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Ecosystem-Based Management for Marine Protected Areas: A Systematic Approach

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Introduction

The recent and ambitious Integrated Maritime Policy (IMP) of the European Union comprises two major pillars: the Marine Strategy Framework Directive (MSFD, 2008/56/EC) and the Maritime Spatial Planning Directive (MSP, 2014/89/EU). Proposed by two different European General Directorates, these IMP regulatory tools aim to coordinate and establish coherent decision-making in order to maximize the sustainable development, economic growth and social cohesion of EU Member States in the marine domain. In addition, regarding biodiversity and nature, the European Commission has adopted an EU Biodiversity Strategy to 2020 (European Commission, 2011) to halt the loss of biodiversity and ecosystem services in the EU by 2020.

The strategy addresses the Aichi Biodiversity Targets adopted by the Convention on Biological Diversity (CBD, 2010), and thus biodiversity protection has become a prerequisite in Europe for sustainable development. The first EU 2020 Biodiversity Strategy target is to 'fully implement the Birds and Habitats Directives' (which corresponds to Aichi targets 1, 11 and 12). The extension of the Natura 2000 network to the offshore environment was particularly emphasized so as to assure the long-term survival of Europe's most valuable marine threatened species and habitats by conserving, 'through effectively and equitably managed, ecologically representative and well connected systems of protected areas and other effective area-based conservation measures', at least 10% of all marine European waters. All of these policy frameworks are based on the utilization of the Ecosystem Approach for their implementation.

The Ecosystem Approach (EA) strategic concept, which accepts that humans are part of the global ecosystem and not separate from it, has emerged as the dominant paradigm for managing coastal and marine ecosystems (Olsen *et al.*, 2009; Farmer *et al.*, 2012). At the heart of the EA is the assumption that coupled social and ecological systems can be studied and managed in a holistic manner. This approach offers new opportunities for sustainable use of the sea but requires better understanding of how marine social-ecological systems operate, how they generate goods and services, how well these benefits are captured, how human

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degradation of the systems affects human welfare and generates costs, and the complex social relations and value systems underpinning human governance of marine systems.

Despite the importance of the EA in a growing number of policy and guidance documents, the concept remains imprecise and this makes the EA appear nebulous, rendering it difficult to put into practice. Because of these difficulties, it has been noted that management applications of EA through Ecosystem-Based Management (EBM) frameworks are wholly dependent on the aspirational visions for the social-ecological systems that deserve to be managed, and that EA and/or EBM are not goals in themselves. Appropriate tools inside effective governance systems are required in order to guide EA implementation; for this to happen, the theory of ecosystem science must be reconciled with the practice of ecosystem management (deReynier *et al.*, 2010). In order for the EA to be more widely adopted in management, we have developed a standardized, stepwise process for management: the Ecosystem-Based Management System (EBMS) (Sardá *et al.*, 2014). The EBMS introduces a common set of tools and procedures and a common language that can facilitate knowledge transfer and capacity building for managers putting the EA into practice.

The conservation of ecosystem structure and functioning to maintain ecosystem services is a priority target of the EA. Genetic diversity is widely endangered and conservation measures need to be introduced rapidly to halt the loss of biodiversity. In the marine environment, we have launched some measures to prevent environmental degradation such as the MSFD that requires all EU marine waters to achieve Good Environmental Status by 2020 (Braun, this volume), and the construction of a large network of Marine Protected Areas (MPAs). An MPA is defined as 'any area or sub-tidal terrain, together with its overlying water and associated flora, fauna, historical and cultural features, which has been reserved by law or other effective means to protect part or all of the enclosed environment (IUCN, 1994). Despite recent large-scale efforts to protect marine waters, especially relatively unaltered pristine places (e.g. around the UK Dependent Territories of Pitcairn Island Marine Reserve – 834 334 km^2; Chagos Marine Protected Area in the Indian Ocean – 640 000 km^2; and Ascension Island Marine Reserve in the South Atlantic – 234 291 km^2; as well as the Marine Reserve of Nazca-Desventuradas Islands in Chile – 297 518 km^2; and the Palau National Marine Sanctuary – 500 000 km^2), the total area of marine protected space is not very large.

Scientists have proposed that at least 20% of the entire ocean space should be protected ('Troubled Waters: A Call for Action' statement – https://marine-conservation.org/marine-reserve-statement/) but only 10% is reflected in official documents such as the Aichi targets. In the Mediterranean, one of the major global marine and coastal biodiversity hotspots (Coll *et al.*, 2010), the Contracting Parties to the Barcelona Convention, through the Protocol Concerning Specially Protected Areas and Biological Diversity in the Mediterranean (SPA/BD Protocol), have established a list of Specially Protected Areas of Mediterranean Importance (SPAMI) in order to promote cooperation in the management and conservation of natural areas, as well as in the protection of threatened species and their habitats (Webster, this volume). Despite this initiative, the entire area of Mediterranean MPAs is not large: they are mostly small and, apart from the Pelagos Marine Mammal Sanctuary (87 500 km^2; http://www.sanctuaire-pelagos.org/), they total around 30 000 km^2, which is clearly not adequate (Gabrié *et al.*, 2012).

Effective marine biodiversity conservation is dependent on a clear scientific rationale for practical interventions (Hiscock, 2014) but also depends on appropriate management. Placing MPAs onto EBM frameworks is urgently needed; they are not two distinct strategies that can substitute each other as has sometimes been said (Halpern *et al.*, 2010), but rather EBM is a way to put MPA targets into practice. This chapter explains the advantages of using an EA strategy for the management of MPAs and describes the need to standardize planning methods and stakeholder engagement (especially if networks are to be built), as well as the importance of incorporating risk assessment for evaluating proposed management activities. Finally, we propose using the EBMS for the management of MPAs since using a standard management tool that allows nested applications improves the protection of the marine environment. We refer to some well-established MPA networks and particular MPA sites as examples of potential EBMS application.

Marine Protected Areas and Networks

For conservation purposes, a key strategy to address many issues affecting marine and coastal ecosystems and resources is the establishment of MPAs and linking them in global network systems. Marine Protected Areas typically support a single societal value – nature conservation – having clear targeted visions (Halpern *et al.*, 2010). Numerous publications have dealt with the design and implementation of MPA networks. In particular, Laffoley (2014) stated five biophysical and ecological principles to guide such efforts: (i) include the full range of biodiversity present in the biogeographic region; (ii) ensure that ecologically significant areas are incorporated; (iii) maintain long-term protection; (iv) ensure ecological linkages; and (v) ensure maximum contributions of individual MPAs to the network. The construction of MPA networks should follow strategic decisions that set objectives for marine conservation as a whole (long-term objectives) and also the formulation of network policies and principles intended to govern those objectives, which may cover more than nature conservation alone (Beal *et al.*, this volume). To examine these issues in practice, two established MPA networks, and one of their component sites, are briefly discussed below.

Network of Marine Protected Area Managers in the Mediterranean (MedPAN)

The Mediterranean Sea is considered to be one of the world's priority ecoregions (UNEP-MAP RAC/SPA, 2010). The objective of MedPAN is to facilitate exchanges between Mediterranean MPAs in order to improve their management (Webster, this volume). Created in 1991, the MedPAN network acts to build the capacity of MPA managers around the Mediterranean basin through the exchange of best practice and the development of tools for the management of MPAs. MedPAN also contributes to the establishment of a representative and coherent ecological network of MPAs, which is a step beyond the more traditional approach of designing MPAs as single independent entities (http://www.aires-marines.com/International/Exchange-Networks/Medpan). MedPAN, in collaboration with the Regional Activity Centre for Specially Protected Areas (RAC/SPA) of the United Nations Environment Programme/Mediterranean Action Plan (UNEP-MAP), has recently reviewed the status of MPAs in the Mediterranean (Gabrié *et al.*, 2012) and made important recommendations for further work (Table 8.1). One of the points highlighted in the report was the low level of

Table 8.1 Main conclusions and recommendations concerning the status of MPAs in the Mediterranean Sea.

Main conclusions

1) Information on Mediterranean MPAs is more accurate than that for other areas. Details have been recorded in the MAPAMED database.
2) The target of 10% protection is far from being achieved.
3) There is still a disproportionate geographical distribution and MPAs are still mainly on the coast.
4) Representativity of ecological sub-regions, habitats and species is very variable.
5) The adequacy and viability of sites is very variable.
6) The ecological coherence is better in the western basin but still low on a Mediterranean scale.
7) MPA management is still insufficient.

Recommendations

1) Reinforce the development of the MPA network in order to achieve the target of 10% of Mediterranean surface area being protected.
2) Reinforce the effectiveness of protection management and evaluation measures in MPAs.
3) Reinforce the resources and tools to ensure evaluation of management effectiveness.
4) Promote the development of evaluation tools on a regional level.
5) Ensure a better management of threats to MPAs.
6) Enhance the international recognition of Mediterranean MPAs.

Source: Adapted from Gabrié *et al.* (2012).

management effectiveness and a lack of application of the EA in management, with a general recommendation that management tools should be better implemented.

Gabrié *et al.* (2012) identified 677 MPAs in the complex environment of the Mediterranean. From the answers of 80 respondents to a questionnaire, 42% had management structures and 84% had permanent staff. Application of a standard management tool could facilitate coordination and harmonization of conservation practices and clearly would facilitate dialogue. It could also work within a nested application, covering regional- and national-level networks as well as single MPAs. Below we consider the 'Cap de Creus' MPA, as an example.

The 'Cap de Creus' MPA

In the north-western part of the Mediterranean, the 'Cap de Creus' region exhibits environmental, social, economic and geographical characteristics that make it unique in the Mediterranean. It includes a large portion of the marine area located off Alt Empordà county (Girona, Spain) protected by two contiguous Sites of Community Importance (SCI) designated under the EU Habitats Directive. The 'Cap de Creus' SCI, which is also a maritime-terrestrial Natural Park (the first one established in Catalonia, in 1998), has an area of 13 844 ha of which 22% is marine. In 2014, the offshore marine waters around the platform and submarine canyons of the region were also proposed by the Spanish government as an SCI denoted 'Sistema de cañones submarinos occidentales del Golfo de León'. This SCI covers an area of 98 772 ha. Together, the two SCIs form one of the largest protected spaces in the Mediterranean Sea and will be referred to as the 'Cap de Creus' area from here on, although they are managed by different national and regional governance structures.

The 'Cap de Creus' area is located at the border between France and Spain where French authorities had already established different protected areas under their national regulations ('Parcs Naturels Marins') and Natura 2000 (Figure 8.1). Consequently it has unique characteristics as an area located in a transboundary region. Moreover, the 'Parc Naturel Marin du Golfe du Lion' goes beyond the median line which separates the French and Spanish territorial waters, which creates an added difficulty concerning the overlap of conservation schemes, planning and management. As a result, this example provides an extremely interesting case for further study and application of the EBM framework.

North-East Asian Marine Protected Areas Network (NEAMPAN)

The United Nations North-East Asian Subregional Programme for Environmental Cooperation (NEASPEC) launched its NEAMPAN project in 2012. It includes five countries: China, Democratic People's Republic of Korea, Republic of Korea, Japan and the Russian Federation. The project aims to establish an effective, functional and representative network of MPAs in the subregion for better conservation of marine and coastal biodiversity and more efficient MPA management. The network focuses on (i) protection of key marine animals and their habitats, (ii) sustainable use of marine resources, and (iii) effective MPA management. NEAMPAN holds regular network meetings, and expects to conduct in-depth research, provide training courses for capacity building, and network with relevant regional and global mechanisms. Nevertheless, a recent assessment of its operations identified some severe limitations for the process, including use of different terminologies, inconsistency in MPA identification, deficiencies in national-level MPA networks, different institutional settings for management, and low level of international cooperation (http://www.neaspec.org/our-work/marine-protected-areas-mpa-north-east-asia). As observed earlier in the MedPAN network, management effectiveness is still far from being achieved, although some success in the region may pave the way for improvements; such is the case of the Suncheon Bay Wetland Protected Area.

Suncheon Bay Wetland Protected Area

The Suncheon Bay (3550 ha) and Muan Tidal Flats (3559 ha) protected areas in the Republic of Korea are recognized as wetlands of international importance under the Ramsar Convention, making them one of the most spectacular places in South Korea. Both sites support a range of threatened migratory birds and are also important for harvesting fish, seaweed and molluscs using traditional techniques. They have been incorporated into the NEAMPAN network and are subject to a large-scale master plan for Suncheon Bay Landscape Conservation. A set of policies have been implemented in the area, starting with setting up a Committee for Suncheon Bay Nature and Ecology that promotes networking activities between civil society groups, government bodies and specialists in the conservation of Suncheon Bay. The mid- to long-term master plan comprises: (i) roadmap of stages to enhance new values of the bay; (ii) analysis of ecological health and change of mudflats and reedbeds; (iii) development of community-based ecotourism and community well-being; (iv) adoption of nature protection priorities; (v) restoration of the mudflats ecosystem; and (vi) enlargement of business and civil society initiatives within the nature protection priorities. A clear governance system, coupled with the establishment of a Suncheon Bay Conservation Fund, makes this MPA a good place to implement an EBM framework approach.

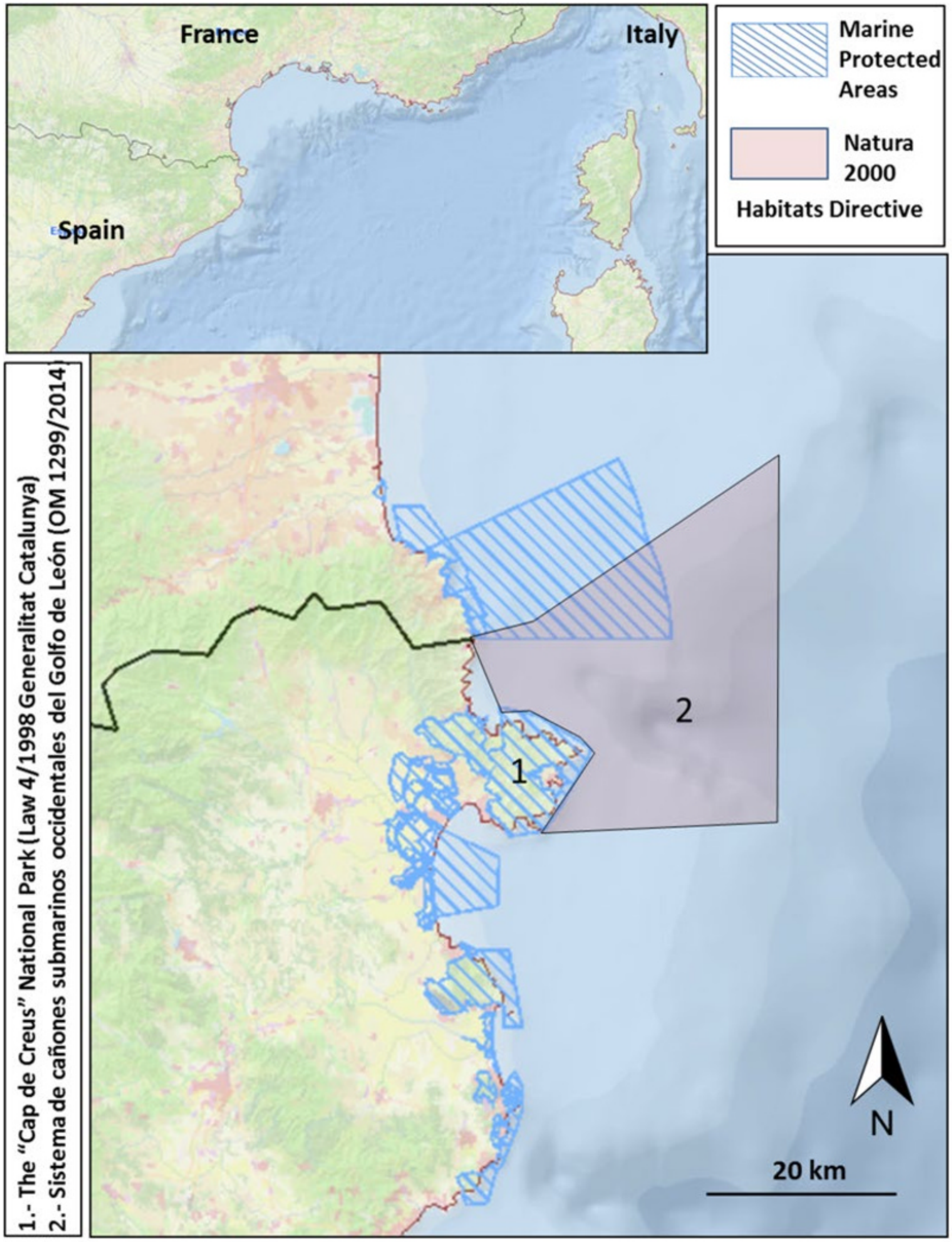

Figure 8.1 The MPAs of the 'Cap de Creus' region. (1) The 'Cap de Creus' SCI, a maritime-terrestrial Natural Park. (2) The 'Sistema de cañones submarinos occidentales del Golfo de León' SCI, an offshore Natura 2000 area.

The Use of Ecosystem-Based Management for MPAs and Networks

Once MPA sites and networks are planned, designed and implemented, and spatially bounded regions containing a particular ecosystem and social system interacting with each other are delimited, then appropriate management tools should follow. Management can be defined as the function that coordinates the efforts of people to accomplish goals and objectives by using the available resources efficiently and effectively. Applying EBM as a framework for managing MPAs and networks is desirable in order to fully incorporate MPAs and networks within a clear EA strategy (Sardá *et al.*, 2014). Essentially, EBM requires consideration of whole ecosystems at a scale that ensures that ecosystem integrity is maintained. It recognizes the complex interactions between species that make up marine ecosystems, and so is underpinned by principles of community biology and ecology. Ecosystem-based management also brings together the human, biological and physical parts of the system for which management action is needed. It adopts a new model of integrated management that addresses the Malawi principles of the EA (CBD, 1998).

In order to use an EBM framework under the EA strategy for MPAs, the Malawi principles need to be translated into management actions. Several aspects that relate EA principles with clear management actions can then be considered:

- Setting the scene of management (principle 6)
- Using a systems approach to management – enhancing participation, achieving a common view on societal choices (principle 1)
- Implementing adaptive management – targeted long-term visions with operational short ones (principle 8)
- Recognizing the importance of the ecosystem structure and function (principle 5)
- Working with decision-making procedures in a decentralized way (principles 2 and 4)
- Developing an environmental accounting framework (principles 3 and 11)
- Taking account of all scaling effects (principles 7 and 9)
- Considering humans as part of the global ecosystem – but having a clear site/network vision and involving all sectors of society (principles 10 and 12).

Setting the Scene of Management

The first task is to determine the area under management. In the case of MPAs this task is normally simple because the boundaries of the area, the social-ecological area to be managed, are precisely defined. After delimitation, management of the area should be based on measures derived from an initial assessment (departure stage) and a desired final vision (desired stage). The desired vision will establish the goals and timescales for environmental performance against which the effectiveness of the management system can be judged.

In formulating the desired vision, joint fact-finding is important in order to develop shared knowledge about the site and reach the best vision while avoiding conflicts. It is a way to guide the process of gathering information, analyse facts, and make informed decisions collectively. An absence of joint activities is very likely to lead to conflicts sooner or later.

Using a Systems Approach to Management

A systems approach to project management enables MPA managers to continuously evaluate the needs of the area; the end results to be achieved in line with the final vision for the MPA; and the needs in terms of resources, budget and time. In order to quantify the desired vision for the MPA, it is recommended to work with something similar to the 'Good Environmental Status' (GES) concept described in the MSFD. We strongly believe this strategic GES concept can be applied worldwide, although obviously, in the case of EU Member States, the descriptor and indicators used in the MPA application will be much stricter. Good Environmental Status should be established individually for every MPA, defined as 'the vision status of the MPA where these provide an ecologically diverse and dynamic environment which is clean, healthy and productive in accordance with its conservation status'. Then, depending on the MPA selected, possible uses made of its marine resources should take place at a sustainable level, ensuring their continuity for future generations, and an evaluation of pressures should be carried out. Figure 8.2 shows a schematic diagram of the GES descriptors set out in the MSFD; for these 11 descriptors, desired state indicators should be

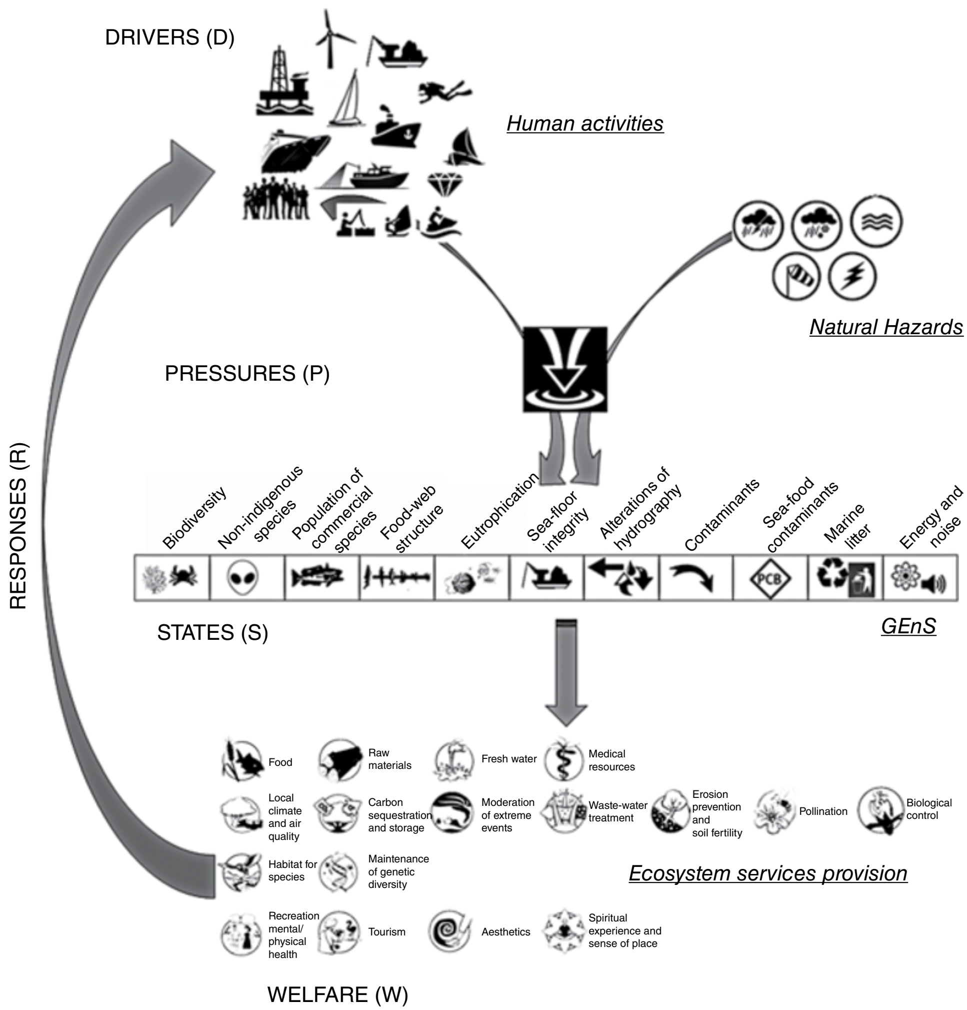

Figure 8.2 A DPSWR representation of the platform of indicators for the EBMS information pillar. Ecosystem service provision icons obtained from The Economics of Ecosystems and Biodiversity (TEEB).

selected in order to evaluate management effectiveness through time depending on the MPA concerned (governance structure, budget, pressures). Figure 8.2 also indicates how these state indicators can be linked with other indicators of the Drivers–Pressures–State–Welfare–Response (DPSWR) social-ecological accounting framework that can be used for aspects related to information (Cooper, 2013; Ojea *et al.*, this volume).

An initial assessment report should be drafted to develop a common understanding of the system under management. It should collate and synthesize all the relevant information (ecosystem overview, socio-economic pressure factors and related stakeholders to be considered in the management guidance) as well as an assessment of the ecosystem services provided by the area since this is an intrinsic part of an EA strategy. This report constitutes an ecosystem overview, the baseline 'status quo' of the MPA.

Implementing Adaptive Management

Having prepared and considered the above-mentioned policy elements (the definition of the present state of the MPA social-ecological system, its 'status quo' or ecosystem overview, and formulation of a desired vision in terms of GES with its provision of ecosystem services), the issue of using adaptive management as a tool both to change and to learn about a system comes to play a key role.

Adaptive management is a structured, iterative process of robust decision-making in the face of uncertainty, which aims to reduce uncertainty over time via system monitoring. Adaptive management offers a practical means of integrating knowledge over social and economic as well as ecological scales. It can accommodate unexpected events by encouraging approaches that build system resilience and is becoming accepted as a valuable tool for delivering the EA. Adaptive management encourages managers to adopt policy cycles for a limited period, closely observing the outcomes of interventions through carefully focused monitoring. At the end of an initial learning period, the model can be further refined and new management objectives set.

Advocating the Use of the Ecosystem Services Vocabulary

One of the basic principles of the EA strategy is the conservation of ecosystem structure and functioning to maintain ecosystem services. Sustaining the long-term capacity of marine ecosystems, and in this case MPAs, to deliver a range of ecosystem services with a focus on both ecosystem health and human well-being is a key part of the management required. This necessitates the identification of how GES generates goods and services based on the MPA vision; how well these benefits are captured; how human activities and natural hazards may affect MPAs and generate costs; and the complex social relations and value systems underpinning human governance.

Although MPAs have the ultimate goal of biodiversity conservation, as Potts *et al.* (2014) have shown, MPAs can also provide direct or indirect benefits for society through the delivery of different ecosystem services. In this context, the mapping of ecosystem services is increasingly recognized as a valuable tool in the management of MPAs and building stakeholder appreciation of such services, and so taking them into account in collaborative approaches (Cárcamo *et al.*, 2014). The concept of ecosystem services is crucial when social and ecological issues need to be managed in a holistic way.

Working with Decision-making Procedures in a Decentralized Way

The inclusion of a risk management standard follows modern management best practice for environmental decision-making.

During recent years the inclusion of these risk management tools into decision-making applications when managing the marine environment has been advocated (MacDiarmid, 1997; Cormier *et al.*, 2013, 2015). In the case of MPAs, the aim is to assess the significant risks that could impede achievement and/or maintenance of GES. These risks basically fall into two main groups: (i) those derived from external pressures and/or events that can separate future and/or present environmental states from the desired ones; and (ii) those related to an evaluation of the capacity of the region and the human activities involved to provide the ecosystem services required by the MPA. Historically, decision-making at this level had been largely sectoral and more judgemental than analytical. Correct selection of the key social-ecological aspects and planning evaluation will increasingly favour programmes intended to reduce negative effects while moving towards GES.

A prioritization tool intended to help MPA managers determine which projects and/or activities should be carried out before others, based on a social trade-off analysis and the established MPA vision (GES), has been described in detail in Sardá *et al.* (2010). The tool works in three sequential stages: (i) the identification procedure, including the identification of the main components of the system and the risk identification process; (ii) the assessment phase, which is the initial prioritization procedure; and (iii) the final decision about priority objectives and targets for the implementation phase.

Developing an Environmental Accounting Framework

A prerequisite for correct environmental management is the comprehensive compilation and analysis of environmental information. This information must be combined with user-friendly tools to facilitate the decision-making process. Traditionally in MPAs, information about the area is linked to monitoring programmes in the context of marine reserves, and observational research that documents variability in natural systems by comparing them with manipulated systems over time. However, other types of information are also needed depending on the management policy cycle and indicators selected.

For example, the information system could employ indicators within the DPSWR social-ecological accounting framework (Figure 8.2). Since conservation of the ecosystem structure and functioning to maintain ecosystem services is the priority target of the EA (see Table 8.2), and the EBMS is based on an EA strategy, description of the ecosystem services desired in the visioning phase is a key point in the indicator analysis. Welfare indicators will be associated with the provision of these ecosystem services. Then, the provision of these ecosystem services will be related to state indicators raised using the GES framework. The vulnerability of services will be expressed as human activities and natural hazards (pressure indicators) that can potentially harm ecosystem state components and ultimately modify their provision of services. The relationship between these indicators is shown in Figure 8.2.

Considering Humans as Part of Global Ecosystems

The participation of society is an essential element of the EA. Normally, MPAs are established through consultation processes: national planning forums, expert panels and so on come up with a list of potential areas for protection that will require governmental approval. Scientific and preparatory work is needed to persuade governments to conserve and restore the richness of marine life and habitat. Once the MPA has been designated, an effective governance structure is

Table 8.2 Relationship between the Ecosystem Approach principles developed by the Convention on Biological Diversity[a)] and their application to MPA management frameworks.

CBD Ecosystem Approach principles	MPA management needs
1) The objectives of management of land, water and living resources are a matter of societal choices	• Use participatory planning: appropriate management schemes should ensure adequate and timely participation in a transparent decision-making process by local populations • Adopt a holistic methodology from a geographic perspective: MPAs cannot be isolated from one another and the regional network should be designed with societal approval
2) Management should be decentralized to the lowest appropriate level	• Develop an effective governance structure to guide MPA management implementation
3) Ecosystem managers should consider the effects (actual or potential) of their activities on adjacent and other ecosystems	• Elucidate the social-ecological dynamics and functioning of the MPA • Integrate all elements relating to the hydrological, geomorphological, climatic, ecological, socio-economic and cultural systems into the prevailing conservation view
4) Recognizing potential gains from management, there is usually a need to understand and manage the ecosystem in an economic context	• Accommodate and prioritize ecosystem services given by MPAs, but also consider the multiplicity of social-ecological activities/events that can be observed in these areas
5) Conservation of ecosystem structure and functioning, to maintain ecosystem services, should be a priority target of the Ecosystem Approach	• The concept of ecosystem services should be central in the management of MPAs
6) Ecosystems must be managed within the limits of their functioning	• MPA management should support natural processes and adopt a long-term perspective • Damage to the MPA should be strongly resisted and, where it occurs, appropriate restoration measure should be taken rapidly
7) The Ecosystem Approach should be undertaken at the appropriate spatial and temporal scales	• MPA management frameworks should be designed in a network context; the use of nested management structures is highly recommended to address this need
8) Recognizing the varying temporal scales and lag-effects that characterize ecosystem processes, objectives for ecosystem management should be set for the long term	• MPA management should be part of a vision-driven process • The ultimate aim is to align this management with obtaining a conservation goal for the MPA that promotes sustainable development in its surrounding area
9) Management must recognize that change is inevitable	• Adaptive management should be incorporated in the planning process to recognize change through a dedicated monitoring programme

(*Continued*)

Table 8.2 (Continued)

CBD Ecosystem Approach principles	MPA management needs
10) The Ecosystem Approach should seek the appropriate balance between, and integration of, conservation and use of biological diversity	• In the case of MPAs this is an intrinsic part of the conservation goal
11) The Ecosystem Approach should consider all forms of relevant information, including scientific and indigenous and local knowledge, innovations and practices	• An information system should be developed to harness results from monitoring and assist decision-making in the management process
12) The Ecosystem Approach should involve all relevant sectors of society and scientific disciplines	• Institutional coordination of the various administrative services and regional and local authorities competent in the coastal and/or marine zone should be required • An appropriate and effective governance structure is needed, from the site level through to established MPA networks

a) https://www.cbd.int/ecosystem/principles.shtml

needed in order to develop and implement management measures, together with identification of the main actors around the MPA that can pressure and/or work with it. In addition, the EA requires the adoption of a holistic attitude from a geographic perspective because the MPA (or MPA network) under management cannot be isolated from its surroundings. The governance structure must promote significant cooperation amongst government bodies, civil society and private interests in the pursuit of collective action. Clearly, a participatory policy can facilitate this work in order to overcome possible operational and financial barriers for management.

A Systematic Approach for Using the EBMS in MPA Management

The EBMS was developed by Sardá *et al.* (2014; http://www.msfd.eu) to integrate EA into management functions. It employs a standardized process for applying EA principles by ensuring the inclusion of essential components such as participation, planning and decision-making, and by promoting accountability and quality assurance. The EBMS seeks to achieve vision-based management objectives that follow sustainable development principles based on the provision of ecosystem services (CBD, 1998; Balvanera *et al.*, 2001; Cognetti and Maltagliati, 2010). The introduction of the EBMS into MPA management can (i) enhance management effectiveness as recommended by Gabrié *et al.* (2012), and (ii) address the need to include the principles of the EA into MPA management practice (see Table 8.2).

The EBMS has a three-pillar structure that facilitates the incorporation of the EA into the management of coastal and marine zones, regardless of the ecosystem or administrative scales (Figure 8.3). The general points to be emphasized are:

- The EBMS follows a vision-driven process: a societal vision needs to be developed prior to the use of the framework, in this case a clear conservation vision.

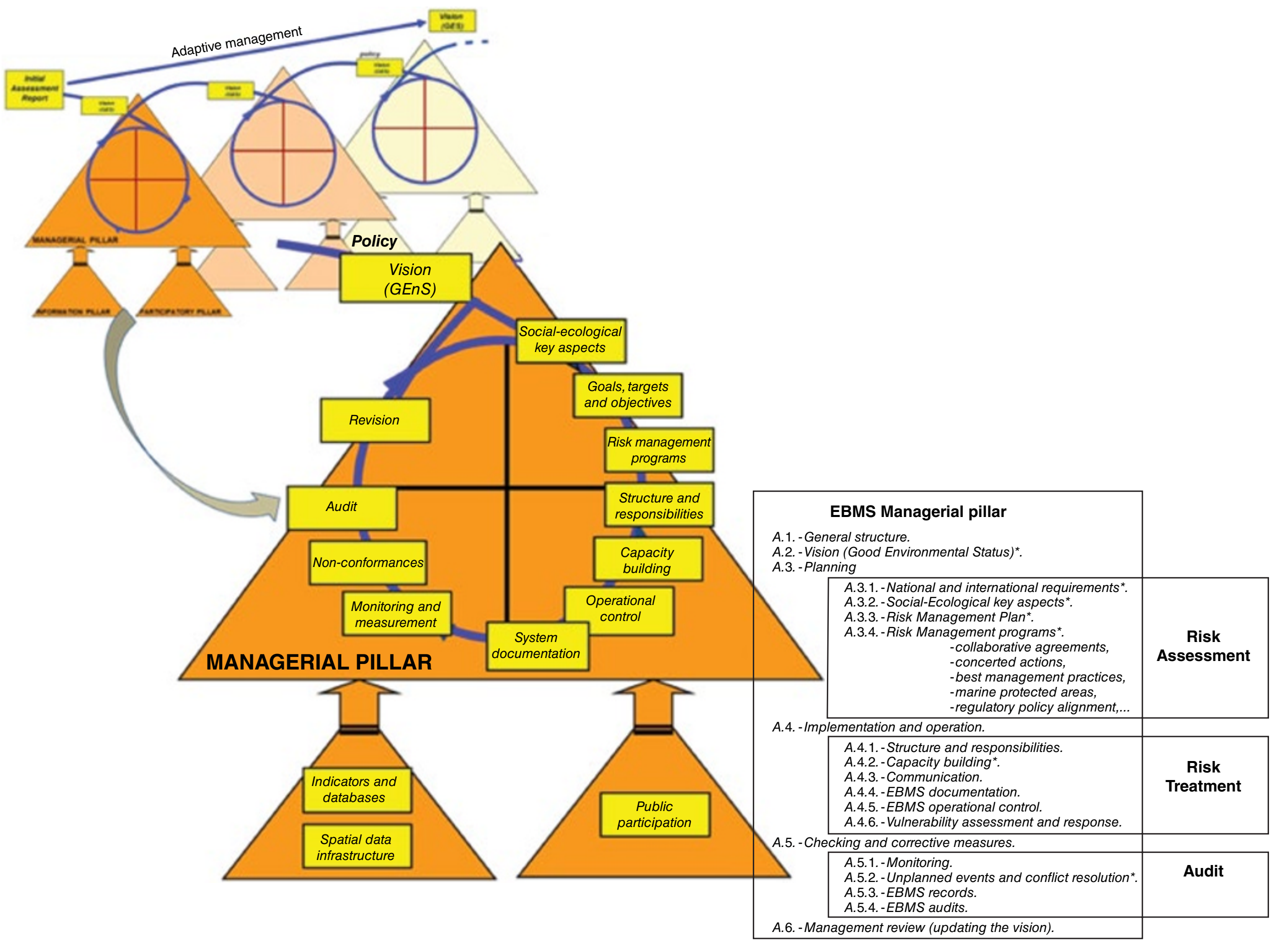

Figure 8.3 The managerial pillar of the EBMS showing the different stages used in the policy cycle, following the Deming cycle of management.

- The system identifies actions and/or activities to reach and/or to maintain this desired vision using risk management tools.
- The system prioritizes actions and/or activities that conserve ecosystem structure and functioning, to maintain ecosystem services. Evaluation measures are incorporated into each policy cycle.
- Information tools follow a DPSWR accounting framework.
- Participatory tools ensure the active involvement of stakeholders.

The *managerial pillar* is the foundation of the system: it is derived from classical environmental and risk management systems that include environmental considerations and objectives within a continuous improvement cycle of adaptive management. The managerial pillar has to be supported by governance structures that provide oversight and thereby ensure that planning and implementation activities adhere to modern environmental principles. It follows the main elements of a Deming cycle loop: policy baseline, planning preparedness, implementation and operation, checking and corrective actions (Deming, 1986). Formally, it works within the structure of ISO 14001 where most of its clauses had been replaced by those used in the previously developed ISO 31000:2009 for risk management (ISO, 2009a, 2009b, 2009c). The elements of the policy cycle have been adapted to work with the principles of the EA (see Table 8.2). A DEcision-MAking (DEMA) tool has been designed to intervene at this planning phase, as the conceptual procedure to bring the above clauses into practice. This iterative DEMA process follows the recent ISO framework for risk management (ISO 31000). The inclusion of a risk management standard follows modern management best practice for environmental decision-making (MacDiarmid, 1997; Cormier *et al.*, 2013, 2015).

Second, the *information pillar* ensures that data and scientific advice are grounded on best available knowledge. It employs the DPSWR social-ecological accounting framework to organize the information on aspects of social and ecological systems relevant to representing the interactions between them (Cooper, 2013). It is structured in line with the so-called Information Factory with two main support tools: a Spatial Data Infrastructure (SDI) that can be appended to a knowledge-based portal, and a platform of indicators linked to the desired provision of MPA ecosystem services (Cinnirella *et al.*, 2011). Both tools should be accessible in the system at any time.

Third, the *participation pillar* brings together institutional coordination, communication and consultation requirements. It is designed to accomplish three main tasks: (i) facilitation of stakeholder identification, (ii) allowing effective participation and conflict resolution, and (iii) enhancing capacity building. Tools are available for the identification of stakeholders (e.g. Sanó, 2009; Bainbridge *et al.*, 2011), and initiatives to generate informed networks of stakeholders and enhancing capacity are beginning to emerge. Without doubt, management faces its greatest difficulties when putting into practice this new paradigm of participative governance and conflict resolution due to the fact that different stakeholders around the MPA (including all national, regional and local authorities competent in the MPA as well as society in general) have different interests (Cormier-Salem, 2014). The use of the EBMS framework could introduce a common language and a common set of procedures facilitating dialogue, coordination, and capacity building between the different offices and public agents involved. At the same time, the use of the EBMS should allow clear statements of future visions for the MPA that could facilitate public engagement and participation.

The EBMS can be used at different scales, from individual MPA sites to different types of network (Beal *et al.*, this volume).

It can facilitate understanding and alleviate common problems related to the terminology used in management activities. Using the two networks considered above (MedPAN and NEAMPAN), good examples for pilot plan applications were identified.

In the 'Cap de Creus', scientific studies in the region (Gili *et al*., 2011, 2012; Lo Iacono *et al*., 2012; Sardá *et al*., 2012) provide excellent baseline information to develop a GES vision for the area as well to set up its initial assessment. In addition, characterization of its conservation status could be made through an assessment of pressures, a stakeholder mapping structure and an ecosystem service review. The closest approximation to this task would be the ecosystem overview and socio-economic overview reports used by the Canadian Department of Fisheries and Oceans, which provide comprehensive descriptions of the current knowledge of ecological, cultural, social and economic considerations for a planning area (DFO, 2005). The 'Cap de Creus' could be a very good example for an EBMS implementation: information is available, management structures are in place, coordination is feasible and a general vision has been developed.

Effective MPA management is one of the main objectives for NEAMPAN. A recent presentation in the Suncheon Bay Wetland Protected Area explored how the EBMS could be applied to this coastal environment, as well as the Muan Tidal Flats. As participatory tools have already been implemented in the Suncheon Bay Wetland Protected Area and a Committee of Suncheon Bay Nature and Ecology drives the authorities to enhance conservation of the bay, this could favour an EBMS application. The use of the EBMS at governmental level to manage the coastal-marine network, and in the NEASPEC to enhance the intergovernmental cooperation mechanism for the region, is possible by applying a nested scaled application of the EBMS.

Discussion and Conclusions

The Ecosystem Approach strategic concept has emerged as the dominant paradigm for managing coastal and marine ecosystems with the main goal of maintaining and/or restoring marine biological integrity to ensure the adequate provision of ecosystem goods and services. Regarding conservation objectives, MPAs are planned and designed to meet long-term nature protection, a clear long-term objective under an EA strategy. Although the majority of MPAs combine protection and the sustainable development of activities, their ultimate vision is to conserve biodiversity, habitat structure and the functioning of the ecosystem. When designing the tactical and operational objectives for running MPAs to achieve visions, goals and targets in these areas, EBM frameworks should be considered. The area can be problematical due to the fact that sometimes the division between the EA and EBM is not clear (Halpern *et al*., 2010). The Ecosystem Approach is a strategic concept whereas EBM is the tactical and operational means to implement the strategy. As MPAs have delimited boundaries around social-ecological systems where a clear vision has been defined, EBM frameworks ought to be deployed to manage these areas to achieve the declared vision. In this chapter we have proposed (i) adoption of the strategy of the MSFD by adopting a GES vision for every MPA under protection that can be linked to its ecosystem services provision, and (ii) use of an EBMS as the standard management tool to reach and/or to maintain this vision (Sardá *et al*., 2014).

The EBMS is designed to be a standard adaptive management methodology to assist MPA managers by providing a common set of tools and procedures and a common language that can facilitate knowledge transfer and capacity building. In addition, the EBMS is easily scalable and can be hierarchically introduced at different spatial scales, which could facilitate the institutional coordination needed to solve the problem of policy fragmentation and differentiated responsibilities normally seen in reality. The EBMS is considered a quality assurance tool in itself, being used in a vision-driven process of continuous improvement (towards achieving GES), necessitating reaching of a prior consensus for the desired future conditions of the MPA environment under management – something that lies at the heart of these designated areas.

The use of the EBMS will allow authorities to manage, in an integrated way, the different functions of the MPA environment and the ecosystem services they provide. The EBMS adds new aspects not considered in a classical MPA management structure:

1) MPA management is part of a clear vision-driven process
2) It adopts a holistic approach from a geographical perspective
3) It requires pressure analysis and institutional coordination inside clear participatory planning
4) Planning is achieved through the use of risk management techniques
5) The concept of ecosystem services is central
6) It uses the DPSWR as its analytical accounting framework of indicators
7) A good final state is based on state indicators using the GES concept
8) It ensures timely participation by the local population.

The basic structure of the EBMS and related material is available as a web platform tool (http://www.msfd.eu) to facilitate training and capacity building.

A large number of MPAs worldwide have in place a management structure and associated permanent staff. Management of these areas, however, is normally carried out using informal systems and tools. It would be easy to conclude from this global pattern that every MPA constitutes a particular case, in which it takes time to understand how it is working and to accomplish the desired objectives. A correct management cycle for all of these areas should focus on measures (monitoring programmes) that allow managers to alleviate negative pressures for the correct functioning of the area, disclosing all the information following transparent sustainable principles. Effective governance structures and relevant tools are needed for this change, and the EBMS has been designed to facilitate this.

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