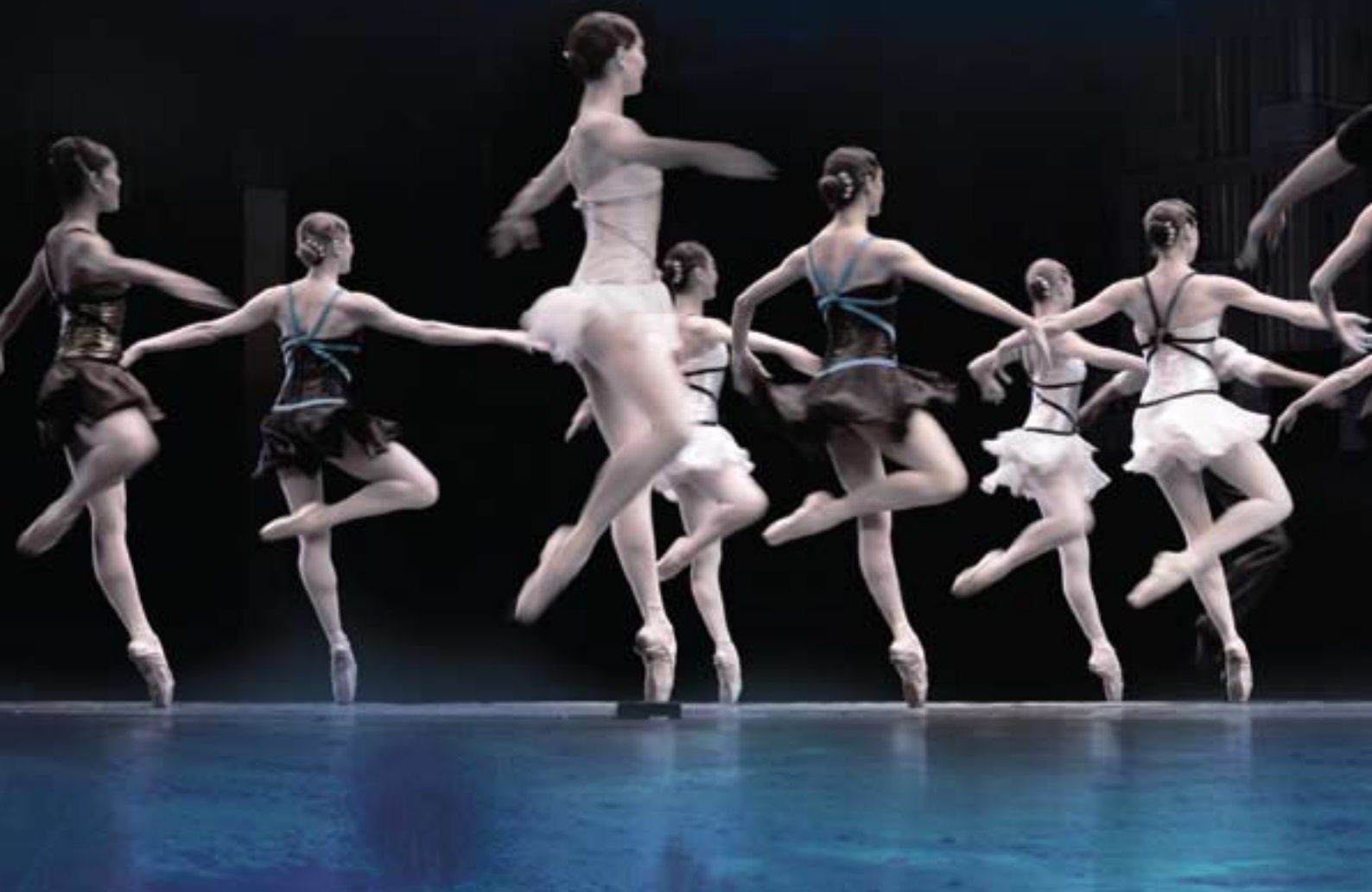
What lies beneath?

Successful marine spatial planning requires the connectedness that exists within the marine environment to flow through our work. ***Erik Olsen*** *considers how current efforts can be enhanced.*



◀ *The act of encapsulating an undersea environment is closer to rendering the unfolding of a dance.*

Our world is three-dimensional, but we conceptualize, manage, and utilize our environment in two-dimensions. We live in houses that are described by floor plans and located in countries that are represented by two-dimensional maps. We write in two dimensions, our computer screens present information in two dimensions, and we store our visual memories in two-dimensional photographs. Cognitively, we favour two-dimensional processes.

The world beneath the waves is also three-dimensional, but it requires an unequivocally three-dimensional representation. Significant processes, components, and geographical features exist simultaneously, one above the other, in a way that completely confounds any attempt to depict it two-dimensionally.

The act of encapsulating an undersea environment is closer to rendering the unfolding of a dance.

Adding the fourth dimension of time complicates the picture further. The processes have duration, the components are often moving, with varying dynamics, and the endless cycle of the seasons imposes constant change. Seen in these terms, the act of encapsulating an undersea environment is closer to rendering the unfolding of a dance.

Merely depicting its subject is the first challenge faced by marine spatial planning (MSP), but its goal – the creation of a management plan that integrates the myriad elements of the different forms of human use, conflicting goals and interests, scientific knowledge, stakeholder involvement, and governance – seems unreachable. And all of this in an environment that is "invisible" to us because it is hidden beneath the waves.

The appeal of MSP is its promise to translate the ecosystem approach into practical management action and to find ways of accommodating the competing demands of human uses in a marine space.

It offers a way of managing marine space while remembering ecological, social, and economic objectives, and a solution to the problem of transforming many, although not all, of the concepts of the ecosystem approach into practical action. Using marine space as an arena, it is possible to test different management approaches and their effects on both the entire ecosystem and human activities, not just on a single ecosystem component or activity.

Unfortunately, few examples of the ecosystem approach (or ecosystem-based management) are practically implemented in management and advice. Moreover, in order to manage ecosystems successfully, it is particularly important to consider the spatial dimension of management. Also, until now, all existing examples of MSP plans take a two-dimensional approach to the final mapping and zoning.

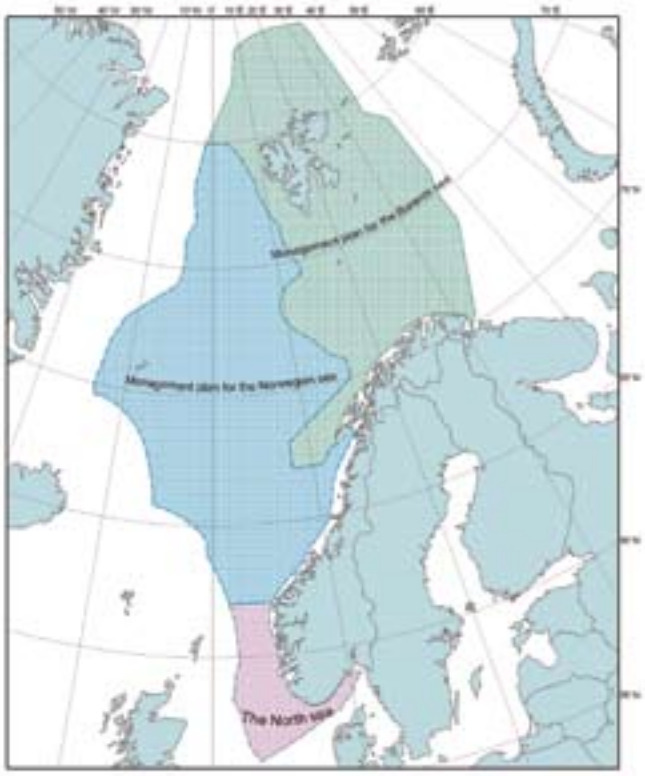
Why all the fuss?

Traditional management of human marine activities has been on a sector-by-sector basis. Spatial considerations have informed sectoral management, but these regulations have not been recognized in a wide cross-sectoral or ecological context, and this is the key point in MSP.

Such planning is accomplished by using marine space as an arena for overlaying, contrasting, and comparing sectoral management with overarching management aims, and, in some cases, identifying sectors where sectoral policies are poorly developed in a spatial context.

We are attempting to manage the human use (or non-use, i.e. conservation) of the marine environment. How we go about this differs from sector to sector. The differences arise from a combination of culture, scientific background, governance, and politics. The successful integration of these often contradictory sectors requires that we find a common ground, and marine space is the most obvious starting point, because all human activities use marine space.

MSP thus offers benefits to all parties involved in managing the marine environment. First and foremost, it offers an overarching system for governance that gives certainties to all parties involved. For managers, it is a practical procedure that leads to compromise management solutions to conflicting interests and aims. For fisher and industry groups, it ensures that their interest



▲ *The areas planned for Norway's three integrated management plans (spatial plans), where the whole ecosystem and all human activities are seen in conjunction.*

in securing rights and access to areas is treated clearly and fairly in the management process. For environmental groups (and other NGOs), it ensures that sectoral management is put in a wider, ecosystem-based context, where aims for good status of the environment are given due considerations. Lastly, for the decision-makers (politicians), it reduces the conflict level and offers a choice of management options that allows those in power to put their political goals into action.

MSP builds on existing sectoral management and policies, and aims to combine these in a spatial context, but it should not be seen as a replacement for existing sector-based management. MSP is a complement to these, a way of encouraging cooperation for the greater good.

Traditional management of human marine activities has been on a sector-by-sector basis, mostly aimed at technical regulations or regulation of intensity.

Spatial complications of species distributions

Marine ecosystems are complex, not only because of the third dimension and inaccessibility, but also because the connectedness of the marine system is much stronger than systems on land. On land, physical features, such as mountains, rivers, lakes, and deserts, form impassable barriers to plants and animals, and function as natural boundaries to their distribution.

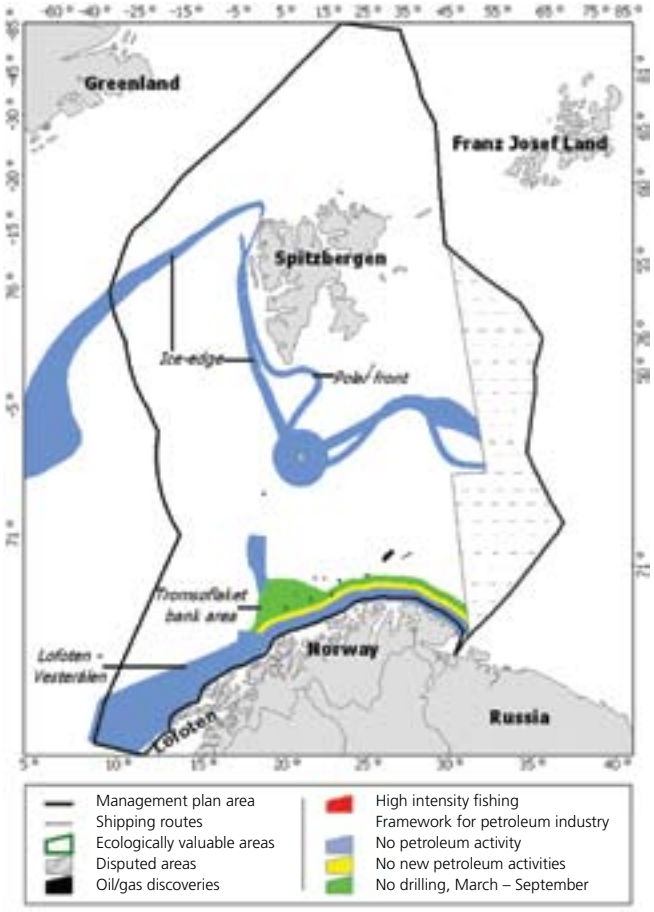
In the marine environment, most organisms have planktonic eggs or larvae that can easily bypass areas of unsuitable bottom habitat, such as trenches and mountain ranges. However, the same water masses that facilitate distribution may act as effective barriers to distribution, preventing the spread of eggs and larvae. The boundaries formed by these water masses are driven by the Earth's climate system and are not static but vary in space and time.

Defining features such as currents, frontal systems, and ice edges in a map suitable for management is difficult at best. In a planning context, this stochasticity is harrowing because it makes it very difficult to create a plan that captures the distribution of ecosystem components in a biologically sensible manner while not oversimplifying.

A map showing the distribution of ice-associated seals in an Arctic ocean can be used as an example. Seal distribution varies with the ice edge, which varies seasonally and interannually, depending on shifting climate conditions. Mapping their distribution area would encompass all areas where they are observed, although at any given time, the seals only use a very small portion of the total potential habitat. A way of circumventing this problem has been to define key areas for ecosystem components, i.e. those areas of greatest importance for the continued survival and productivity of the component.

What has been achieved

Current MSP development has focused on the interaction between human activities and the environment. The socio-economic dimension has largely been overlooked and is the greatest shortcoming of most existing plans. This may be because many MSP plans have been developed by managers with the support of natural scientists and engineers, while social scientists and economists have, at best, played a peripheral role. Including them as equal members in the development of MSP is necessary to give socio-economic considerations their proper place in MSP. Without it, the plans will be



▲ *The zoning plan for the petroleum industry in the Barents Sea integrated management plan (from Olsen* et al.*, 2007).*

unable to predict the effect on a community's jobs, taxes, infrastructure development, etc. – all essential knowledge for the decision-makers when making final decisions on contentious issues, or balancing socio-economic returns against conservation. Current MSP plans have mostly been driven by the needs of managers and decision-makers, often under tight time restrictions. Therefore, most processes have been largely expert-based and many have not been given a thorough review owing to time constraints. Our experience from fishery management demonstrates the value of thorough scientific reviews of our management plans and advice. This facilitates the acceptance of the plans and advice among all parties because quality is controlled. Most current MSP plans lack this review, and invite criticism that calls into question the validity of the plan itself.

The role of science in MSP

Scientific knowledge and analysis play a crucial role in successful MSP, and are relevant and useful at all stages. Scientific advisors typically follow the processes from start to finish. Some stages of the MSP process depend more than others on scientific input, including: (i) setting goals and objectives, (ii) establishing a baseline, and (iii) looking into the future. All of these stages depend on a thorough scientific understanding of the ecosystem and its human uses. MSP requires not only traditional species-specific advice on population levels, distribution, and life history, but also demands knowledge based on ecological science of trophic interactions, ecosystem goods and services, and vulnerability to human activities. All of this knowledge should also, to a large extent, be made available for mapping so that integrated maps and analyses of ecosystem components, vulnerability, and human use can be developed.

Currently, this is the major challenge of scientific advice to MSP processes. MSP requires integrated scientific advice, but science is typically specialized and distributed so that each scientific community controls its own dataset. Sharing data through international web services is essential to supporting MSP, and there are currently several regional and international projects and processes in place that support this. This provides the necessary infrastructure for sharing data and knowledge, but at this early stage, most of the data resides in closed databases at institutions.

For ICES to succeed as the foremost advisor on marine science in our area, also in relation to MSP, requires us to put this extra effort into our analyses and reporting.

How ICES contributes

ICES is aware of the push for the development of MSP plans both internationally and within the ICES area. Europe is in the forefront of the development of MSP, in terms of both practical management plans and developing its theoretical foundations. Therefore, in 2010, ICES launched a strategic initiative on MSP: the Joint ACOM/SCICOM Strategic Initiative on Area-based Science and Management (SIASM). The aim of this initiative is to develop the scientific foundations for MSP.

The first step in this process has been to ask what is the role of science in MSP and how can ICES aid the development of this role? This was the key issue for debate at a workshop in Lisbon in November 2010 (Workshop on the Science for Area-based Management: Coastal and Marine Spatial Planning in Practice). It is clear that the scientists who act as advisors in an MSP process must often act as both managers and scientists. Having dual roles is difficult, and they should be very clear on what role is appropriate at any stage in an MSP process.

The role of ICES Science is to provide knowledge, a role that ICES has played for more than 100 years in numerous management processes. It is clear that ICES can and should play an important role in MSP development in the ICES area. However, ICES work has traditionally concentrated on ecosystem components and on sectors rather than on ecosystems. Most of ICES output has been in the form of text and tables; distribution of the maps that are produced is usually limited to expert group reports. In order to be useful to MSP, our ICES products must be made available for spatial presentation and analyses. We must make the spatial data behind our maps and reports readily available for future use. In most cases, this is easy, but it requires a little extra effort on the part of the scientists in the expert groups, as well as ICES data managers. However, for ICES to succeed as the foremost advisor on marine science in our area, and in relation to MSP, requires us to put this extra effort into our analyses and reporting. With the development of the EU's Marine Strategy Framework Directive, and a probable increase in wind-energy projects as well as numerous regional initiatives, it is certain that our usual clients will require ICES to be capable of giving advice in a more spatial context relevant to MSP. ICES is in a unique position to provide the scientific knowledge necessary to support managers to establish MSP plans with a vision. Let us use our opportunity to contribute constructively to changing the world!

Literature cited

Douvere, F., and Ehler, C. 2009. New perspectives on sea use management: initial findings from European experience with marine spatial planning. Journal of Environmental Management, 90: 77–88.

Olsen et al. *2007. The Norwegian ecosystem-based management plan for the Barents Sea: a case study. ICES Journal of Marine Science, 64: 599–602.*

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Most organisms have planktonic eggs or larvae that can easily bypass areas of unsuitable bottom habitat, thereby bypassing trenches, mountain ranges, etc. However, the same water masses that simplify distribution may act as more effective barriers to distribution, preventing the spread of eggs and larvae.

DO IT YOURSELF

Marine spatial planning (MSP) concentrates on the uses of marine space in order to integrate the management of all human uses in an ecosystem-based context. A broad and commonly cited definition of MSP is:

> Analysing and allocating parts of three-dimensional marine spaces to specific uses and non-use, to achieve ecological, economic, and social objectives that are usually specified through a political process. (Douvere and Eheler, 2007.)

Development of practical approaches to MSP started after the Johannesburg Declaration in 2002, but after 2006, the field exploded, and an Internet search for "marine spatial planning" now returns hundreds of thousands of articles or reports on the issue. Many of these are either practical guides to implementing MSP or reports on how MSP has been implemented in different sea areas. The drive to implement MSP is so strong that it is being put in place before it has been fully developed scientifically and institutionally.

In this respect, managers and decision-makers are spearheading the process while scientists are evaluating the pros and cons of these early plans in order to develop codes of good practice, while developing the theoretical framework from the bottom. A challenge at this stage, therefore, is to combine the theoretical approaches with the best practices developed from real-world MSP plans.

Several nations that have developed, or are developing, MSP plans have carried out such a review in order to combine best practices and a theoretical framework, but the most comprehensive reviews have been made by intergovernmental institutions, such as UNESCO, EU, and HELCOM. Several practical guides to developing MSP have appeared, with many commonalities.

- MSP is a dynamic, regular management process, not a static plan that is made once and set in stone. It is similar to other management cycles that are used in the sectoral management of fisheries, petroleum, and other human sectors.
- Involvement of stakeholders at all stages of the process is essential to the establishment of an acceptance for the MSP plan.
- Setting common goals and establishing a governance structure are important steps prior to evaluating concrete management options.
- Establishing a baseline for human activities and the state of the ecosystem (and to map this) is essential to pinpointing both key issues at stake: main pressures and gaps in current knowledge.
- Look into the future. An MSP plan should analyse or define future conditions in terms of both human development and ecosystem state (e.g. taking into account changes in the Earth's climate).
- Mapping and analysing conflicts of interests is an essential step towards achieving the integration of sectors and interests.
- A map showing different uses and non-uses (e.g. marine protected areas) allocated to the area is an essential output of an MSP plan.

Implement, monitor, and revise the plan

Making a zoning plan is just one step in an MSP process, the success of which depends on completing the other steps. All managers and decision-makers who want to develop an MSP plan in order to have a zoning plan that solves all conflicts should bear this in mind, and they should show restraint and allow adequate time to conduct a comprehensive MSP process, as advised by all existing guides for best practice.