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The importance of marine spatial planning in advancing ecosystem-based sea use management

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ABSTRACT

During the past 10 years, the evolution of marine spatial planning (MSP) and ocean zoning has become a crucial step in making ecosystem-based, sea use management a reality. The idea was initially stimulated by international and national interest in developing marine protected areas, e.g., the Great Barrier Reef Marine Park. More recent attention has been placed on managing the multiple use of marine space, especially in areas where conflicts among users and the environment are already clear, e.g., in the North Sea. Even more recent concern has focused on the need to conserve nature, especially ecologically and biologically sensitive areas, in the context of multi-use planning of ocean space. Despite academic discussions and the fact that some countries already have started implementation, the scope of MSP has not been clearly defined. Terms such as integrated management, marine spatial management, and ocean zoning are all used inconsistently. This is one of the reasons why its importance is not more seriously reflected at the levels of policy and decision-making in most countries. This article attempts to deal with this problem. It describes why MSP is an essential step to achieve ecosystem-based sea use management, how it can be defined and what its core objectives are. The article concludes with an analysis of the use and achievements of MSP worldwide, with particular focus on new approaches in Europe.

1. Introduction

Spatial planning is an essential tool for managing the use of land in many parts of the world. Land use planning arose in response to specific social and economic problems—and later environmental problems—that were triggered by the industrial revolution at the end of the 19th century. As soon as coal became a principal raw material, it tended to concentrate industry where supplies were available. Former villages grew rapidly into industrialized places, attracting large numbers of people to their centers, but with virtually no infrastructure to accommodate them. Water supplies were lacking or contaminated, and overcrowding became the basic cause for spreading cholera epidemics. In an early example of spatial analysis, outbreaks and ravages in the city center were systematically associated with the water supply from one single location [1]. The need and advantages of proper spatial planning became quickly obvious.

Today, comprehensive land use planning is commonly used as a central component of developmental and environmental planning in terrestrial areas in both North America and Europe [2]. The traditional project-by-project, permit-by-permit approach has been enhanced by a comprehensive planning process that lays out a vision for the future development, growth and use of certain areas. Today, this approach has become the standard for terrestrial land-use planning and management.

On the other hand, with only a few exceptions, no clearly articulated spatial vision for the future use of marine areas exists—no plan-based approach to management [3]. This does not mean that activities taking place in our seas are unregulated or that we do not allocate ocean space already. To the contrary, ocean space has been regulated or allocated in a number of different ways, but most importantly, this has been done predominantly within individual economic sectors. Obvious examples of "sectoral zoning" include ship channels, disposal areas, military security zones, concession zones for mineral extraction, aquaculture sites, and most recently marine protected areas [4]. At present, there are few frameworks that facilitate integrated strategic and comprehensive planning in relation to all activities taking place in marine areas [5]. The lack of such a framework, often translates into:

(1) A spatial and temporal overlap of human activities and their objectives, causing conflicts (user–user and user–environment conflicts) in the coastal and marine environment.
(2) A lack of connection between the various authorities responsible for individual activities or the protection and management of the environment as a whole.

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(3) A lack of connection between offshore activities and resource use and onshore communities that are dependent on them.
(4) A lack of conservation of biologically and ecologically sensitive marine areas.
(5) A lack of investment certainty for marine developers and users of ocean resources [2].

Marine spatial planning (MSP) provides an integrated process that can deal effectively with these situations. The next sections will discuss why spatial planning (consequently referred to as MSP) is a key tool to make ecosystem-based, sea use management a reality, how it can be defined and what its objectives are. The article will conclude with a short overview of the use and achievements of MSP today and the emerging shift in Europe toward the establishment of MSP as a core aspect for future sea use management strategies.

2. Marine spatial planning as a tool to make ecosystem-based, sea use management a reality

The results of the recent Millennium Ecosystem Assessment (MEA), as well as other global and regional assessments of the marine environment, recognize that biodiversity in the world's oceans and coastal areas continue to decline. Last year, a group of leading scientists concluded in *Science* that, "*the loss of marine biodiversity is increasingly impairing the ocean's ability to produce seafood, resist diseases, filter pollutants, maintain water quality and recover from perturbations such as over-fishing and climate change*" [6]. The MEA recognizes that people are at the center of this evolution. Over the past 50 years, humans have changed ecosystems, including marine ecosystems, more rapidly and extensively than in any comparable period in human history [7].

Rapid population growth, technological change and improvement, and growing consumer demands, have all considerably increased the need for more food, more energy and more trade. Because of limited or diminishing resources on land, an increasing larger share of goods and services needs to come from coastal and marine areas. Resource extraction is expanding progressively into deeper waters and further offshore [8]. Aquaculture, offshore energy, maritime transport and tourism are all facing increasingly flourishing and prosperous times in coming years. Future outlooks for offshore activities confirm that this trend will continue, and even more likely accelerate, in the next decades.[1]

All these activities have already considerably increased the demand for ocean space, and will continue to do so in the future. In some parts of the world, combined demands for human use of ocean space have exceeded about three times the available space [9,10].

Because of overlapping objectives, not all uses are compatible with one another and are competing for ocean space or have adverse effects on each other (*user–user conflicts*, e.g., oil and gas development and fisheries) [11]. A comprehensive study on the interactions among users completed for the Belgian Part of the North Sea classified conflicts among users from "manageable in time, space and overlap" to "mutual exclusion." A visualization of this user–user interaction shows clearly that conflicts or negative impacts among users far outreach their positive interactions (Fig. 1) [12].

However, conflicts among users and the development of offshore economic activities are not the only pressing issue in the oceans. The biggest concern today is the impact of all these activities on the marine environment or, in other words, the conflicts between human use and the marine environment (*user–environment conflicts*). With resources being limited both in space and amount, economic development has proven to be devastating for many places and resources, elevating competition among users and interest groups and resulting in increasingly undesirable effects, including over-fishing, loss and destruction of habitat, pollution, climate change, and the cumulative threats to the health of the oceans as a whole.

Also, irrespective of the existence of conflicts and human impacts, marine ecosystems have an inherent need to function sustainably. The same can be said from an economic perspective. Offshore economic sectors, to continue their existence and remain economically viable, have to develop and function sustainably as well.

The multiple objectives related to achieving economic and environmental sustainability, and the need to minimize and reduce conflicts of both types (*user–user* and *user–environment* conflicts) can only be dealt with through an integrated approach to management. This is nothing new. In the late 1930s, an integrated, multiple objective approach was first introduced in water resource management in the United States. Highly influenced by system analysis concepts (management of complex systems, e.g., the lunar landing program) of the late 1950s and the environmental movements of the 1960s and early 1970s, it was further deepened in the context of *Integrated Coastal Zone Management* (ICZM, or alternatively *Integrated Coastal and Marine Area Management* (IMCAM)) during the 1980s–1990s. Since the late 1970s, the scientific community has increasingly drawn the attention to the problems in the oceans—from biodiversity losses and transformed food webs to marine pollution and warming waters—and has sought for ways to preserve certain areas for their ecological value.[2] Especially during the last decade, many of these evolving trends and disciplines have merged together, evoking a new paradigm shift toward an *ecosystem-based approach* to sea use management, built on the recognition that "*the nature of nature itself is integrated* [13]."

Many scientists have advocated reforms centered on the idea of ecosystem-based, sea use management. To date, however, a feasible method for translating this attractive concept into operational management practice has not emerged [4]. Concepts regarding both integrated and ecosystem-based management are often too broad, too abstract and too complex for resource managers to enable effective implementation [14]. One way to achieve a better and more effective implementation of

[1] For example, the share of natural gas production derived from offshore exploitation is expected to grow to nearly 40% by 2030 (compared to 20–25% in 1990) as exploration and developments will shift to more lucrative offshore sites, a trend partly stimulated by ongoing high oil prices. A substantial contribution is expected from renewables (e.g., offshore windfarms) by 2030, mainly because of exploitation costs. [See: World energy outlook 2004. OECD/IEA International Energy Agency (IEA), 2004.] Global future growth for the cruise business is estimated at an annual rate of 8%, while eco-tourism, such as whale watching has grown to a multi-million dollar business in nearly 25 years, on an average growth rate of 12% since 1990. [See: Worldwide cruise ship activity. World Tourism Organization, 2003. p. 9 and F. Kanji. A Global perspective on the challenges of coastal tourism. Coastal Development Centre, Kasetsart University, Bangkok, Thailand, 16 November 2006.]. Aquaculture is expanding and intensifying in almost all regions of the world and has grown to about 43% of global fish consumption (in comparison to only 9% in 1980). [See: Delgado C, et al. Fish to 2020. Supply and demand in changing global markets. International Food Policy Research Institute and World Fish Center, 2003. p. 81 and The State of World Fisheries and Aquaculture (SOFIA), United Nations Food and Agriculture Organization, 2004.]

[2] The period in between single sector approaches and the shift toward an ecosystem approach was marked by the idea of an integrated approach, and in particular in the form of ICZM, first proposed in the late 1960s. However, while ICZM addressed problems in the terrestrial coastal zone, very few applications of ICZM extended into the sea. The focus of ICZM lies on integrated management across sectors. Ecosystem-based management elaborates further on this but takes also ecological considerations into account explicitly.

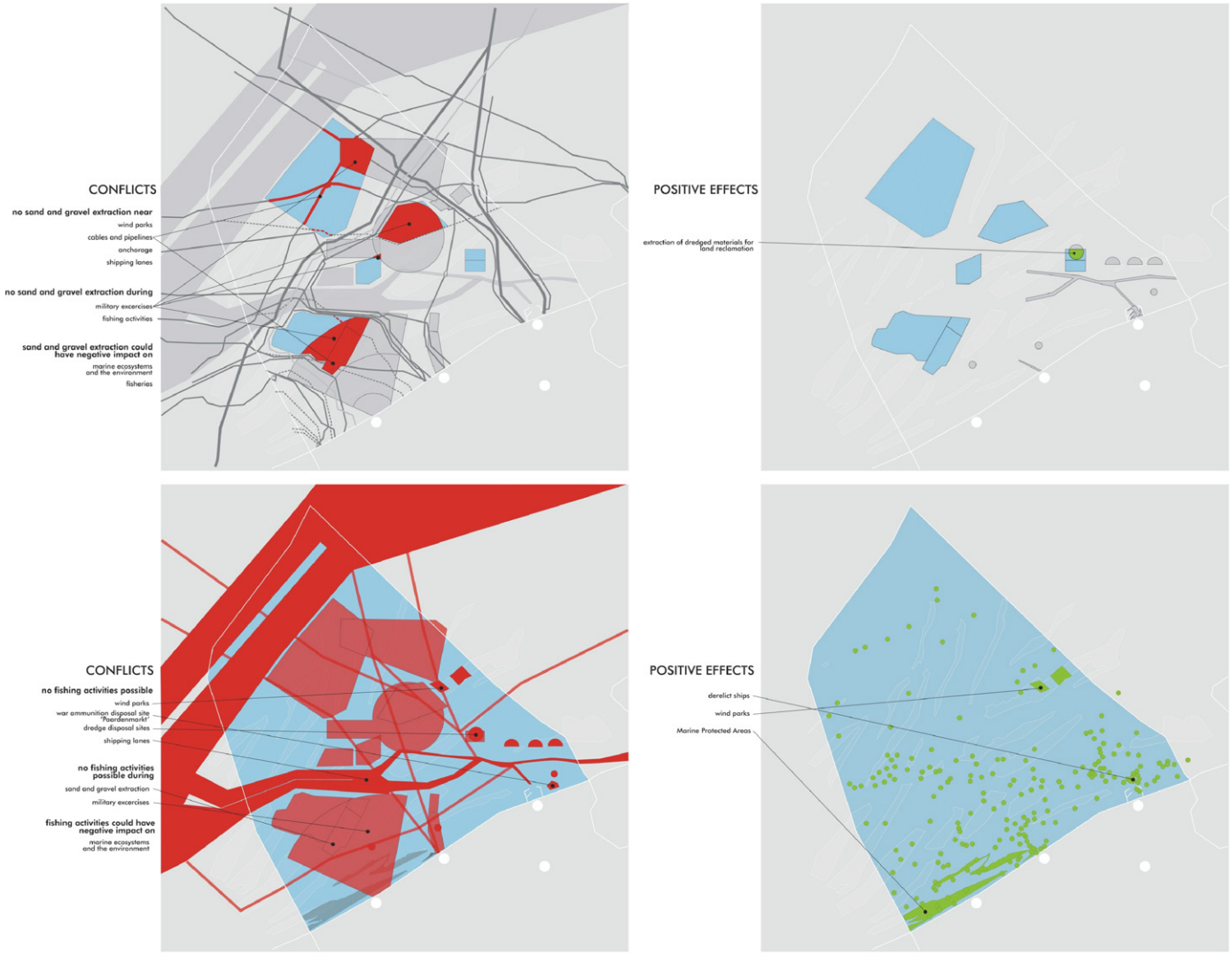

Fig. 1. Positive and negative interactions of uses among each other in the Belgian Part of the North Sea. (Source: Maes et al., 2005).

ecosystem-based management in the marine environment is through the use of MSP.

Ecosystem-based management is place- or area-based in focusing on a specific ecosystem and the range of activities affecting it [15,42]. This emphasis on managing places is a key characteristic of ecosystem-based management and is a marked departure from existing approaches that usually focus on a single species, sector, activity or concern [16]. Where *sectoral management* implies that each sector regulates particular *activities* or projects *taking place at a particular location* (or site) within a certain area, the *management of areas* implies that, after a certain area has been defined, sustainable development and use will be established *for all activities in the whole area* [2].

Two European regional commissions for the protection of the marine environment, OSPAR[3] and HELCOM,[4] have jointly defined an ecosystem approach to sea use management as [17,18]:

> The comprehensive integrated management of human activities based on the best available scientific knowledge about the ecosystem and its dynamics, in order to identify and take action on influences which are critical to the health of marine ecosystems, thereby achieving sustainable use of goods and services and maintenance of ecosystem integrity.

Today, the ecosystem approach has become widely accepted as a key framework for delivering sustainable development in both the terrestrial and the coastal and marine environment. It provides an important framework for assessing biodiversity and ecosystem services and evaluating and implementing potential responses. The Convention on Biological Diversity (CBD) refers to the ecosystem approach as "a strategy for the integrated management of land, water, and living resources that promotes conservation and sustainable use in an equitable way." Application of the ecosystem approach involves a focus on the functional relationships and processes within ecosystems, attention to the distribution of benefits that flow from ecosystem services, the use of adaptive management practices, the need to carry out management actions at multiple scales, and inter-sectoral cooperation. A number of other established approaches, such as integrated water resources management and integrated ocean and coastal area management, are consistent with the ecosystem approach and support its application in various sectors or biomes, including coastal and marine environments. In fact, the application of ecosystem approaches in the marine and coastal areas builds on

[3] OSPAR is the Commission for the Protection of the Marine Environment of the Northeast Atlantic. More information on: www.ospar.org.

[4] HELCOM is the Baltic Marine Environment Protection Commission. More information on: www.helcom.fi.

the concept of integrated management, already widely used for the management of these areas [19].

An in-depth review of the application of the ecosystem approach, carried out by the CBD, revealed, however, that various barriers prevent actual implementation of ecosystem-based management. Despite its broad acceptance and wide range of principles, definitions and guidelines, the ecosystem approach is still more a concept, widely discussed at scientific fora, but with few examples of actual practice. It is increasingly clear that governments and stakeholders lack the necessary tools to make an ecosystem approach operational in the marine environment, especially with regard to cross-sectoral integration. In particular, the concept lacks *concrete* guidance that allows balancing conservation and sustainable use of natural resources. The CBD review recognizes that the implementation of an ecosystem approach to coastal and ocean management is a complex and demanding process, and that—among other needs—practical tools need to be developed that can make this process more tangible [20]. Other research conducted to evaluate current practice and application of the ecosystem-based management resulted in similar conclusions and confirm the need for more operational tools that can move implementation forward [14]. One way to this is through the use and application of MSP.

A range of tools and measures will be needed to implement the multiple objectives of an ecosystem-based management approach (Fig. 2), but a focus on the spatial and temporal aspects of ecosystem-based management is one way to make this approach more tangible. MSP can do this because it:

- *Addresses the heterogeneity of marine ecosystems in a practical manner*. MSP takes into account that some things only occur in certain places. Important ecological areas, for example, are located in areas of high diversity, endemism or productivity, spawning and nursery areas, and migration stopover points [42]. At the same time, economic activity will (and can) only take place where the resources are located, as for example, oil and gas deposits, sand and gravel deposits, and areas of sustained winds or waves.
- *Focuses on influencing the behavior of humans and their activities over time.* Although goals and objectives for a certain area are usually set for both ecosystem/natural processes and human activities, it is only the human component (human activities and resource use) that can be managed (not the ecosystem itself), e.g., through management measures (incentives) that change behavior of humans and their activities over time.
- *Provides a management framework for new and previously inaccessible scientific information.* Through remote sensing, tracking technologies, and global positioning technologies, science is making visible what had previously been hidden or inaccessible and increases the need for a management framework that allows the effective integration and use of new scientific information in decision-making processes.
- *Makes conflicts and compatibilities among human uses visible*, and therefore tangible. Through the mapping of ecosystems, their characteristics, and human activities affecting it one can *see* where conflicts are or will be located.
- *Guides single-sector management toward integrative decision-making.* The development of marine spatial plans for an entire region visualizes alternative scenarios (drawn from a specified set of sectoral objectives) for ecosystem-based management, which in turn can provide guidance to a range of decision-makers, each responsible for only a particular sector or activity of the entire area (e.g., fisheries managers will see what conflicts and compatibilities their management plans will have with plans for the offshore development of wind farms).

The place-based characteristics of ecosystems, natural resources, and human activities affecting them, increases the need to look at the "system" from a spatial and temporal perspective and implies that all policies and management strategies (e.g., fisheries management, marine transportation management, and marine protected area management) directed toward influencing human use of ecosystems and their resources will inherently have a spatial and temporal dimension.

As will be described later, MSP is a process that can influence *where and when* human activities occur in marine spaces. It is important to bear in mind, however, other measures will be needed for the management of the *performance* of human activities and ecological aspects of the marine environment. The latter includes measures that deal with the input, process and output of human activities in the marine environment [21] (Fig. 2).

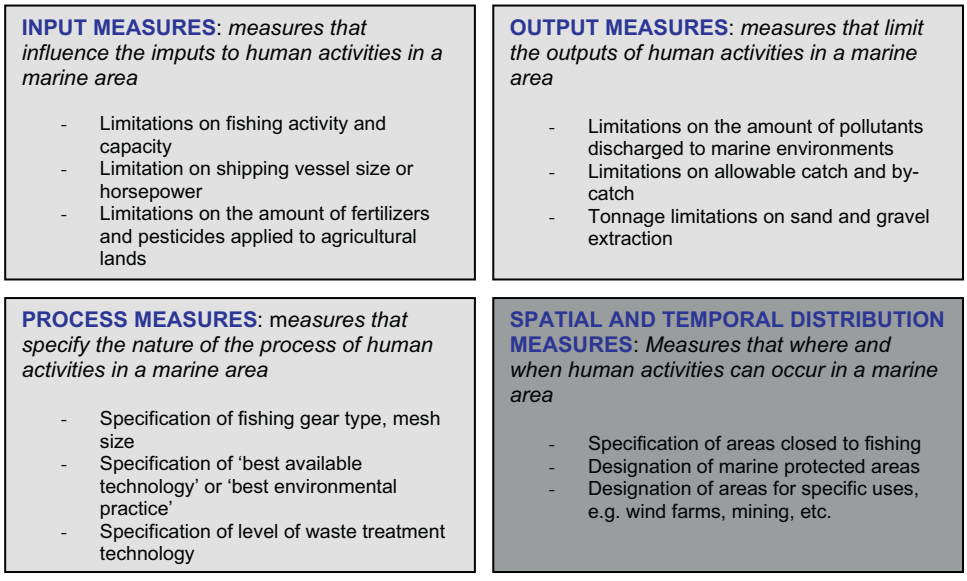

Fig. 2. Types of measures for ecosystem-based, sea use management. (Source: Douvere and Ehler, 2007).

3. Defining marine spatial planning

MSP is not radically different from spatial planning on land. Although the context and outcomes are different because of the dynamic and three-dimensional nature of marine environments, the land use planning concepts and techniques can rather easily be translated to the marine environment [43]. As on land, spatial planning in the marine environment is a means to [5]:

> Create and establish a more rational organization of the use of marine space and the interactions between its uses, to balance demands for development with the need to protect the environment, and to achieve social and economic objectives in an open and planned way.

In its broadest sense, MSP is about [22].

> Analyzing and allocating parts of three-dimensional marine spaces to specific uses, to achieve ecological, economic, and social objectives that are usually specified through the political process.

MSP aims to provide a mechanism for a strategic and integrated plan-based approach for marine management that makes it possible to look at the "bigger picture" and to manage current and potential conflicting uses, the cumulative effects of human activities, and marine protection. MSP provides an opportunity not only to better manage and understand the marine environment, but also allows a long-term planning in a way that processes become more transparent with greater certainty in permitting, planning and allocation for both developers and environmental managers [2]. In doing so, it can replace the current piecemeal view, and make sure that commitments made in a number of important international and national marine policy and legislation, including commitments to apply an ecosystem approach, can be fulfilled [3].

To be effective, MSP needs to be conducted as a continuous, iterative, and adaptive process and consists of at least three ongoing phases (Fig. 3) [22]:

(1) *Planning and analysis*: Generating and adopting one or more integrated, comprehensive spatial plans for the protection, enhancement and sustainable use and development of the sea and its resources [43]. The planning and analysis phase will be based on a set of research initiatives (including mapping) that address both environmental and human processes [42,44].
(2) *Implementation*: Implementing the plan through the execution of programmed works or investments, enabling change, encouraging improvement and through regulation and incentives, and enforcement of proposed changes and ongoing activities in, on, over and under the sea, in accordance with the plans [45,46]; and
(3) *Monitoring and evaluation*: Assessing the effectiveness of the plans, their time scales and implementation mechanisms, considering ways in which they need to be improved and establishing review and adaptation procedures. Results of evaluation are fed back into the planning and analysis element of management, and the process begins again [47].

The ultimate decision on what space will be allocated for what use (or non-use) is a matter of societal choice. People are central to the decision-making process and are the agents for change. As such, relevant stakeholders, including the wider public, need to be properly involved throughout the MSP process, and are in fact, critical to a successful outcome [48]. Finally, all steps of this process need financing on a continuing basis to achieve management goals and objectives.

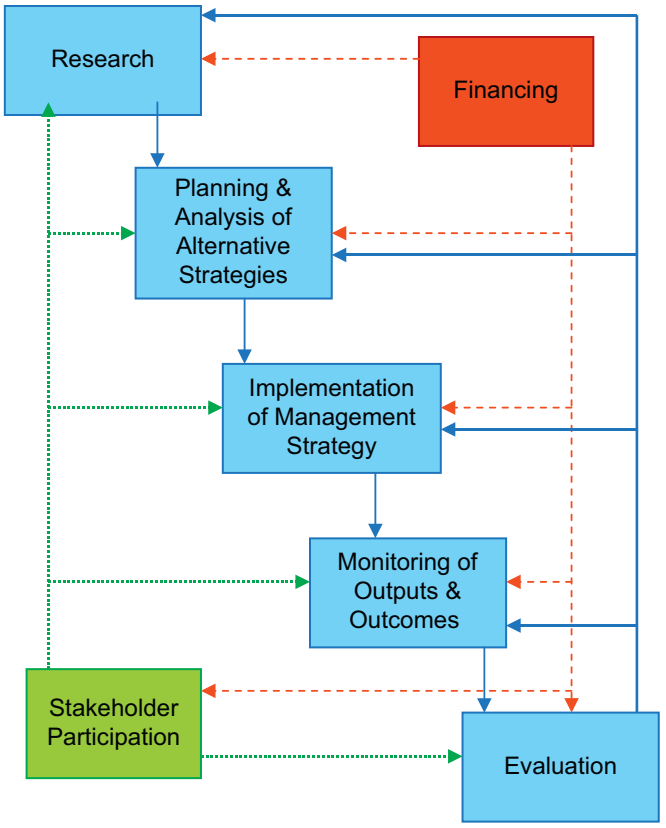

Fig. 3. Essential elements of a marine spatial management process. (Source: Ehler and Douvere, 2007).

4. The use and achievements of marine spatial planning today

4.1. The international context

During the last decade, MSP has gained considerable importance in establishing ecosystem-based management in the marine environment. Several countries have begun to move the conceptual work forward and have started implementing, or at least experimenting with, spatial planning in their marine and coastal environment. Early plans and initiatives toward MSP have been brought forward to establish marine protected areas. The focus of these plans has mainly been to ensure that conservation objectives are not impaired by human activity. More recent attention, however, has been placed on managing the multiple use of marine space, especially in densely used areas where conflicts among users and the environment are already clear, e.g., in the North Sea (Table 1).

One of the best-known examples is Australia's Great Barrier Reef Marine Park (GBRMP). Spatial planning and zoning, largely considered as the cornerstone of the management strategy for the protection of the Great Barrier Reef permit various human activities, including fisheries and tourism, while simultaneously providing a high level of protection for specific areas. The spatial plan, first developed in 1981, has evolved and changed considerably in response to the dynamic nature of both the marine environment and policy [23,47].

MSP and zoning is also an important element in the management of the Trilateral Wadden Sea Cooperation Area. The Wadden Sea Plan, developed as a trans-boundary initiative between the Netherlands, Germany and Denmark to protect and manage on a common basis a shared coastal wetland system, is an interesting

Table 1
From marine protected area management to multiple objective MSP

Country	Initiative	Year
Australia	Great Barrier Reef Marine Park Zoning and Re-Zoning	1978-–2005
USA	Florida Keys National Marine Sanctuary and Tortugas Ecological Reserve; Channel Islands National Marine Sanctuary	1990–2001
NL-DE-DK	Trilateral Wadden Sea Plan	1993–2010
Canada	Large Oceans Management Areas, e.g., Eastern Scotian Shelf Integrated Management, 2006–2012	1998–2007
Australia	Marine Bioregional Planning	2002–ongoing
China	Marine Functional Zoning of Territorial Sea	2002–ongoing
UK	Irish Sea Pilot Project	2002–2005
Belgium	Master Plan for the Belgian part of the North Sea	2003–2005
The Netherlands	Integrated Management Plan for North Sea 2015	2003–ongoing
Germany	Spatial Plan for North Sea and Baltic Sea	2004–ongoing
Norway	Integrated Management Plan for Barents Sea	2005–2006

example of the use of spatial planning in an international context. While spatial differentiation of functions and activities are used according to national legislation, the various national zoning systems have similar structures. Essentially, they consist of zero-use zones, high-level protection zones, and general access zones [24].

The Florida Keys National Marine Sanctuary Management Plan considers the establishment of an MSP system that includes 25 different types of zones with varying levels of limited use. MSP is also becoming a significant consideration in management plans for the Channel Islands National Marine Sanctuary, the Coastal Zone Management Program in Massachusetts, and the Eastern Scotian Shelf Integrated Management (ESSIM) Initiative in Canada.

A lesser-known example is the establishment of a marine functional zoning system in China. In January 2002, the Law on the Management of Sea Use came into force, establishing an initial regional planning system and an integrated management framework for marine development and conservation in China. The new legislation has established three principles, including:

- *The right to the sea-use authorization system*: According to the law, the seas are owned by the State. The State Council exercises the ownership of the seas on behalf of the State. Any entity or individual who intends to use the sea must apply in advance and obtain the right to use the sea. They are authorized only after the approval of the national government.
- *A marine functional zoning system*: The law stipulates that any use of the sea areas must comply with the marine functional zoning scheme established by the State. The scheme is the foundation for marine management, under which the sea is divided into different types of functional zones (according to the criteria related to ecological functions and priority use), to regulate and guide rational use of the sea area.
- *A user-fee system*: The right to sea use is protected under the State's legal system, which requires that any entity or individual who uses the sea must pay a fee in accordance with the regulations of the State council. This system stipulates that the sea is a State-owned asset, and all entities and individuals who intend to use the sea to carry out production and other economic activities, must pay for its use.

Starting in 2000, under the overall supervision of the State Council, along with other relevant ministries and coastal provinces, autonomous regions and municipalities formulated a nation-wide marine functional zoning scheme. Over two-thirds of the zoning schemes of the 11 coastal provinces, autonomous regions, and municipalities of China have been completed and approved by their respective local governments for implementation (Fig. 4) [25,26].

With the exception of China, most international plans have been brought forward to establish marine protected areas and marine reserves. In Europe however—and most particularly in the North Sea area—the focus of MSP has become much broader allowing the establishment of an ecosystem-based management beyond the rather narrow scope of marine protected areas. Spatial planning in European countries pays more attention to enhancing the efficient use of ocean space as a whole, identifying opportunities for shared use, and resolving conflicts among different sea uses, and users and the environment. Various countries, including the Netherlands, Belgium, Germany and the UK, have taken global leadership in the development and—to some extent—implementation of spatial planning in the marine environment. Early benefits that have arisen from these experiences, in conjunction with a promising shift in recent European marine policy, are setting the stage for new directions in future sea use management.

4.2. The increasing need for marine spatial planning in Europe

For centuries, the oceans have been of major strategic importance to the economic and social development of Europe. The European Union (EU) has a coastline of 68,000 km, equivalent to seven times that of the United States and four times that of Russia. Almost half of Europe's population lives within 50 km of the coast. As a result of this close association between European citizens and their seas, coastal and marine areas are heavily affected by increasing conflicts among competing users [27].

As early as 1999, the *European Spatial Development Perspective* recognized that all sectoral policies have a territorial (or spatial) impact and that a spatial plan is the most appropriate means of ensuring coherence and resolving conflicts between sectoral interests and policies [28]. During recent years, the need for the development of a comprehensive MSP system for European seas has become increasingly more important, as reflected in various legal and policy documents.

Most recently, the EU Green Paper "*Toward a Future Maritime Policy for the Union: A European Vision for the Oceans and Seas*," sees MSP as a key tool for the management of a growing and increasingly competing maritime economy, while at the same time safeguarding marine biodiversity. More concretely, the Maritime Policy describes MSP as a means to [29]:

- Coordinate the spatial implementation of offshore renewable energy with other activities;
- Provide financial security for investment decisions;
- Manage the competition among various uses and objectives of the marine environment;
- Develop a stable regulatory environment that ensures better and simpler regulation toward the location of economic activity;
- Ensure that individual decision on activities, taken at a national or regional level, but affecting the same ecosystem or cross-border activities (e.g., pipelines, shipping routes), are dealt with in a coherent manner;
- Ensure consistency between land and marine systems; and
- Ensure that the future development of offshore activities is consistent with the need to evolve multilateral rules.

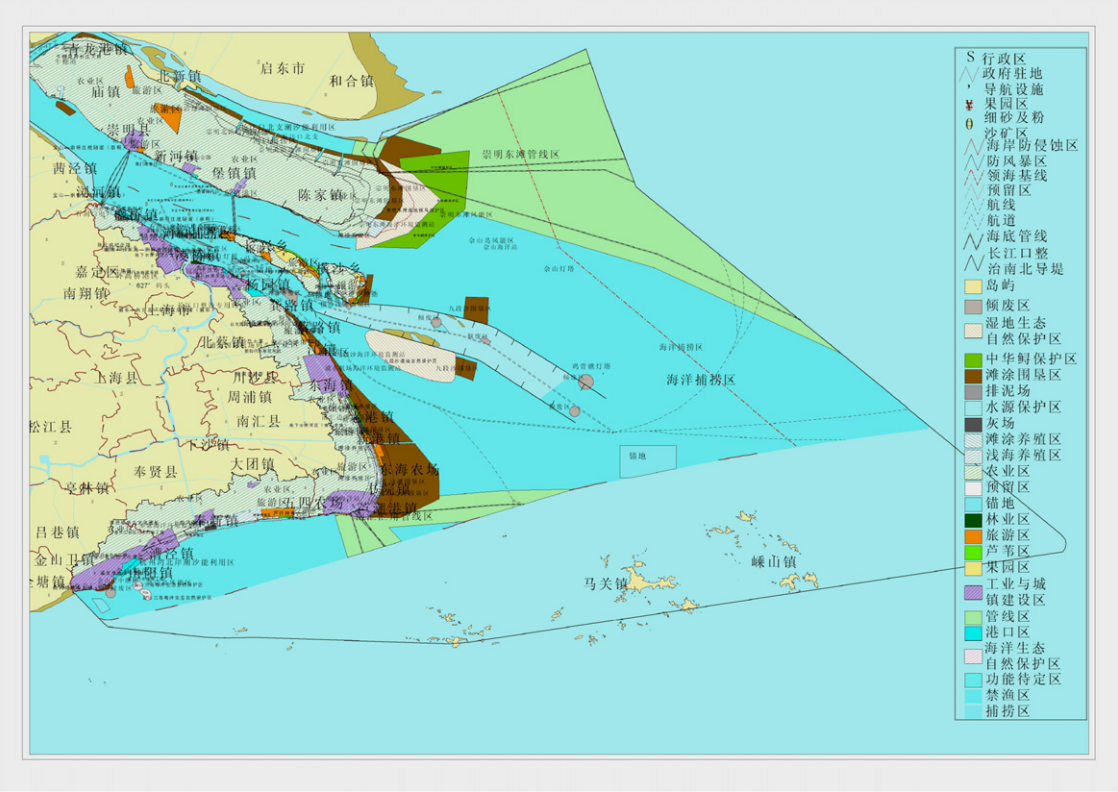

Fig. 4. Shanghai zoning scheme, China, 2007. (Source: State Oceanic Administration, China, 2007).

The EU Marine Strategy [30], the environmental pillar of the EU Maritime Policy, introduced the principle of ecosystem-based MSP [31] and provides a supportive framework for national initiatives toward spatial planning, designed for achieving a good status for the environment. In its proposal for a Marine Strategy Directive, the EU explicitly mentions the need to develop management measures that influence where and when an activity is allowed to occur.[5] The EU calls on national states to set up spatial planning processes and considers its own role as "*to lay down parameters, define the geographic extent of the regions involved (which has been done through the development of eco-regions), and identify the elements that are in the common interest*" [29].

Among the most important drivers for MSP in Europe is the European legislation on conservation as part of the EU contribution to implement the 1992 CBD. The most significant are the Birds Directive [31], providing a framework for the identification and classification of "Special Protection Areas (SPAs)" for rare, vulnerable or regularly occurring species, and the Habitats Directive [32] requiring member states to select, designate and protect sites that support certain natural habitats or species of plants or animals as "Special Areas of Conservation (SACs)." Together, the SACs and SPAs aim to create a network of protected areas across the EU, known as Natura 2000, which forms the cornerstone of Europe's nature conservation policy.

Despite that European legal and policy requirements for MSP have not yet fully developed, several countries have, on their own initiative, taken global leadership in developing—and in some cases implementing—MSP. In particular, the North Sea region has a long history of competition and conflicts relating to access and use of space and resources for trade and fishing. Today, in addition to these historic uses, many other industries have become important competitors for ocean space for infrastructure, the exploitation of natural resources, military use and the protection of the natural environment in the North Sea. In some countries, overall demand for ocean space exceeds three times the available space [10], which makes the need for some form of spatial management increasingly urgent.

In 2005, the Netherlands developed an overarching spatial planning framework for the Dutch Part of the North Sea described in the *National Spatial Planning Policy Document* (SPPD). The primary objective of MSP in the Netherlands is to "*enhance the economic importance of the North Sea and maintain and develop the international ecological and landscape features by developing and harmonizing sustainable economic activities in the North Sea, taking into account the ecological landscape features of the North Sea*" [33]. How the spatial policy of the SPPD will be implemented is described in the *Integrated Management Plan for the North Sea 2015* (IMPNS 2015) [33], in which the overall objective for spatial planning is translated into the need for a healthy, safe and profitable sea. The Dutch marine spatial policy provides the market (i.e., economic sectors and industries) flexibility to develop offshore initiatives and projects. To limit the risks involved in complete market freedom, the spatial policy provides a guiding spatial planning framework in which location-based uses (usage zones), a zoning scheme for growth functions, and a number of exclusion policies are defined. Central to the Dutch marine spatial management is a system of permits for the regulation of offshore activities. Additionally, a set of other tools has been developed to provide insight into spatial developments and potential problems and facilitate managing the use of space. These new tools include "opportunity maps" that shows where a use is permitted in the current framework and is most likely to

[5] Article 12(1) of the Proposal for a Directive of the European Parliament and of the Council Establishing a Framework for Community Action in the field of Marine Environmental Policy (Marine Strategy Directive), Council of the European Union, 2005/0211(COD), Brussels, 20 December 2006, p. 31.

develop in the future, a spatial monitoring and permit tracking system, an integrated (spatial) assessment framework for issuing permits, exploratory spatial studies for specific functions, a disadvantage compensation possibility for users harmed by another legal ocean use, and a system to support joint initiatives in which parties combine the use of ocean space. The Dutch MSP initiative is designed for the period 2005–2015 and will be reviewed after its first 5 years. Current experiences, especially with regard to offshore wind industry, tend to stimulate a bigger role for MSP (e.g., more zones and accompanying criteria for specific uses) in future sea use management in the Netherlands.

Belgium is among the first countries to actually start implementing an operational, multiple-use planning system covering its territorial sea and exclusive economic zone (EEZ) [34]. The core issues of the Belgian MSP policy framework include the development of offshore wind farms, the delimitation of marine protected areas, a policy plan for sustainable sand and gravel extraction, enhanced financial resources for the prevention of oil pollution, the mapping of marine habitats, protection of wrecks valuable for biodiversity, and the management of land-based activities affecting the marine environment. Together, these objectives provided the basis for a "Master Plan" that has been implemented incrementally since 2003. The first two phases of the "Master Plan" are now operational and focus on:

- Spatial delimitations for sand and gravel extraction and a zone for future offshore wind energy projects (phase 1), followed by
- Delimitation of marine protected areas as part of the Natura 2000 Network (phase 2).

The spatial plan has led to a more diverse zoning system for sand and gravel extraction that includes new management zones with sequential rotation for the most intensive exploitation areas, seasonally closed zones in which extraction is prohibited during fish spawning seasons, and an exploration zone where potential future use is examined. The zones defined for wind farms now allow companies to submit proposals without the former risks of denial of permit or compensation costs to other marine resource users (e.g., fisheries) resulting from the lack of a spatial framework for the area as a whole. Future initiatives concerning spatial planning in Belgium will focus on the protection of marine shipwrecks for archeological, biodiversity, and ecological interests, development of a marine component for existing terrestrial protected areas, and the allocation of a research zone for alternative fishing methods [35].

Although still in an earlier phase than in Belgium and the Netherlands, MSP has also started to play a key role in the latest marine management initiatives in Germany and the UK. In March 2007, the government of the UK released its Marine Bill White Paper [5]. A key element of the Marine Bill is the introduction of a new system of MSP for the entire UK marine area that will allow a strategic, plan-led approach to the use of marine space and the interactions between its uses. MSP in the UK aims to "*look more strategically at the whole of the marine environment, the way that we use and protect our resources and the interactions between different activities that affect them*." A spatial planning system will encompass all activities and will be directed to deliver sustainable development by facilitating forward looking decision making. Marine plans, that will be developed by a newly established "Marine Management Organization," will guide decisions on license applications and other issues, and provide users of the sea with more certainty. The potential and ability of MSP to judge the combined effects of many activities over time, is one of the key considerations toward implementation of MSP in the UK. The feasibility and practicality of developing and applying MSP in the waters of the UK have been extensively researched and tested through a pilot project conducted in the Irish Sea, concluded in 2004 [36]. The Marine Bill is expected to be introduced to Parliament toward the end of 2008.

Germany extended its Federal Spatial Planning Act to the exclusive economic zone (EEZ) in 2004, and is therefore among the first countries (along with China) to have a legal requirement for the development of MSP. The spatial planning initiative [37] for the EEZ started with the development of a set of goals and principles for spatial planning in the framework of the United Nations Convention on the Law of the Sea (UNCLOS). In 2007, the Federal Maritime and Hydrographic Agency completed a draft spatial plan and an associated environmental report for the German EEZ in both the North Sea and the Baltic Sea. A final plan is expected to be published for public review in 2008. The aim of the spatial plan is "*to establish sustainable development of ocean space, in which social and economic demands for space are consistent with the ecological* functions *of space*." The associated environmental report aims to identify and evaluate the likely significant effects on the environment that could result from implementing the spatial plan. The German spatial planning approach includes the possibility to designate areas as:

- *Priority areas* that are reserved for defined use in which other conflicting uses are excluded;
- *Reservation areas* that are reserved for defined use in which other conflicting uses are excluded; and
- *Suitable areas* in which defined uses are allowed inside, but excluded outside, the designated areas.

In the German territorial sea, the *Länder* are responsible for spatial planning, which can be done in the framework of the State Planning Act. Mecklenburg-Vorpommern (Baltic Sea) and Niedersachsen (Lower Saxony; North Sea) already expanded their existing spatial plans form the landside to the coast area. Mecklenburg-Vorpommern extended its 2005 Spatial Development Programme to "*ensure conflict management between the demands of new technologies, tourism and nature protection and traditional sectors like shipping, fishing and defense at an early stage*." [38]

Of considerable importance in the examples of the Netherlands, Belgium, Germany and the UK is their use and application of MSP for the management of multiple-use in the entire marine area. While marine protected areas in all countries will be part of the tools used for marine conservation, they are considered in the wider context of an MSP strategy for the entire area that balances them with the need to ensure economic growth and stability—such as shipping and port infrastructure or wind farms—and other biodiversity or habitat considerations outside the protected area.

Another important aspect of European MSP is reflected in initiatives toward trans-boundary cooperation. Both in the North Sea and the Baltic Sea, regional organizations (OSPAR in the North Sea region, HELCOM in the Baltic region) are taking considerable efforts to stimulate neighboring countries to embed their marine spatial plans in the broader, regional context that takes into account ecosystem issues beyond their national boundaries. During the first Joint OSPAR-HELCOM Ministerial Meeting (JMM) in 2003, the ministers recognized the benefits of MSP as a tool to implement an ecosystem-based approach to the management of human activities in the marine environment [17]. In 2006, the ministers of the 6th North Sea Conference in Götenborg, Sweden [39], reinforced their commitment to further develop and implement the use of spatial planning as a tool in the management of different actions in coastal and marine areas at national

and regional level in the North Sea. The OSPAR Working Group on Spatial Planning is designing a set of guidelines to implement MSP in the North Atlantic Region [40]. HELCOM is currently developing a broad-scale spatial zoning template for the Baltic Sea area [41].

5. Conclusion

For over 30 years, MSP has been a key element in the successful implementation of ecosystem-based management in Australia's GBRMP. Other countries, including Canada, the United States and more recently China, have also started to implement—or at least experiment with—MSP in their marine environment. But while most of these initiatives were brought forward to establish marine protected areas, more recent marine spatial plans in European countries, e.g., Belgium, Germany, the Netherlands, and the UK, focus on managing the multiple uses of marine spaces as whole. While marine protected areas in these countries remain an important aspect for marine conservation, they are considered in the wider context of an MSP strategy designed for the entire area that balances them with the need to ensure economic growth and stability and biodiversity considerations outside the protected area.

These ongoing efforts to develop MSP, and in particular the increasing reflection of its importance in European policy, strongly illustrate its potential to make the implementation of ecosystem-based, sea use management a much more tangible process. Conducted as a continuous, iterative, and adaptive process, MSP has the potential to provide a more practical way to implement ecosystem-based, sea use management, most importantly because it recognizes the heterogeneity of marine ecosystems, focuses on influencing the behavior of humans and their activities over time, provides a management framework for new and previously inaccessible scientific data, makes conflicts and compatibilities among human uses more visible and therefore comprehensible, and has the potential to guide single sector management toward integrated sea use management.

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