

Ecosystem-Based Marine Spatial Management: An Evolving Paradigm for the Management of Coastal and Marine Places

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INTRODUCTION

The development and industrialization of the world's oceans has evolved rapidly since the 15th century.¹ Ongoing population growth, technological development, and growing consumer demand increased considerably the need for more food, energy, and trade. Future outlooks for offshore activities confirm that this evolution has not come to an end and is even likely to accelerate in the coming decades. The share of natural gas production derived from offshore exploitation, for example, is expected to grow to nearly 40 percent by 2030 (compared to 20–25 percent in 1990), as exploration and developments will shift to more lucrative offshore sites, a trend partly stimulated by high oil prices. A substantial contribution is expected from renewable energy (e.g., offshore wind farms and wave parks) by 2030, mainly because of decreasing exploitation costs.² Future global growth of the cruise ship industry is estimated at an annual rate of 8 percent, while eco-tourism has grown to a multi-million dollar business in nearly 25 years, on an average annual growth rate of 12 percent since 1990.³

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1. H. Smith, "The Industrialisation of the World Ocean," *Ocean and Coastal Management* 44 (2001): 563–566.

2. *World Energy Outlook 2004*. OECD/IEA International Energy Agency (IEA), 2004.

3. *Worldwide Cruise Ship Activity*. World Tourism Organization, 2003, pp. 9; F. Kanji, *A Global Perspective on the Challenges of Coastal Tourism* (Bangkok, Thailand: Coastal Development Centre, Kasetsart University, 16 November 2006).

Ocean Yearbook 23: 1–26.

2 Issues and Prospects

Aquaculture is expanding and intensifying in almost all regions of the world and has grown to about 43 percent of current global fish consumption (in comparison to only 9 percent in 1980).⁴ An inevitable question arises: how can development be sustained, keeping marine industries economically viable, while conserving places that are critical for the health of the marine environment and its biodiversity?

While in the past, industrialization of ocean use has been most prominent in fisheries, maritime transport, communications, oil and gas exploitation, marine recreation, and coastal engineering, it is particularly the rise of new uses, such as renewable energy and nature conservation initiatives, which has made decision-makers recognize the need to develop and implement an integrated and more rational use of ocean space. In most cases it has been because of growing and interactive pressures, often driven by incompatible demands for ocean space, which have forced governance systems to face complex, multi-sectoral issues. In New Zealand, for example, the issues of Maori rights and marine conservation came into sharp political focus at the same time. In European examples, the cumulative crush of shipping, fisheries, renewable energy, recreation, land-based pollution sources, and conservation requirements could no longer be ignored. In the case of the Australian Great Barrier Reef, the pressures of mineral exploitation, developing tourism, and national pride in an iconic ecosystem drove the process toward an adaptive, integrated marine spatial management process.

Ocean resources are limited both in space and abundance and the pressure on the marine environment, resulting from an expansion of existing use and the rise of new ones, has been devastating to many places. Essentially, increased activity in the marine environment has led to two important types of conflict. First, not all uses are compatible with one another and are competing for ocean space or have adverse effects on each other (*user vs. user conflicts*). Numerous examples exist of conflicts between ocean users both globally and locally and include, for example, incompatibilities between the fast-growing, billion-dollar submarine cable industry and fisheries, causing damage to, or loss of, fishing gear or huge repair costs and lost revenues for cable disruptions.⁵ Other user conflicts include wind farms located near shipping routes or traffic separation schemes, causing high risks of collisions and loss of cargo. In New Zealand, spatial conflicts have

4. C. Delgado, W. Nikolas, M. Rosegrant, S. Meijer and M. Ahmed, *Fish to 2020, Supply and Demand in Changing Global Markets*, International Food Policy Research Institute and World Fish Center, 2003, p. 81; See also *The State of World Fisheries and Aquaculture* (Rome: Food and Agriculture Organization of the United Nations, 2004).

5. S. Coffen-Smout and G. Herbert, "Submarine Cables: A Challenge for Ocean Management," *Marine Policy* 24 (2000): 441–448.

arisen from legislative obligations to uphold the historic and indigenous rights of fishers with more recent obligations toward nature conservation.⁶ Spatial use conflicts also occur within one particular use and refer, for example, to the use of different gear types for fisheries in certain areas, or the competition over use of space between commercial and recreational fisheries. Studies in California have illustrated that new commercial ocean activities will only exacerbate conflicts between users.⁷

Second, not all uses are compatible with the needs of a healthy and sustainable environment and cause conflicts between users and the environment (*user vs. environment conflicts*). Too often, ocean uses are located in sensitive biological and ecological areas without much consideration of their impact. Many scientific studies document the degradation of the world's oceans, the decline of marine ecosystems, and the collapse of important fish species, illustrating that this is increasingly impairing the ocean's ability to produce the goods and services essential for life on Earth.⁸ Recent research measured the cumulative impacts of human offshore activities on the marine environment at a global scale and concluded that almost half (41 percent) of the world's oceans is strongly affected by multiple stresses. Highly affected regions include the Eastern Caribbean, the North Sea, and Japanese waters. Only a few areas around the North and South poles remain relatively unaffected by human activities. Negative cumulative impacts of human activities on coastal and marine ecosystems would probably be higher if historical effects, unreported extraction, recreational use (including fishing), disease, and point-source pollution were incorporated in future measurements.⁹

Many of the conflicts described above can and have been avoided or reduced through marine spatial management by influencing the location of human activities in space and time. During recent years, marine spatial management (which includes marine spatial planning) has become increas-

6. R. Bess and R. Rallapudi, "Spatial Conflicts in New Zealand Fisheries: The Rights of Fishers and Protection of the Marine Environment," *Marine Policy* 31 (2007): 719–729.

7. D. Sivas and M. Caldwell, "A New Vision for Californian Ocean Governance: Comprehensive Ecosystem-Based Marine Zoning," *Stanford Environmental Law Journal* 27 (2008): 209–270.

8. B. Worm, E. Barbier, N. Beaumont, J. Duffy, C. Folke, B. Halpern, J. Jackson, H. Lotze, F. Micheli, S. Palumbi, E. Sala, K. Selkoe, J. Stachowicz, and R. Watson, "Impacts of Biodiversity Loss on Ocean Ecosystem Services," *Science* 314 (2006): 787–790.

9. B. Halpern, S. Walbridge, K. Selkoe, C. Kappel, F. Micheli, C. Agrosa, J. Bruno, K. Casey, C. Ebert, H. Fox, R. Fujita, D. Heinemann, H. Lenihan, E. Madin, M. Perry, E. Selig, M. Spalding, R. Steneck, R. Watson, "A Global Map of Human Impact on Marine Ecosystems," *Science* 319 (2008): 948–952.

ingly important as a way to make ecosystem-based management¹⁰ a reality in coastal and marine environments.¹¹ While concepts regarding ecosystem-based management are often considered too broad, too abstract and too complex to enable effective implementation,¹² marine spatial management proves to be a way to make this process more tangible.¹³ Innovative and successful initiatives toward the development and implementation of ecosystem-based marine spatial management have been taken in both highly-used marine areas such as the North Sea, the Baltic Sea, the coastal area around China, and in large ocean areas such as Canada, Australia and New Zealand. A key characteristic of these marine spatial management initiatives is their ability to provide integration across multiple uses and sectors, to minimize conflicts, to maximize sustainable economic development, and to protect important habitat and biodiversity areas.¹⁴

10. The Convention on Biological Diversity describes ecosystem-based management as “a strategy for integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way. The ecosystem approach is based on the application of appropriate scientific methodologies focused on levels of biological organization, which encompass the essential processes, functions and interactions among organisms and their environment. It recognizes that humans, with their cultural diversity, are an integral component of ecosystems.” (Convention on Biological Diversity. Decision V/6 of the Conference of the Parties to the Convention on Biological Diversity. Ecosystem Approach, available online: <<http://www.biodiv.org>>).

11. L. Crowder, G. Osherenko, O. Young, S. Aïramé, E. Norse, N. Baron, J. Day, F. Douvère, C. Ehler, B. Halpern, S. Langdon, K. McLeod, J. Ogden, R. Peach, A. Rosenberg, and J. Wilson, “Resolving Mismatches in U.S. Ocean Governance,” *Science* 313 (2006): 617–618. See also C. Ehler and F. Douvère, “Visions for a Sea Change. Report of the First International Workshop on Marine Spatial Planning,” Intergovernmental Oceanographic Commission and Man and the Biosphere Programme. IOC Manual and Guides No. 48, IOCAM Dossier No. 4 (Paris: UNESCO, 2007); and F. Douvère, “The Importance of Marine Spatial Planning in Advancing Ecosystem-based Sea Use Management,” *Marine Policy* 32, no. 5 (September 2008).

12. K. Arkema, S. Abramson and B. Dewsbury, “Marine Ecosystem-Based Management: From Characterization to Implementation,” *Frontiers in Ecology and the Environment* 4 (2006): 525–532.

13. O. Young, G. Osherenko, J. Ekstrom, L. Crowder, J. Ogden, J. Wilson, J. Day, F. Douvère, C. Ehler, K. McLeod, B. Halpern, and R. Peach, “Solving the Crisis in Ocean Governance: Place-Based Management of Marine Ecosystems,” *Environment* 49 (2007): 21–30.

14. Ehler and Douvère, n. 11 above.

ECOSYSTEM-BASED MARINE SPATIAL MANAGEMENT: CHALLENGES AND OPPORTUNITIES

Most coastal countries already allocate ocean space. Among the most obvious are concession zones for resource exploitation (offshore oil and gas and development areas), designation of dumping sites, delineation of shipping routes and traffic separation schemes, and the designation of areas for nature protection.

Several of these allocations of ocean space result from international and regional agreements. At the global scale, the United Nations Convention on the Law of the Sea (UNCLOS) provides an overarching framework for the allocation of ocean space to national states through the codification of concepts such as the territorial sea of 12 nautical miles, the exclusive economic zone of 200 nautical miles, the contiguous zone, the continental shelf, and the high seas.¹⁵ Others include agreements on the delineation of special areas for the prevention of sea pollution introduced by the International Maritime Organization (IMO),¹⁶ the protection of cultural and natural world heritage (World Heritage Convention),¹⁷ or the designation of areas for the conservation of birds and habitat under the European Union directives¹⁸ and OSPAR Convention.

The problem with current practice, however, is that the designation of areas for both economic activities and nature protection is done on a single-sector basis.¹⁹ Current practice has no plan-based approach and has little or no consideration of the policies and plans of other uses or sectors or conservation requirements that may be conflicting or incompatible. For example, as nations move progressively toward establishing networks of marine protected areas as an alternative to individual sites, the management of ocean spaces outside the protected area becomes increasingly more

15. United Nations Convention on the Law of the Sea (1982), available online: <<http://www.un.org/Depts/los/index.htm>>.

16. International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto (MARPOL 73/78), available online: <www.imo.org>

17. Convention Concerning the Protection of the World Cultural and Natural Heritage. United Nations Educational, Scientific and Cultural Organization, Paris (1972), available online: <<http://whc.unesco.org/en/conventiontext>>.

18. Council of the European Communities Directive 79/409/EEC of 2 April 1979 on the Conservation of Wild Birds, OJ L 103, 24 March 1979 (as amended) and Council of the European Communities Directive 92/43/EEC of 21 May 1992 on the Conservation of Natural Habitats and of Wild Fauna and Flora, OJ L 206, 22 July 1992.

19. B. Halpern, "Managing for Cumulative Impacts in Ecosystem-based Management through Ocean Zoning," *Ocean and Coastal Management* 51 (2008): 203–211.

important. Establishing boundaries for management and planning efforts are also most often based on political considerations and not necessarily meaningful from an ecological perspective.

Triggered by the consequences of the industrial revolution, a similar situation was found on land about 100 years ago. Today, comprehensive land use planning is commonly used as a central component of developmental and environmental planning of land areas in both North America and Europe. The traditional project-by-project, permit-by-permit approach is now often guided by a comprehensive planning process that lays out a vision for the future development, growth, use, and protection of terrestrial areas. Today, this approach has become the standard for land-use planning and management. With only a few exceptions, no clearly articulated spatial vision for the future use of marine areas exists. In most cases, ocean management policies have not been translated into integrated, strategic and comprehensive spatial planning of all activities taking place in marine areas. The lack of such planning often translates into:²⁰

1. Spatial and temporal overlap of human activities and their objectives, causing user vs. user and user vs. environment conflicts in the marine environment;
2. Lack of connection between the various authorities responsible for individual activities or the protection and management of the environment as a whole;
3. Lack of connection between offshore activities and resource use and onshore communities that are dependent on them;
4. Lack of conservation of biologically and ecologically sensitive marine areas; and
5. Lack of investment certainty for marine developers and users of ocean resources.

Marine spatial planning 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, land use planning concepts and methodologies can rather easily be translated to the marine environment. As on land, spatial planning in the marine environment is a means to:

Create and establish a more rational organization of the use of marine space and the interactions between its uses, to balance demands for

20. Douvere, n. 11 above.

FIG. 1.—Types of Measures for Ecosystem-Based Sea Use Management

<p>INPUT MEASURES: <i>measures that influence the inputs to human activities in a marine area</i></p> <ul style="list-style-type: none"> • Limitations on fishing activity and capacity • Limitation on shipping vessel size or horsepower • Limitations on the amount of fertilizers and pesticides applied to agricultural lands 	<p>OUTPUT MEASURES: <i>measures that limit the outputs of human activities in a marine area</i></p> <ul style="list-style-type: none"> • Limitations on the amount of pollutants discharged to marine environments • Limitations on allowable catch and by-catch • Tonnage limitations on sand and gravel extraction
<p>PROCESS MEASURES: <i>measures that specify the nature of the process of human activities in a marine area</i></p> <ul style="list-style-type: none"> • Specification of fishing gear type, mesh size • Specification of 'best available technology' or 'best environmental practice' • Specification of level of waste treatment technology 	<p>SPATIAL AND TEMPORAL DISTRIBUTION MEASURES: <i>Measures what, where and when human activities can occur in a marine area</i></p> <ul style="list-style-type: none"> • Specification of areas closed to fishing • Designation of marine protected areas • Designation of areas for specific uses, e.g., wind farms, mining, etc.

Source: F. Douvere and C. Ehler, 2008.

development with the need to protect the environment, and to achieve social and economic objectives in an open and planned way.²¹

In its broadest sense, marine spatial management is about

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.²²

Marine spatial management 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 potentially conflicting uses to reduce the cumulative effects of human activities, and to deliver marine protection. It is meant to enhance the present sector-oriented management with a more comprehensive and coordinated approach to the multiple and increasingly expanding and

21. DEFRA, *A Sea Change. A Marine Bill White Paper*. Presented to Parliament by the Secretary of State for Environment, Food and Rural Affairs by Command of Her Majesty (London, 2007).

22. Ehler and Douvere, n. 11 above.

conflicting uses of the sea.²³ It provides an opportunity not only to better manage and understand the marine environment, but also allows long-term planning so that processes become more transparent with greater certainty in permitting, planning, and allocation for both developers and environmental managers.²⁴ In doing so, it can replace the current piecemeal view and make sure that commitments made in international and national marine policy and legislation, including commitments to apply an ecosystem approach, can be fulfilled.²⁵

It is important, however, to recognize that marine spatial management can only influence the spatial and temporal distribution of human activities. To implement the multiple objectives of an ecosystem-based management approach, a range of tools will be needed including measures that influence the input, the output, and the processes of human activities (Figure 1).

A focus on the spatial and temporal aspects of ecosystem-based management is one way to make this approach more tangible. Marine spatial management (including planning) does this by:

- Defining the boundaries of the ecosystem to be managed;
- Defining ocean spaces with special ecological or biological value within the ecosystem;
- Defining ocean spaces with special economic value and potential;
- Defining ocean spaces where the effects of human activities interact positively or negatively with ecological functions and processes; and
- Defining where conflicts are occurring or might occur (user vs. user and user vs. environment conflicts).

Through this process of defining spaces, marine spatial management:

- *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. 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;

23. D. Degnbol and D. Wilson, "Spatial Planning on the North Sea: A Case of Cross-scale Linkages," *Marine Policy* 32 (2008): 189–200.

24. CoastNET, *Spatial Planning in the Coastal and Marine Environment: Next Steps to Action*. Report of a CoastNET Conference (London: University of London, 2003).

25. F. Douvere and C. Ehler, "New Perspectives on Sea Use Management: Initial Findings from European Experience with Marine Spatial Planning," *Journal for Environmental Management* (forthcoming February 2009).

- *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 or 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; and
- *Guides single-sector management toward integrated decision-making.* The development of a marine spatial plan 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).²⁶

THE PRACTICE OF ECOSYSTEM-BASED MARINE SPATIAL MANAGEMENT

During the last decade, marine spatial management 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 management in the marine and coastal environment. Analysis of marine spatial management initiatives in various countries shows a clear evolution from early spatial plans designed to establish and manage marine protected areas (Australia and USA), to multiple-use marine spatial management (Northwest Europe and China), to more recent, systematic efforts to underpin the design of multiple-use marine spatial management with an ecosystem approach (Australia, New Zealand and Canada).

26. *Id.*

Marine Spatial Management for Nature Protection

Early marine spatial plans were first used to manage marine protected areas.²⁷ The focus of these plans has mainly been to ensure that conservation objectives were not impaired by human activity. 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. Spatial management in the GBRMP is based on eight zones, ranging from the least restrictive "general use zone" in which shipping and most commercial fishing is allowed, to the most restrictive "preservation zone" where virtually no use is permitted.²⁸ The spatial plan, first developed in 1981, has evolved and changed considerably in response to the dynamic nature of both the marine environment and perceived effectiveness of the first zoning plan.²⁹ When monitoring results showed that ecosystem protection goals were not being achieved, preservation zones were increased, up to about a third of the entire area.³⁰

Marine spatial planning 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 a shared coastal wetland system, is an interesting example of the use of spatial management 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 no-use zones, high-level protection zones, and general access zones.³¹

Another well-known example of marine spatial management as a means to conserve nature is the Florida Keys National Marine Sanctuary in the United States. Similar to the GBRMP, spatial management has been implemented through temporal and geographic zoning to ensure the protection of the Sanctuary and its resources and lessen the concentrated

27. Degnbol and Wilson, n. 23 above.

28. Great Barrier Reef Marine Park Authority, Great Barrier Reef Marine Park Zoning Plan 2003, available online: <http://www.gbrmpa.gov.au/__data/assets/pdf_file/0016/10591/Zoning_Plan.pdf>.

29. J. Day, "The Need and Practice of Monitoring, Evaluating and Adapting Marine Planning and Management: Lessons from the Great Barrier Reef Marine Park," *Marine Policy* 32, no. 5 (September 2008).

30. *Id.*

31. J. Enemark, Secretary of the Common Wadden Sea Secretariat, pers. comm. (February 2007).

impact to marine organisms on heavily used reefs. In addition to the existing management areas, four new zone types were implemented throughout the Sanctuary, including: Wildlife Management Areas focusing on sensitive wildlife populations and ranging from no-access buffer zones to closed zones; Ecological Reserves focusing on large, contiguous diverse habitats, allowing activities that are compatible with resource protection; Sanctuary Preservation Areas focusing on heavily used reefs, prohibiting all consumptive activities; and, Special-use Areas reserved for scientific research, education, restoration and monitoring, only allowing specific uses and limited in their length of duration.³²

While the long-standing experience of the GBRMP and Florida Keys National Marine Sanctuary provides valuable lessons about the elements of a successful marine spatial management process (see below), it is important to realize that their context and associated challenges (each of them is of iconic value and implemented in large, relatively low impact areas) is substantially different from the highly-used and industrialized marine areas in most other places around the world.

Marine Spatial Management for Multiple-Use Objectives

More recent attention has been placed on managing the multiple use (which includes nature protection) of marine space. This is especially the case in densely used areas such as the North Sea (North-West Europe) where conflicts among users and the environment are already clear. Here, marine spatial management has developed quickly, although often on an *ad hoc* basis. The main drivers for the implementation of marine spatial management in these areas come from both the demand for new ocean uses, such as offshore wind energy generation and aquaculture, and international requirements for the protection and conservation of ecologically and biologically valuable areas. The Netherlands and Belgium have both implemented marine spatial planning. Marine spatial planning is also underway in Germany and the United Kingdom, but both countries have chosen to first establish a strong legal basis for marine spatial planning before starting to develop spatial plans and initiatives.

In 2005, The Netherlands developed an overarching spatial planning framework for the Dutch area of the North Sea, with the primary objective to “enhance the economic importance of the North Sea and maintain and develop the international ecological and landscape features by developing and harmonizing sustainable spatial-economic activities in the North Sea,

32. See the Zoning Action Plan of the Florida Keys National Marine Sanctuary, available online: <<http://floridakeys.noaa.gov/regs/zoning.html>>.

taking into account the ecological landscape features.”³³ Implementation of the spatial policy is described in the Integrated Management Plan for the North Sea 2015 (IMPNS 2015),³⁴ 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 private sector flexibility to develop offshore initiatives and projects. To limit the risks involved in complete market freedom, the spatial policy provides a guiding spatial management framework in which location-based uses (usage zones), a zoning scheme for growth options, and several exclusion policies, are defined. Central to the Dutch marine spatial management framework 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 to facilitate managing the use of ocean space. These new tools include “opportunity maps” that show where a use is permitted in the current framework and is most likely to 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 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 (Figure 2). The Dutch spatial planning initiative is designed for the period 2005–2015 and will be reviewed after its first five years. Current experiences, especially with regard to the offshore wind industry, tend to stimulate a bigger role for spatial planning (e.g., more zones and accompanying criteria for specific uses) in future sea use management in The Netherlands.

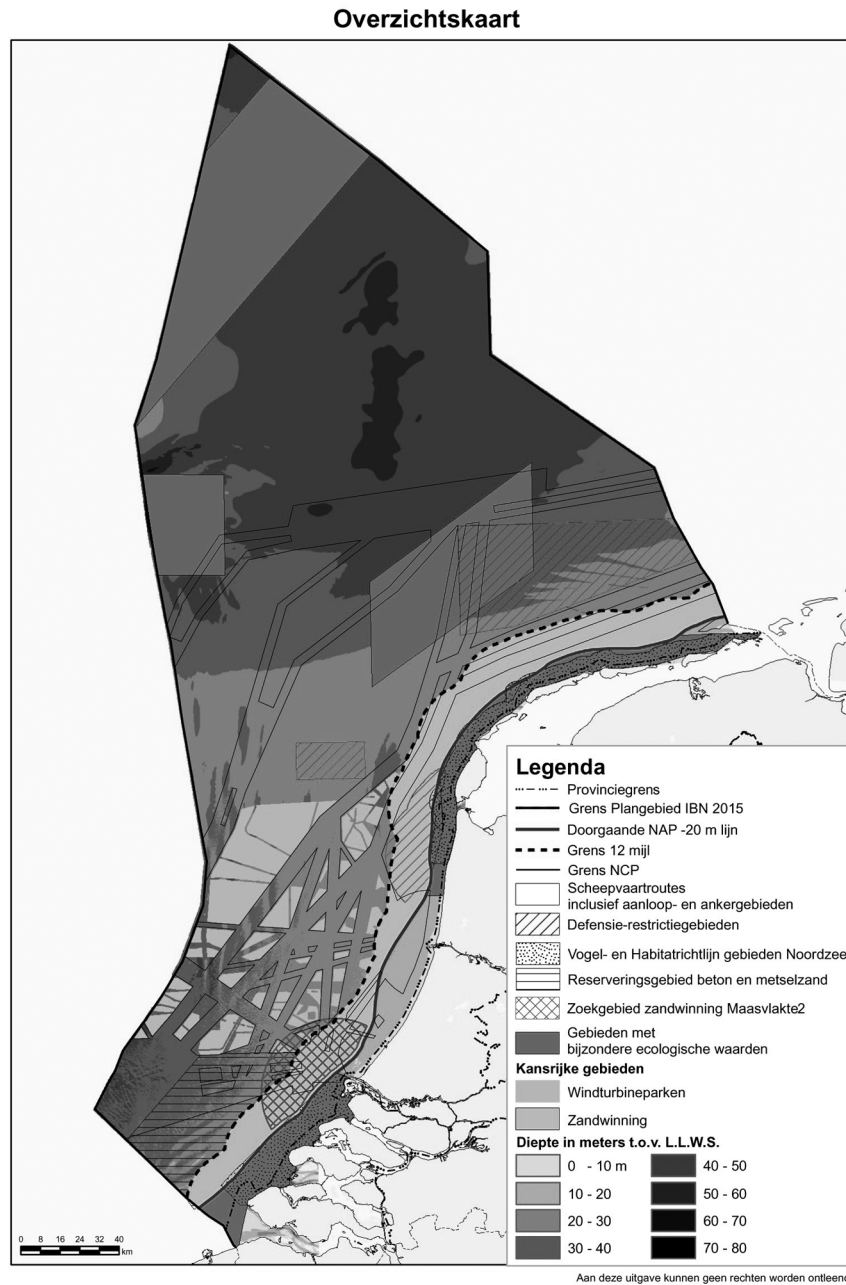
Belgium recently implemented an operational, multiple-use planning system covering its territorial sea and exclusive economic zone.³⁵ The core objectives of the Belgian spatial planning policy framework include the development of offshore wind farms, the delimitation of marine protected areas, a policy plan for sustainable sand and gravel extraction, 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 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

33. Integrated Management Plan for the North Sea 2015 (IMPNS 2015), Interdepartmental Directors Consultative Committee (The Netherlands, 2005).

34. *Id.*

35. C. Plasman and U. Van Hessche, “Duurzaam beheer van de Noordzee,” *Argus Milieumagazine* 3 (2004): 4–7.

FIG. 2.—Marine Spatial Management in the Dutch Part of the North Sea



Source: Rijkswaterstaat Noordzee, 2005. Used by permission.

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.³⁶

Marine spatial management is also underway in the United Kingdom and Germany. In March 2007, the United Kingdom government released its Marine Bill White Paper.³⁷ A key element of the Marine Bill is the introduction of a new system of marine spatial management for the entire U.K. marine area that will allow a strategic, plan-led approach to the use of marine space and the interactions between its uses. Marine spatial management in the United Kingdom 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.”³⁸ A spatial planning system will encompass all activities and will be directed to deliver sustainable development by facilitating proactive decision-making. Marine plans will be developed by a newly established “Marine Management Organization”, that will guide decisions on license applications and other issues, and provide users of the sea with more certainty. The potential and ability of spatial management to judge the combined effects of many activities over time is one of the key considerations toward implementation of spatial management in the United Kingdom. The feasibility and practicality of developing and applying marine spatial management in the waters of the United Kingdom have been extensively researched and tested through a pilot project conducted in the Irish Sea, concluded in 2004.³⁹ The Marine Bill has been introduced to the Parliament of the United Kingdom and is likely to come into effect in late 2009.

Finally, Germany extended its *Federal Spatial Planning Act* to the EEZ in 2004. The spatial planning initiative for the EEZ started with the development of a set of goals and principles for spatial planning in the framework of UNCLOS. In 2007, the Federal Maritime and Hydrographic Agency completed a draft spatial plan and an associated environmental report for

36. F. Douvere, F. Maes, A. Vanhulle and J. Schrijvers, “The Role of Spatial Planning in Sea Use Management: The Belgian Case,” *Marine Policy* 31 (2007): 182–191.

37. DEFRA, n. 21 above.

38. *Id.*

39. *The Irish Sea Pilot*, Report to DEFRA by the Joint Nature Conservation Committee (United Kingdom, 2004).

the German EEZ in both the North Sea and the Baltic Sea. 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.”⁴⁰ 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 management approach includes the possible designation of “priority areas” and “reservation areas,” 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. A final plan was published in June 2008.⁴¹ In the German territorial sea, the Länder (states) are responsible for spatial management, including planning. Mecklenburg-Vorpommern (Baltic Sea) and Niedersachsen (Lower Saxony; North Sea) expanded their existing spatial plans from the landside to the coast area. In 2005, Mecklenburg-Vorpommern extended its 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.”⁴²

Of considerable importance in the examples of The Netherlands, Belgium, Germany, and the United Kingdom, is their use and application of marine spatial management to govern multiple-uses in the entire marine area under their jurisdiction. 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 a marine spatial management strategy for the entire area that balances them with the need to ensure economic growth and stability for infrastructure investments (e.g., port extensions, aquaculture facilities, and wind farms).

A major challenge in all four of the countries, however, is the need to underpin marine spatial planning efforts with an ecosystem approach. The North Sea is a dynamic and interconnected ecosystem that should be considered as a whole. The interconnectedness of adjacent ocean spaces, the cross-boundary impact of ocean uses, and the broader scale needed to be ecologically meaningful, require that marine spatial plans developed at the national level are embedded in a broader, international context and integrate, or at least address, the dynamics of the system as a whole. None of

40. N. Nolte. Head Spatial Planning Unit, Bundesamt für Seeschifffahrt und Hydrographie, pers. comm. (August 2007).

41. Federal Maritime and Hydrographic Agency, available online: <http://www.bsh.de/en/The_BSH/Notifications/Spatial_Planning_in_the_German_EEZ.jsp>.

42. Landesraumentwicklungsprogramm Mecklenburg-Vorpommern, Ministerium für Arbeit, Bau und Landesentwicklung Mecklenburg-Vorpommern (Germany, 2005).

the spatial planning initiatives described above have integrated or addressed this broader international context, nor do they have a framework in place that might allow cooperation in the future.⁴³ However, the new turn that European marine management is taking is very promising. The 2007 EU Green Paper “Towards a Future Maritime Policy for the Union: A European Vision for the Oceans and Seas”⁴⁴ (Maritime Policy) and the Marine Strategy⁴⁵ introduced the principle of ecosystem-based marine spatial planning and initiated the concept of “marine regions” as larger, ecologically meaningful, management units that can stimulate cooperation between Member States in achieving the EU objectives for the marine environment, including ecosystem-based marine spatial management (Figure 3).⁴⁶

Similar efforts toward multiple-use marine spatial management are also underway 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. 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 provincial or local governments for implementation.⁴⁷

Marine Spatial Planning Based on an Ecosystem Approach

More systematic approaches toward the establishment of ecosystem-based marine spatial management have started to emerge in Australia (outside the GBRMP), New Zealand and Canada. For example, Australia has used the concept of “marine bio-regionalization” as a platform for the development of marine spatial management since the late 1990s. Bio-regionalization

43. Douvere and Ehler, n. 25 above.

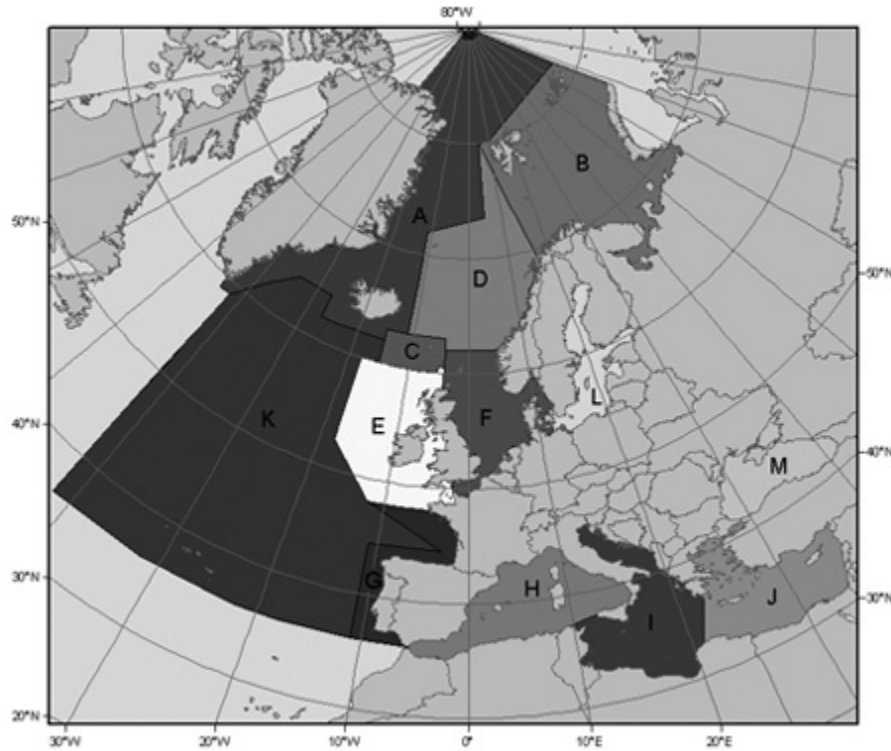
44. Commission of the European Communities. *Green Paper: Towards a Future Maritime Policy for the Union: A Vision for the Oceans and Seas*, COM(2006)275 final (Brussels, 2006).

45. Thematic Strategy on the protection and conservation of the marine environment. Communication from the Commission to the Council and the European Parliament. COM(2005)504 final (Brussels, 2005).

46. European Commission, *EU Marine Strategy. The Story Behind the Strategy* (Brussels, 2006).

47. H. Li, “The Impacts and Implications of the Legal Framework for Sea Use Planning and Management in China,” *Ocean and Coastal Management* 49 (2006): 717–726.

FIG. 3.—Marine Regions as Proposed by the International Council for the Exploration of the Sea (ICES)

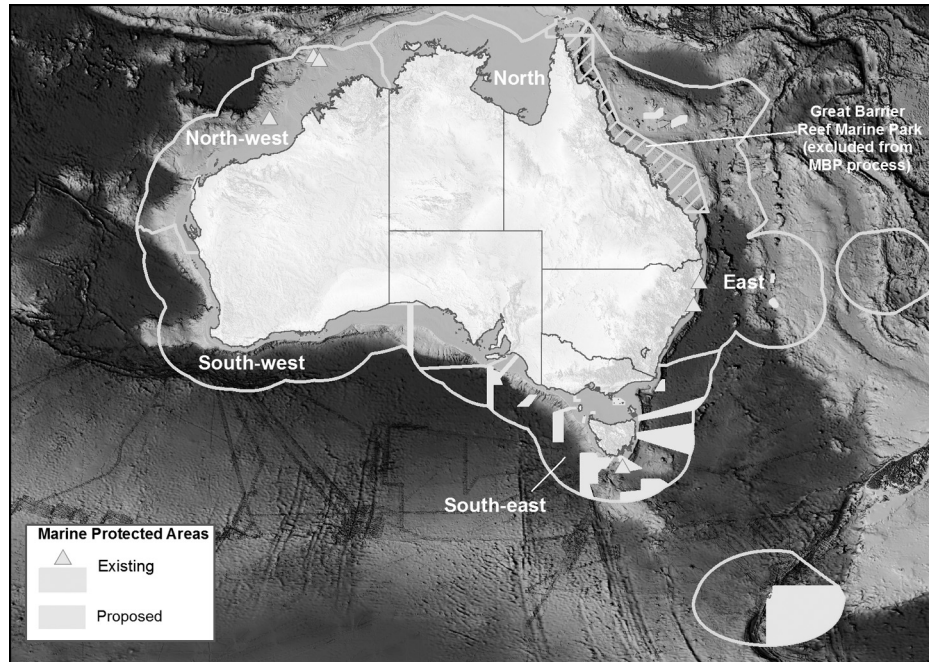


Source. Reproduced with permission of ICES.

describes the spatial patterns in the benthic (on or near the sea floor) and pelagic environments at scales appropriate to marine spatial management. Bio-regionalization is used, among other purposes, to define ecologically-based planning and management units, to map their location, structure and composition, to provide the basis to select biologically and ecologically important areas for protection, to provide a systematic framework for finer-scale planning and management of ocean uses, and to provide a spatial framework for environmental assessments.⁴⁸ The bio-regionalization process has the overall objective to provide a “clearer focus on conservation and sustainable management of the marine environment and offer greater

48. Commonwealth of Australia, National Marine Bioregionalisation of Australia, Summary (Australia: Department of Environment and Heritage, 2005).

FIG. 4.—Marine Planning Regions in Australia



Source: Australian Government, 2006. Used by permission.

certainty for industry.”⁴⁹ The waters around Australia (outside the GBRMP) have been divided into five marine regions: South-East, South-West, North-West, North, and East (Figure 4). Each marine region is further divided into “bioregions” based on ecological similarities, species distributions, and oceanographic and seafloor characteristics. These bioregions reflect the understanding of the region’s ecology and underpin the spatial management process.⁵⁰

For each of these marine regions, a bioregional plan is being completed that contains:

49. Australian Government, Marine Bioregional Planning, available online: <<http://www.environment.gov.au/coasts/mbp/index.html>>.

50. Australian Government, Department of the Environment and Water Resources, The South-west Marine Bioregional Plan/Bioregional Profile (Australia, 2007).

- A description of the regions' key habitats, plants and animals, natural processes, human uses and benefits, and threats to the long-term ecological sustainability of the region;
- Detailed description of the various statutory obligations that apply to the region;
- Identification of regional priorities for protection of conservation values, based on an appreciation of threats; and
- Identification of how environmental quality and condition of the area will be monitored in the future.

The development of marine bioregional plans is comprised of three main stages. The first stage of the planning process involves developing a "regional profile" for each marine region. The regional profile gives details about the various statutory obligations with regard to nature protection and other marine spatial management measures. It also sets out the objectives for the identification of a network of marine protected areas in the region. The second stage involves development of a "draft plan" that contains a strategic regional assessment of conservation values and current and emerging pressures on the marine environment. The assessment of the draft plan identifies key conservation and heritage priorities for each marine region and the range of legislative and administrative tools available to manage them. The third and final stage involves the development of the "bioregional plan," which is completed after public consultation of the draft plan. It identifies conservation values in the region, priorities and measures for the protection of these values, a network of marine protected areas, and a set of sustainability indicators that will be used to assess the health of the marine environment into the future.⁵¹ A plan for the South-East Marine Region⁵² has been completed and a bioregional profile has been completed for the South-West Marine Region.⁵³ The other four plans are in development and will be completed by 2012.

Similar efforts are underway in New Zealand where coastal and deepwater classification systems have been developed to identify bio-geographic regions that will underpin the management of ocean spaces.

51. Australian Government, Department of the Environment and Heritage. *Marine Bioregional Planning, A new focus for Australia's marine planning* (Australia, 2006).

52. Australian Government, National Oceans Office, *South-East Regional Marine Plan: Implementing Australia's Oceans Policy in the South-East Marine Region* (Australia, 2004).

53. Australian Government, Department of the Environment and Water Resources. *The South-West Marine Bioregional Plan. Bioregional Profile, A Description of the Ecosystems, Conservation Values and Uses of the South-West Marine Region* (Australia, 2007).

Thirteen coastal bio-geographic regions have been identified on the premise that similar physical habitats and ecosystems, if separated by enough space, will contain different biological communities due to a combination of broad-scale factors, including oceanography, current dynamics, large-scale latitudinal gradients, climate, or barriers to dispersal. A Marine Environment Classification (MEC) with 20 class levels has been developed as a primary tool for classification in the deepwater environments of New Zealand's EEZ.⁵⁴

Although in an earlier stage, a similar approach toward marine spatial management is taken in Canada. Five Large Ocean Management Areas (LOMAs)⁵⁵ have been identified to address large-scale ocean space issues and provide the context for future spatial management. Canada's marine spatial framework is further developed around 19 ecological units (marine eco-regions) based on scientific criteria delineated to ensure that management areas capture ecosystem-scale features, patterns and trends.⁵⁶ Marine spatial management is furthest developed for the Eastern Scotian Shelf where a strategic plan for integrated ocean management has been developed and released.⁵⁷ As part of the plan, human uses have been identified and mapped and objectives have been set for future management of ocean space.⁵⁸

Finally, although marine spatial management initiatives in Europe are developing within national boundaries, it is promising that the European Commission's approach attempts to focus future efforts on the concept of marine regions and sub-regions. Similar to Australia's and Canada's experiences, these marine regions are defined on the basis of physical and ecosystem characteristics, including hydrologic, oceanographic, and bio-geographic features, rather than simply on the consideration of political boundaries.⁵⁹

54. Department of Conservation, *Marine Protected Areas: Classification, Protection Standard and Implementation Guidelines* (New Zealand, 2008).

55. The LOMAs identified include Placentia Bay/Grand Banks, the Scotian Shelf, the Gulf of St. Lawrence, the Beaufort Sea, and the Pacific North Coast.

56. Fisheries and Oceans Canada, "Workshop Report: Bringing International Lessons Learned and Good Practices to Bear on Canada's MPA Networks Framework" (unpublished report, Ottawa, 9–10 January 2008).

57. Fisheries and Oceans Canada, Oceans and Habitat Branch. *Eastern Scotian Shelf Integrated Ocean Management Plan* (Government of Canada: Dartmouth, Nova Scotia, 2007), available online: <<http://www.mar.dfo-mpo.gc.ca/oceans/e/essim/essim-intro-e.html>>.

58. J. Walmsley, S. Coffen-Smout, T. Hall, G. Herbert, "Development of a Human Use Objectives Framework for Integrated Management of the Eastern Scotian Shelf," *Coastal Management* 35 (2007): 23–50.

59. L. Juda, "The European Union and Ocean Use Management: The Marine Strategy and the Maritime Policy," *Ocean Development and International Law* 38 (2007): 259–282.

THE PROCESS OF ECOSYSTEM-BASED MARINE SPATIAL MANAGEMENT

There is not one model of practical experience that shows how to best develop spatial management in the marine environment. One way to extract lessons learned from experiences is to look at one (or more) element of the process that has been done successfully in a particular place. Stakeholder involvement and the incorporation of ecological criteria tend to be further developed in Australia and Canada, while methods toward conflict resolution and user-compatibilities within multiple-use environments are generally more evolved in Europe. The latter also illustrates the pros and cons of different approaches to establish legal authority for marine spatial management, and reveals the weakness of not cooperating across international boundaries. Academic exercises in Europe have studied the benefits of developing alternative scenarios for the future use of ocean space as a way toward more systematic planning for sustainable development.⁶⁰ China, on the other hand, illustrates ways to sustain financial sources for spatial management by introducing a user fee system.⁶¹

The need for a continuous, iterative, and adaptive approach to marine spatial management is well illustrated in the substantial experience of Australia's GBRMP. Despite its principal focus on marine protection, as opposed to balancing economic, social, and ecological objectives in Europe, spatial management has been the cornerstone of the management of the GBRMP for over 30 years, and illustrates clearly the need for evaluation, monitoring and adaptation of marine spatial plans.⁶² European examples illustrate that spatial management should include sufficient flexibility to adapt to changing circumstances that result from technological developments, shifting priorities, or the need to expand existing infrastructure.

Practices around the world, as well as academic literature on the subject, demonstrate that marine spatial management should not be limited to a one-time plan. Spatial management, as any other type of management, is a process that is futile if it is not matched by a long-term commitment of people, equipment, and financing.⁶³ Generally, marine spatial management will consist of at least three ongoing phases (Figure 5):⁶⁴

60. F. Maes, J. Schrijvers, and A. Vanhulle, *A Flood of Space. Towards a Spatial Structure Plan for Sustainable Management of the North Sea* (Ghent: Belgian Science Policy, 2005).

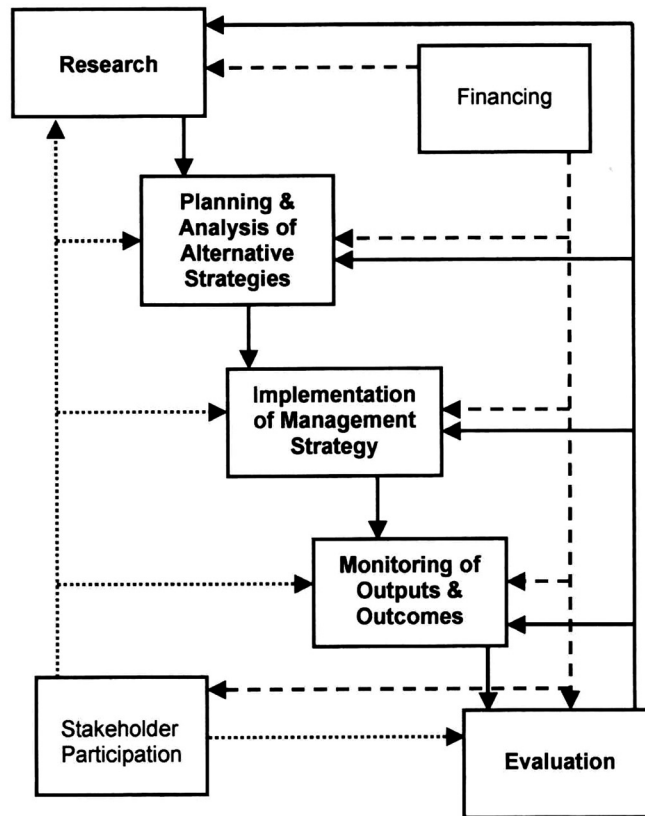
61. Li, n. 47 above.

62. J. Day, "Zoning Lessons from the Great Barrier Reef Marine Park," *Ocean and Coastal Management* 45 (2002): 139–156.

63. R. Kenchington, honorary fellow, Center for Marine Policy, University of Wollongong, Australia, pers. comm. (May 2008).

64. Ehler and Douvere, n. 11 above.

FIG. 5.—Essential Elements of a Marine Spatial Management Process



Source: C. Ehler and F. Douvère, 2007.

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. Plans will incorporate alternative options for the future use of ocean space. The planning and analysis phase should be based on applied research (including mapping) that address both environmental and human processes;
2. *Implementation*: implementing the plan through the execution of programmed works or investments, enabling change, encouraging improvement, enforcement of proposed changes through regulation and incentives, and ongoing activities in, on, over and under the sea, in accordance with the plans; 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.

The planning and analysis for marine spatial management should be based on the results of directed research and data collection. While most of the examples discussed above focus on the use of ecological and biological data, it is indispensable for successful spatial management to give an equally important weight to the human dimension.⁶⁵ Research and data information needed for ecosystem-based marine spatial management should focus on:

- Biological and ecological research and data collection to identify areas of ecological and biological significance (the ecological dimension); and
- Social and economic research and data collection to connect offshore activities with onshore communities, cultures, and socio-economic factors (the human dimension).⁶⁶

Finally, the management of the marine environment involves the management of people.⁶⁷ As spatial management attempts to establish an integrated approach across sectors, it is crucial that stakeholders are involved throughout the process. Several types of involvement exist, ranging from communication, where there is no actual participation, to negotiation, where decision-making power is shared among various stakeholders.⁶⁸

65. *Id.*

66. K. St. Martin, "Making Space for Community Resource Management in Fisheries," *The Annals of the American Association of Geographers* 91: 122–142; see also K. St. Martin and M. Hall-Arber, "The Missing Layer: Geo-technologies, Communities, and Implications for Marine Spatial Planning," *Marine Policy* 32, no. 5 (September 2008).

67. R. Kenchington, *Managing Marine Environments* (New York: Taylor & Francis, 1990).

68. Other types of stakeholder involvement include information, consultation, dialogue or concertation. Concertation is a form of stakeholder participation introduced in the context of managing biosphere reserves and refers to a form of stakeholder involvement whereby the goal is to develop a common and shared vision among the stakeholders regarding the management of resources with a view to acting, deciding or defending collectively before decision makers. See M. Bouamrane, *Biodiversity and Stakeholders: Concertation Itineraries, Biosphere Reserves, Technical Notes* (Paris: UNESCO, 2006). See also R. Pomeroy and F. Douvère, "The Engagement of Stakeholders in the Marine Spatial Planning Process," *Marine Policy* 32, no. 5 (September 2008).

THE FUTURE OF ECOSYSTEM-BASED MARINE SPATIAL MANAGEMENT

Although critical voices about the potential, nature and scope of spatial management exist,⁶⁹ the fact that ecosystem-based management is place-based and needs a more systematic spatial and temporal approach is generally accepted.⁷⁰ What is missing, however, is a clear demonstration of how it can be implemented. As no single, readily applicable best practice exists, many have expressed the need for better-defined tools, procedures, and guidelines that support the implementation of ecosystem-based, marine spatial management.⁷¹

This assumption has been the main conclusion of the two years of work of the Ocean Zoning Working Group of the National Center for Ecological Analysis and Synthesis (NCEAS), University of California, Santa Barbara.⁷² A similar conclusion was drawn from the first UNESCO International Workshop on the use of marine spatial planning as a tool to implement ecosystem-based, sea use management.⁷³ In its latest communication, the European Commission confirmed that integrated marine spatial management is fundamental and announced its plans to develop a system for the exchange of good practices and guidance to facilitate and encourage implementation of ecosystem-based marine spatial management.⁷⁴

Under the auspices of UNESCO's Intergovernmental Oceanographic Commission (IOC) and Man and the Biosphere Programme (MAB), a comprehensive set of guidelines and principles for the implementation of ecosystem-based marine spatial management is under development. In the first phase, at least ten international examples of marine spatial management, at different stages of development, will be analyzed and documented with the objective of providing necessary and fundamental information for applications of ecosystem-based marine spatial management. The analysis

69. See, for example, D. Peel and M. Lloyd, "The Social Reconstruction of the Marine Environment: Towards Marine Spatial Planning?" *Town Planning Review* 75 (2004): 359–378.

70. Crowder et al., n. 11 above.

71. Ehler and Douvere, n. 11 above.

72. National Center for Ecological Analysis and Synthesis (NCEAS), University of California, Santa Barbara. Further information available online: <<http://www.nceas.ucsb.edu>>.

73. F. Douvere and C. Ehler, "International Workshop on Marine Spatial Planning, UNESCO, Paris, 8–10 November 2006. Conference Report," *Marine Policy* 31 (2007): 582–583.

74. Commission Staff Working Document, Accompanying document to the communication from the Commission, An Integrated Maritime Policy for the European Union, Commission of the European Communities, SEC(2007)1278/2 provisional version (Brussels, 10 October 2007).

and documentation of international examples focus on steps taken during the marine spatial management process that have led to successful implementation and desired outcomes. An indication of crucial steps will allow decision-makers and resource managers to better determine their priorities in implementing ecosystem-based marine spatial management. In a second stage, a draft of the guidelines and principles manual will be tested, fine-tuned, and adapted to the context of specific marine ecosystems through regional meetings and workshops. Two regional meetings are planned in places that are ready for marine spatial management. The final guidelines will be published in May 2009.⁷⁵

CONCLUSION

Ocean resources are limited both in space and abundance. The ongoing industrialization and expansion of ocean uses and the rise of new uses have increased considerably the demand for ocean space. In some areas, combined demand for ocean space exceeds already more than three times the available space. Today, this trend has led to two important types of conflict; conflicts among users as a result of incompatible demands for ocean space, and conflicts between users and the environment resulting from the impact of uses on sensitive ecological areas. During recent years, marine spatial management, underpinned by an ecosystem approach, has been brought forward as a way to deal with these conflicts and to apply an ecosystem approach to the management of the marine environment. Marine spatial management can do this by (a) addressing the heterogeneity of marine ecosystems in a practical manner; (b) focusing on influencing behavior of humans and their activities over time; (c) providing a management framework for new and previously inaccessible scientific information; (d) making conflicts and compatibilities among human uses visible, and therefore, tangible; and (e) guiding single-sector management toward integrated decision-making.

Throughout the world, several countries have begun to move the conceptual work forward and have started to implement marine spatial management successfully. While early plans such as Australia's GBRMP spatial plan or the Florida Keys National Marine Sanctuary management plan were brought forward to establish and manage marine protected areas, more recent attention has been placed on multiple-use of marine space. The Netherlands and Belgium have implemented marine spatial manage-

75. Intergovernmental Oceanographic Commission and Man and the Biosphere Programme, UNESCO. *Ecosystem-based, Marine Spatial Management*, available online: <<http://ioc3.unesco.org/marinesp>>.

ment through which nature conservation requirements and new demands for ocean use were merged successfully. Germany, the United Kingdom and China also have similar multiple-use marine spatial management underway. A major challenge in Europe is the need to undertake marine spatial management in broader areas, with boundaries drawn on the basis of ecological considerations rather than political ones. This challenge is greatly stimulated by the European Union as part of its newly released Maritime Policy and the introduction of “marine regions” in the context of the Marine Strategy. More systematic attempts to underpin marine spatial management with an ecosystem approach have been taken in Australia, Canada and New Zealand.

Although no parallel can be drawn between the contexts and associated challenges of the GBRMP and the densely-used areas in Europe or China, some very important lessons can be learned about the process of ecosystem-based marine spatial management. The long-standing experience of the GBRMP illustrates the need to conduct marine spatial management in a continuous manner, one that allows monitoring and evaluating initial plans and adapting them to changing circumstances. It also illustrates that stakeholder involvement and sustainable financing are critical to a successful outcome of marine spatial management. The more recent spatial management initiatives in Europe focus more on resolving conflicts among users and a shared use of ocean space. Finally, ecosystem-based marine spatial plans should be based on sound research and data that addresses the ecological and human dimension of marine spatial management in an equally important way. While biological and ecological information can enable the identification of areas of ecological and biological significance—the ecological dimension, social and economic information should establish the connection of offshore activities with onshore communities, cultures, economies, and constituencies—e.g., the human dimension.