step approach (from Visions for a sea change, IOC-UNESCO 2007)

The PEGASO Integrated Assessment toolbox could provide support for the majority of the above mentioned phases.

Step 4: Organizing Stakeholder Participation and Step 3 Organizing the Process through Pre-planning: Public participation is an essential requirement for MSP and should be adopted throughout the process. Public participation is widely recognised as a necessary tool to ensure a s uccessful implementation of environmental policies: the Conference on Environment and Development (Earth Summit) in Rio de Janeiro in 1992, Principle 10 and

Agenda 21 both called for increased public participation in environmental decision-making and led to the adoption in Europe of the Aarhus Convention. Furthermore, participation has become a fundamental pillar of environmental processes as described in the Water Framework Directive (2000/60/EC), the 2002 EU Recommendation on ICZM (2002/413/EC), the 2008 Marine Strategy Framework Directive (2008/56/EC), and the Mediterranean Protocol on ICZM. Participation can be defined as a process where individuals, groups and organisations choose to take an active role in making decisions that affect them. In the context of the PEGASO project a number of participatory tools have been tested and applied in different contexts and at different scales showing the potential of the application of this approach to support stakeholder engagement and as a way to promote a two ways communication between scientists, practitioners and decision-makers. For more information on the participation tools developed and refined by PEGASO for the purpose of ICZM, refer to the PEGASO Coastal wiki information.

Step 5: Defying and analyzing existing conditions. As mentioned earlier in the case of MPS, and especially in the Mediterranean context, it will important to assess the existing conditions of marine areas, but also to assess the potential impacts of the human activities, and deriving pressures, in the coastal zones. To this particular end, the PEGASO tools of Land and Ecosystem Account (LEAC), and the Cumulative Impact Mapping (CIM) would be of particular interest. In particular LEAC assesses a range of policy-relevant ecosystem properties and functions, such as land cover, habitats and primary production. (For more details on the LEAC methodology and results of PEGASO LEAC for the Mediterranean and Black Sea regions, refer to the PEGASO Coastal Wiki).

In order to evaluate the cumulative and synergistic effect of the land-based and marine-based activities on the marine habitats the CIM could be applied. The changing states of ecosystems and related services are directly or indirectly linked to the pressures and impacts from human activities, which is want we want to manage in ICZM. An innovative approach applied by PEGASO was to map the cumulative impact of human activities on marine ecosystems. Cumulative impact mapping is created by overlaying individual threat maps and using vulnerability scores to estimate ecological impacts. Individual threat maps look at individual human activities that impact marine ecosystems by estimating the ecological consequences of these activities and by quantifying the vulnerability of different ecosystems to these activities. Based on a m ethodology designed by Halpern et al., the cumulative impact maps provide critical information on the sustainability of human activities. These can be put into practical use for evaluating where certain activities can continue with little effect on marine habitats, where other activities might need to be stopped or moved to less sensitive areas, and where to focus efforts on protecting remaining pristine areas. The application of seascape ecology could also be an important tool to be applied in this phase and will be presented through an example in the following paragraph.

Step 6: Defying and analyzing future conditions. Scenarios are "*sets of plausible stories, supported with data and simulations, about how the future might unfold from current conditions under alternative human choices*". Scenarios have become important management and policy-support tools. Broadly their purpose is to allow decision makers to think through the implications of different assumptions about the ways socio-ecological systems_might respond to different drivers of change. This is, of course a difficult task because in practice it is very hard to make predictions about the future for anything other than simple, well-behaved systems. Scenario thinking is therefore intended to help us cope with more complex situations involving a high degree of uncertainty. In the context of PEGASO Bayesian Belief Network (BBN) (Haines-Young, 2011; Haines-Younget al., 2014b) have been used to enable people to storyboard the way they think or believe systems are structured and pot entially onto model both qualitatively and q uantitatively how systems behave. A first step in constructing a BBN is to draw up an influence diagram, describing the causal relationships between the variables that people think make up the system. The influence diagrams can also be used to develop 'what if' scenarios by simulating the variation of the elements of the diagram itself to verify the consequences on t he elements of the diagram. BBN can be used as a powerful tool in the simulation of different scenarios of different uses of the marine space.

2.2 Case study: Seascape ecology as a decision-support tool for marine spatial planning

Marine spatial planning (MSP) is gaining popularity worldwide as a means of balancing the competing uses of coastal resources and their conservation. This framework allows for an ecosystem-based management of human activities by identifying the conflicts between the human uses and threats and ecosystem health and functioning (Collie et al. 2012). This spatially explicit approach to environmental planning is in the early stages of its application and the decision support tools (for example cost-benefit analysis, GIS-based mapping tools or expert surveys) for existing MSPs are inconsistent and varied. Improving decision-support tools requires quantitative information on the response of coastal ecosystems to human activities (Collie et al. 2012). The emerging field of seascape ecology has the potential to provide this information through the use of spatial pattern metrics.

The seascape ecology approach has been derived from the theoretical and analytical frameworks of landscape ecology. The application of landscape ecology concepts and techniques to the seascape have been explored for coastal environments, with particular success in shallow-water benthic ecosystems (Böstrom et al. 2011). This highly interdisciplinary approach allows for a better understanding of the multiscale relationships between spatial patterns and ecological processes (Böstrom et al. 2011; Wedding et al. 2011). Quantifying the spatial patterns of a seascape using spatial pattern metrics provides decision-makers with a consistent method for monitoring changes and comparing seascape structure across temporal and spatial scales (Wedding et al. 2011).

Spatial metrics are usually formulas or algorithms that are used to quantify: (a) the landscape/seascape composition (the abundance and diversity of habitats), (b) the spatial configuration (the spatial arrangement of habitat patches in the mosaic), and (c) the fractal dimension (patch shape complexity) (Wedding et al. 2011). These metrics reflect the seascape structure which can be linked to the ecological processes of the seascape. For example, Meynecke et al. (2008) were able to use spatial metrics to link geomorphic coastal features to nearshore fisheries production. Similarly, Pittman et al. (2007b) could predict fish assemblage attributes and density based on seascape structure. Linking ecosystem services (such as the support of fisheries, coastal protection or carbon sequestration) to seascape structure would provide socio-economic information on the consequences of seascape change.

Furthermore, the effects of human uses and threats to seascapes, and thus also the ecological processes and ecosystem services supported, can be identified using spatial pattern metrics and multivariate analysis techniques (e.g. Principal components analysis). This tool allows for a better understanding of the consequences of conflicting uses.

The following case study seeks to demonstrate the use of seascape ecology tools and techniques for assessing the consequences of human activities on ecosystem services. Study sites in Spain's Balearic Islands were chosen due to the presence of a mosaic of habitats representative of typical Mediterranean seascapes, the high conservation interest in the area and the availability of spatial data. The location of the study sites also made for an interesting comparative study between different intensities of human activities. Carbon sequestration by seagrass and Simpson's diversity index (as a proxy for biodiversity) were included as examples of how ecosystem services can be included in marine spatial planning using seascape ecology techniques.

The Balearic Islands case study

Study area

The Balearic Islands are located 175 km west of the Iberian Peninsula in the western Mediterranean Sea. Eight study sites were chosen (Figure 4) to represent different levels of disturbance, protection and seascape richness.

Agricultural runoff, shipping (container ships, ferries, and recreational vessels), commercial fishing, and tourism related pressures (coastal development, additional pressure on natural resources) constitute the main sources of disturbance (Box et al. 2007; Diedrich et al. 2010). While all of the 8 study sites are classified as Sites of Community Importance (SCI) under the European Union Habitats Directive, only two are IUCN category protected areas, namely the Cabrera Archipelago (IUCN category II) and Es Vedrà (IUCN category IV).

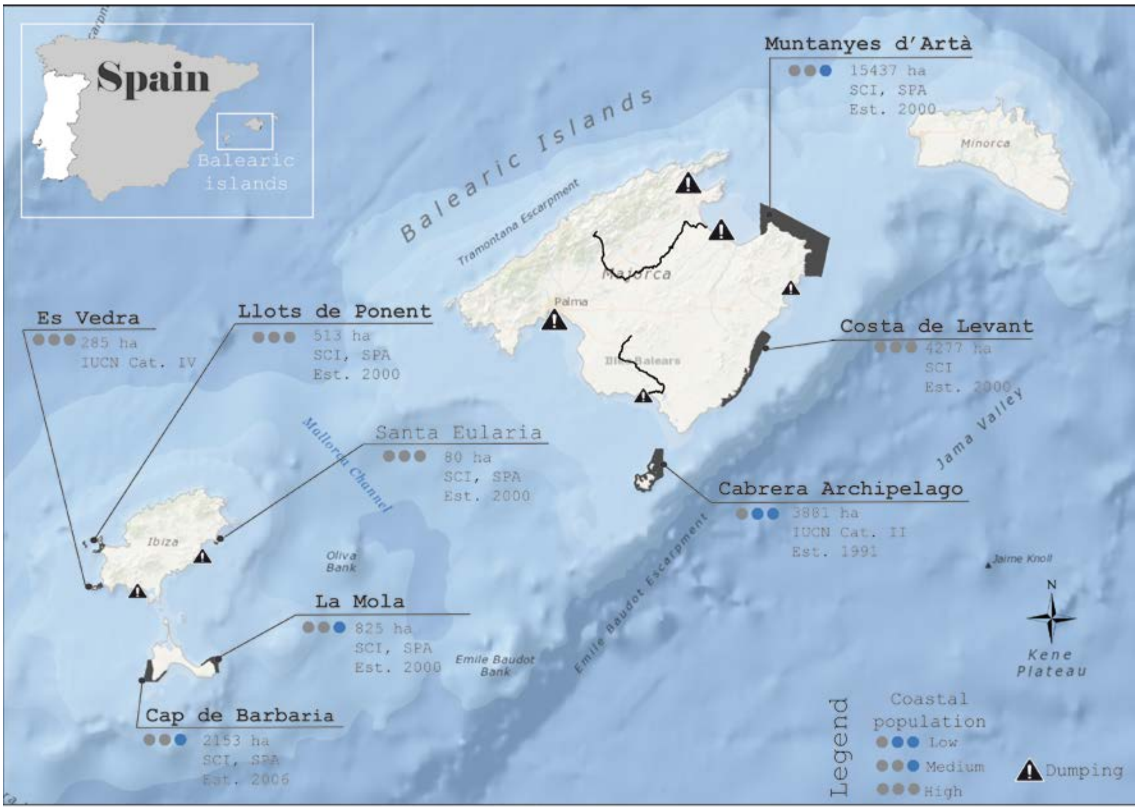

Figure 4 Eight study sites in the Balearic Islands were selected for this study.

Ecologically important areas

Two species of seagrass were present in the study area, namely *Posidonia oceanica* and *Cymodocea nodosa*. These seagrass meadows are highly productive ecosystems that support a variety of fauna and flora as well as acting as a nursery and breeding ground for marine organisms (Bostrom et al. 2006a). They also play an important role in coastal processes such as sediment deposition, attenuating currents and wave energy and stabilizing unconsolidated sediments (Gacia et al. 1999). *Posidonia oceanica* is endemic to the Mediterranean Sea and is considered a key species because of its extensive distribution in the littoral and the essential role this species plays in biological, biogeochemical and physical processes in the Mediterranean coastal areas (Fornes et al. 2006). Posidonia seagrass beds are highly sensitive to deterioration in water quality and pollution is recognized as the greatest threat to this species. *Cymodocea nodosa*, also known as little Neptune grass, is found in the shallow waters of the Mediterranean Sea favouring unstable sandy sediments. For this reason, erosion is a major threat.

Both species of seagrass are important sinks of carbon. Through the process of photosynthesis, seagrass plants combine CO_2, water and l ight to produce glucose for energy, releasing O_2 as a bi-product. As the glucose is metabolised, carbon molecules are absorbed by the plant and are stored in the leaves, roots and rhizomes. Carbon is also accumulated in seagrass meadows through particle trapping and sediment deposition. Accumulated carbon is stored in the soil under seagrass meadows and i n dense rhizome mattes that can remain intact for hundreds, if not thousands of years. As accumulated carbon is a relatively small quantity for the spatial and temporal scale of this study, only carbon captured through metabolism was quantified in this study. Figure 5 shows the distribution of seagrass in the study sites as well as the quantity of carbon sequestered by seagrass meadows.

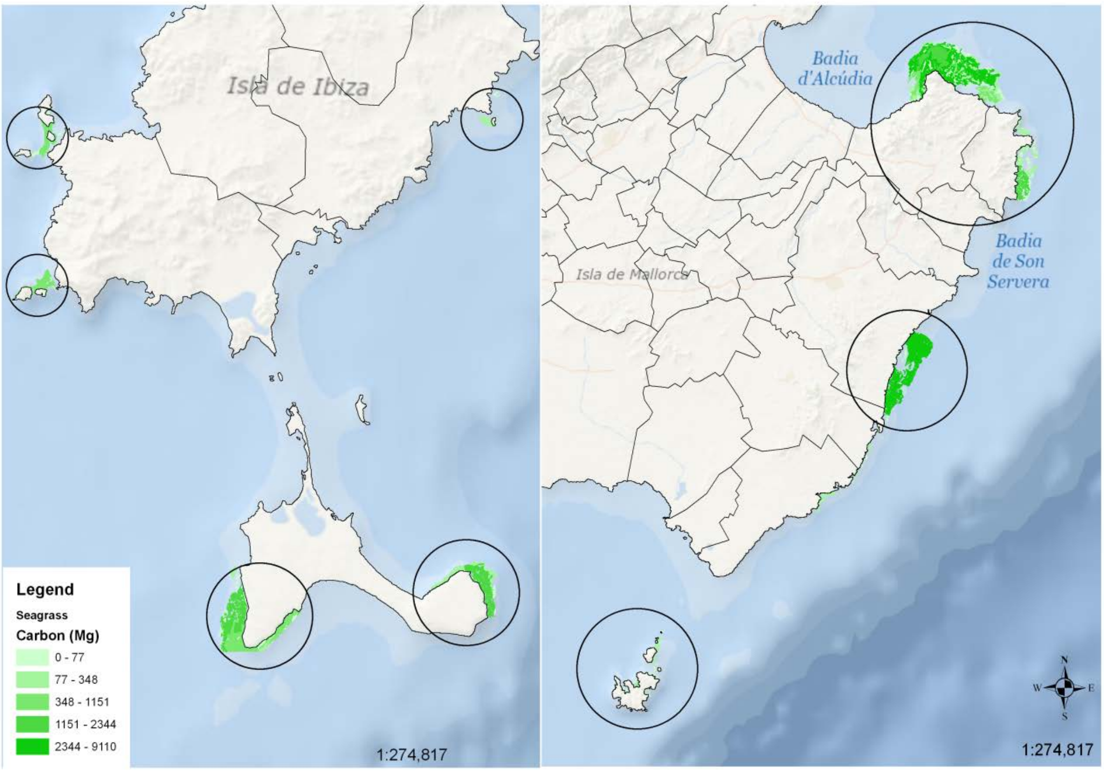

Figure 5 Carbon sequatration by seagrass was calculated in the eight study sites (circled).

Detailed seascape maps of the eight study sites were obtained from the Posidonia LIFE project (Posidonia LIFE, 2003). The benthic habitats were mapped by the project using a side-scan sonar technique for areas between 5 and 35 m deep and orthophotos for areas at depths between 0 and 5 m. The maps were produced at a scale of 1:1,000. The GIS cartography was downloaded from the Posidonia LIFE website (http://lifeposidonia.caib.es).

Seagrass meadows were extracted from the benthic habitat maps and spatial pattern metrics were calculated using the V-LATE v1.1 extension (Tiede 2005) in ArcMap v9.3 (ESRI). This extension is a vector-based landscape analysis tool that was used to calculate sixteen metrics that described seascape composition, edge, proximity, diversity, shape complexity and subdivision, which is a measure of fragmentation (Table 1).

Table 1 ***A total of 16 spatial pattern metrics were calculated using V-LATE software***

Abbreviation	Spatial pattern metric
NP	Number of patches
CA	Class area
ED	Edge density
MedPS	Median patch size
MPS	Mean patch size
PSSD	Stand deviation of patch size
TE	Total edge
MPE	Mean patch edge
PROP	Proportion
MSI	Mean shape index
MPAR	Mean perimeter:area ratio
MFRACT	Mean fractal dimension
DIV	Division
SPLIT	Splitting index
MESH	Mesh
MNN	Mean nearest neighbour

Current human activities

Spatial maps of the human activities in the study area included shipping traffic, underwater cables, the Human Influence Index (HII), coastal population, and the location of towns. The HII is based on nine global data layers that cover human land use and infrastructure, human population pressure and human access. Study sites were attributed the average HII score for the terrestrial area closest to the seascape and the coastal population number of municipalities adjacent to the site. The mean intensity of shipping was also assigned to each study site, as was the distance to the nearest town and underwater cable. The average distance of a patch to the shore was also included in the analysis.

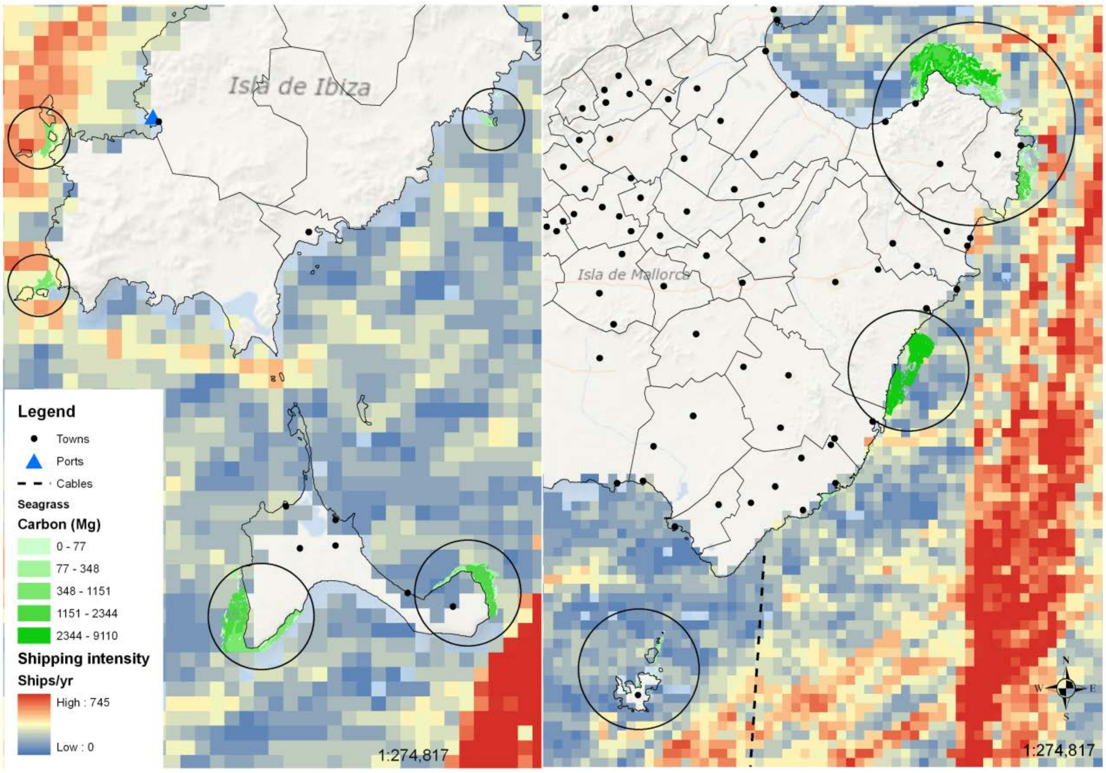

Figure 6 ***The human activities were mapped in relation to the seagrass meadows in the study sites.***

Influence of human activities on ecologically important areas

A Principal Components Analysis (PCA) was performed in order to extract any underlying, uncorrelated factors and to determine if, and which human activities were influencing the spatial structure of the seagrass meadows. Factors with an eigenvalue greater than 1 were extracted and the variables and cases plotted on the factor plane to explore the correlations with the PCA axes. The seascape metrics were projected as active variables with the human activities as supplementary variables. A nonparametric test of statistical dependence between the spatial metrics and human activities was also done using Spearman's rank correlation coefficient.

The results show that two factors account for 65% of the variance in the data. Factor 1 describes the composition and complexity of the seascape, while the configuration is described by factor 2. The distance to shore variable is strongly related to factor 2 indicating that seascapes nearer to the coast tend to consist of a greater number of small patches that are less complex in shape. The further the meadows are from shore, the more complex they are. While the distance to town, HII and population variables are significantly correlated to each other, they do not have a big influence on seascape structure. The distance to underwater cables has a moderate positive correlation with patch size and complexity meaning that patches increase in size and complexity further away from cables. Interestingly, shipping traffic had a negligible effect on seascape structure.

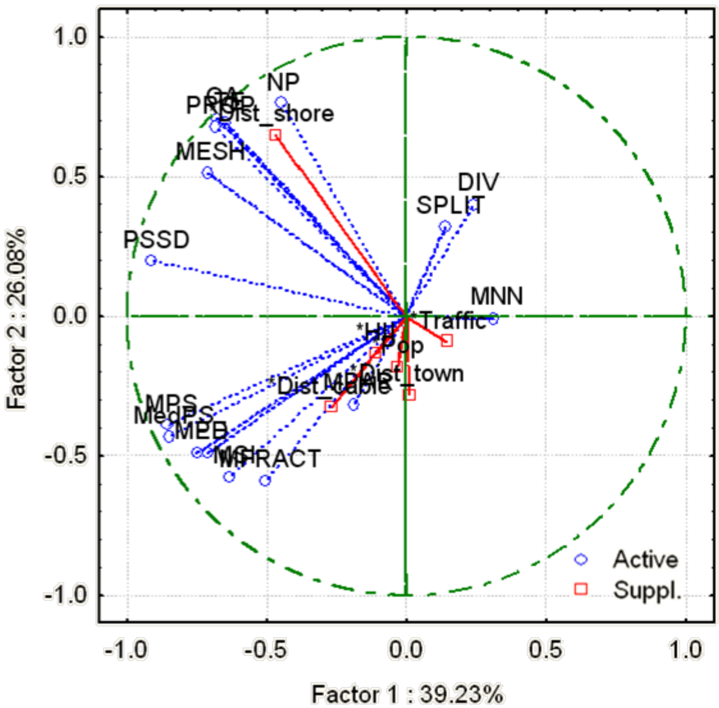

Figure 7 ***The factor loading plot illustrates the two factors that describe the relationship between seascape structure and human activities***

Influence of human activities on ecosystem service delivery

The effect of human activities on ec osystem service delivery was determined using the amount of carbon captured by seagrass and the heterogeneity of seascapes as a proxy for biodiversity.

Carbon sequestration differs between species of seagrass. Different carbon models were used to calculation carbon capture by *Posidonia oceanica* (C_{Po}) and *Cymodocea nodosa* (C_{Cn}). The C_{Po} model was based on the studies by Alcoverro et al. (2001) and Fourqurean et al. (2007) (Equation 1). Biomass derived from shoot density is used to estimate carbon capture by the leaves, rhizomes and roots on *Posidonia oceanica* meadows.

Equation 1: Carbon capture (Mg C_{Po}) by Posidonia oceanica meadows was calculated as the sum of the percentages of carbon contained in the leaf, rhizome and root biomass (g DW) for the patch area (m^2).

$$Mg\ C_{Po} = \frac{(biomass_x \times shoots\ m^{-2} \times area) \times (^{\%C_x}/_{100})}{10^6}$$

Table 2: The carbon captured by Posidonia oceanica *meadows was based on the percent carbon of the dry biomass calculate by Alcoverro et al. 2001 and *Fourqurean et al. 2007.*

	Biomass (g DW $shoot^{-1}$)	% C	Average g C m^{-2} for healthy meadows	Average g C m^{-2} for degraded meadows
Leaf*	0.57	37.8	135	101
Rhizome	0.79	38.4	190	142
Root	0.47	41.5	122	91

The C_{Cn} model was derived from the study by Perez et al. (1994) and estimates carbon captures based on the biomass of leaves, rhizomes and r oots of *Cymodocea nodosa* meadows (Equation 2). Degraded meadows were included in the analysis under the assumption that the density of the seagrass meadows was 75% of the healthy meadows.

Equation 2: The quantity of carbon sequestered by Cymodocea nodosa *was calculated as the sum of the percentages of C captured in the biomass of the leaves, rhizomes and roots for the area of the seagrass patch.*

$$Mg\ C_{Cn} = \frac{(biomass_x \times area) \times (^{\%C_x}/_{100})}{10^6}$$

Table 2 ***The carbon captured by* Cymodocea nodosa *meadows was calculated using the biomass and percent carbon values derived by Perez et al. 1994.***

	Biomass (g DW m^{-2})	% C	Average g C m^{-2} for healthy meadows	Average g C m^{-2} for degraded meadows
Leaf	319	34	108	81
Rhizome	263	42	110	83
Root	125	32	40	30

The heterogeneity of seascapes was used as a pr oxy for biodiversity. Heterogeneous seascapes provide a wider range of habitats for organisms and are therefore capable of supporting more biodiversity. Simpson's richness, diversity and evenness were calculated based on the number of different habitats present in each study site and their relative abundance. These variables were included in the data analysis to determine the impact of human activities on biodiversity.

Table 3 Simpson's richness, diversity and evenness were calculated for each study site as a proxy for biodiversity. The amount of carbon captured by seagrass is given.

Site	Richness (R)	Diversity (D)	Evenness (E)	Total carbon captured (Mg C)
Arta	17	4,40	0,26	25718,88
Barbaria	15	4,04	0,27	3733,66
Cabrera	24	5,03	0,21	1226,34
Eularia	6	1,60	0,27	279,19
Levant	9	2,86	0,32	9369,70
Mola	10	3,47	0,35	2058,76
Ponent	13	3,67	0,28	813,87

Vedra	9	2,67	0,30	694,00

A Principal Components Analysis (PCA) was used to identify any correlations between human activities and ecosystem service delivery. Factors with an eigenvalue greater than 1 were extracted and the variables and cases plotted on the factor plane to explore the correlations with the PCA axes. The human activities were projected as the active variables with the quantity of carbon sequestered by seagrass patches and Simpson's richness (R), diversity (D) and evenness (E) as the supplementary variables. A nonparametric test of statistical dependence between the human activities and ecosystem services was performed using Spearman's rank correlation coefficient.

The PCA showed that two factors account for 61% of the variance in the data. The first factor describes the human influence on the seascape (distance to town, HII, coastal population and shipping traffic). This factor has a strong negative influence on habitat richness (R) and diversity (D) indicating that human activities reduce biodiversity. Areas where the HII is highest are associated with greater habitat evenness. This means that highly impacted areas consist of fewer types of habitats and therefore have less potential to support biodiversity. Factor 2 describes the distance to shore and to underwater cables. Carbon sequestration is positively correlated to the distance to shore meaning carbon sequestration increases further away from the coastline.

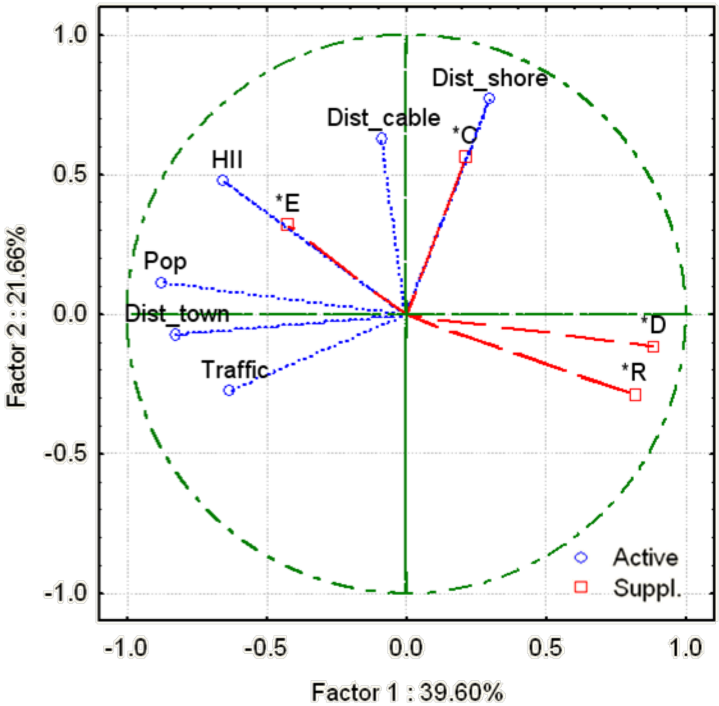

Figure 8 The factor loadings plot for the impact of human activities on ecosystem services shows a strong negative correlation between human presence and biodiversity.

	Dist_shore	Dist_town	HII	Dist_cable	Pop	Traffic	R	D	E
C	0,26	0,04	-0,04	0,23	-0,13	-0,30	-0,03	-0,02	0,20
Dist_shore		-0,05	0,19	0,33	-0,06	-0,18	0,18	0,21	-0,15
Dist_town			0,22	0,24	**0,51**	**0,65**	**-0,57**	**-0,59**	0,22
HII				0,02	**0,75**	0,20	**-0,59**	**-0,57**	0,30
Dist_cable					-0,05	0,09	-0,12	-0,15	0,34
Pop						0,33	**-0,88**	**-0,87**	**0,61**
Traffic							-0,34	-0,38	0,15
R								**1,00**	**-0,77**
D									**-0,76**

Table 4 ***A Spearman's rank correlation was performed to determine the relationship between human activities and ecosystem services (Carbon capture (C), Habitat richness (R), diversity (D) and evenness (E)). Highlighted coefficients are significant at p<0.05.***

2.2.1 Conclusion

Human pressure has resulted in an alarming loss of biodiversity that threatens the resilience of coastal ecosystems and their ability to deliver ecosystem services (Burkhard et al. 2010; Coll et al. 2010). MSP seeks to optimize ecosystem service delivery while balancing human needs. In this case study we demonstrated how seascape ecology techniques can be used to determine the effects of human activities on ecosystem services. This tool can be used to make better-informed decisions in MSPs. Information on w here to focus management decisions and the consequences of actions is essential for effective marine spatial planning.

The results of the multivariate analysis identified which human activities are influencing the seascape of the Balearic Islands and how. We recommend increasing the distance between ecologically important areas and human activities to increase ecosystem service delivery.

The techniques used in this case study can be applied to any seascape where digital benthic habitat maps and s patial data of human activities are available. Quantifying seascape structure is also a cost and time-effective means of baseline characterization and monitoring changes in seascape condition. Including seascape ecology techniques in marine spatial planning would allow for better management while providing an ecologically meaningful base for decision-making.

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