Marine Spatial Planning in the Nordic region

– Principles, Perspectives and Opportunities

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Outcomes from the Nordic Forum on MPAs in Marine Spatial Planning

Mette Blæsbjerg, Janet Pawlak, Thomas Kirk Sørensen, Ole Vestergaard

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Content

Preface	9
Key messages	11
Summary	13
1. The concept of marine spatial planning	15
An ocean of conflict	15
Need for integrated management approaches	15
What is marine spatial planning?	16
Ecosystem-based management via marine spatial planning.....	16
Zoning the Ocean	17
Current status of marine spatial planning	17
2. Scope, targets and legal basis for marine spatial planning	19
International frameworks	19
Regional frameworks	19
The EU Framework.....	20
Cross-sectoral national systems of MSP.....	21
3. Marine spatial planning in practice	23
Key principles of marine spatial planning	23
The planning process	23
Implementation	26
Monitoring and evaluation.....	27
Science-based policy and management.....	27
Transboundary cooperation and management.....	27
4. Information, mapping and spatial management tools	31
Use of data and mapping in marine spatial management	31
Diverse sources of data and information	33
Tools for spatial management.....	34
Decision-support tools	35
5. Stakeholder participation	41
Why stakeholder participation in MSP?	41
Methods for stakeholder participation	41
Participatory MSP processes	41
6. Marine protected areas in wider marine spatial planning	45
What are Marine Protected Areas?	45
Types and design of Marine Protected Areas	46
Transboundary networks of MPAs.....	46
MPAs in fisheries management.....	46
The use of MPAs in the Nordic region	47

7. Planning for uncertainty: A changing climate	51
Ecosystem vulnerability to a changing climate	51
Implications of climate change for management in the Nordic temperate region	51
A changing Arctic	51
8. Nordic perspectives and opportunities.....	53
Nordic MSP activities	53
Nordic characteristics in relation to marine spatial management	53
Common Nordic approaches?	54
Institutional frameworks for marine spatial management in the Nordic region.....	54
Arctic opportunities	55
9. Application of spatial planning for different maritime sectors	61
Fisheries	61
Offshore wind energy.....	66
Oil and gas exploitation in Nordic waters	69
Shipping and maritime transport activities	71
Aquaculture	71
Extraction of marine aggregates from the seabed	73
10. Conclusions and Recommendations	75
Key issues and recommendations	76
11. References	79
Workshop presentations	79
12. Acknowledgements	83
13. Dansk resume	85
Annex 1. Workshop programme and Objectives	87
Workshop Objectives	87
Workshop lectures and case studies:.....	87
Group sessions and plenary	88
Annex 2. Workshop Participants.....	91

Case studies

- Guidelines for Implementing Ecosystem-based Marine Spatial Management
- Marine spatial planning in the Irish Sea – A pilot study
- Applications of large-scale marine mapping in marine management – the MAREANO programme
- Application of marine habitat mapping in marine spatial planning – the VELMU project in Finland
- Mapping and planning in the Baltic Sea – the BALANCE project
- Developing Good Practices in the use of planning tools: Marxan
- Making room for everyone – Stakeholder participation in Kosterhavet and Hvaler
- Designations for the Natura 2000 Network of protected areas
- FAO Guidelines on Marine Protected Areas as a Fisheries Management Tool
- Development of an integrated management plan for the Lofoten – Barents Sea area
- Management planning of Greenland's living resources
- Resource management and mapping: North Sea RAC activities
- Dynamic fisheries management in the Faroe Islands
- Towards area-based management of sandeels in the North Sea: The importance of large-scale connectivity
- The expansion of the wind energy industry in Denmark
- Integrated management of culture and fishery of mussels in the Limfjord, Denmark

Preface

Increasing demands on marine resources and activities taking place in the marine area are compromising the future use and viability of the marine environment. The need to pursue new approaches and commitments for a sustainable utilization of marine resources has therefore become clear. Marine spatial planning is considered a promising tool for the regulation and protection of the marine environment, offering an integrated approach to managing the multiple and potentially conflicting uses of the sea.

To address a set of key questions relating to marine spatial planning in a Nordic context, the project “Nordic Forum on MPAs in Marine Spatial Planning” was established in 2006 with support from the Nordic Council of Ministers (Working Group on Environment and Fisheries). Its purpose is to integrate, synthesize and disseminate knowledge from recent and developing Nordic activities over a three-year period, taking into account international experience.

On 6–8 June 2007, the Nordic Forum, jointly with the Danish National Institute for Aquatic Resources, the Danish Forest and Nature Agency (now the Danish Agency for Spatial and Environmental Planning), and the Danish Society for Marine Biology, hosted the Nordic Workshop on Marine Spatial Planning. This large workshop brought together more than 100 researchers, marine planners and managers, and representatives from non-governmental organizations (NGOs) and industry. The purpose of the workshop was to: 1) obtain an overview of current marine spatial planning activities in the Nordic region and beyond; 2) provide insight into the concept and possibilities of marine spatial planning and identify case studies in the Nordic region where relevant activities have been conducted; 3) join efforts in the Nordic region to build common spatial management approaches; and 4) build partnerships and identify mutual learning opportunities to strengthen trans-national cooperation in the Nordic region. Workshop sessions presented new research findings and reviewed regional case studies and best practices related to habitat mapping and area-based

management, marine zoning, and marine protected areas. Participants took part in a series of break-out sessions and plenary discussions, which considered strategies and recommendations for future development of a more integrated management of the Nordic marine environment. An overview of workshop themes, discussions and participants are presented in Annex 1 and 2. The presentations can be downloaded from the workshop website: www.nordicMPAforum.org.

This report presents experiences and views gained regarding key concepts of marine spatial planning, relevant legislation, practices and elements of the planning procedures, application of mapping and decision-support tools, use of marine protected areas within wider marine spatial planning, and prospects and conflicts in relation to important maritime sectors, nature conservation, and other interests in the Nordic region.

Presentations and discussions held at the Nordic workshop serve as the basis for the contents of this report, supplemented by recent studies and background information, but have been divided into separate chapters covering the major topics discussed within the workshop. Selected workshop presentations have been included as case studies, highlighting different regional aspects of marine spatial planning. Finally, recommendations for future approaches to marine spatial planning in the Nordic region are presented based on panel discussions, presentations, and recommendations of the experts gathered at the workshop. The editors of this report have aimed to correctly interpret the workshop presentations, discussions, and recommendations, and regret any cases of misinterpretation that may have occurred. Accordingly, the editors are solely responsible for the contents of this report.

The report provides an introduction and discussion document on Nordic marine spatial planning intended for planners and managers in local, national and regional administrations, policy-makers, interest groups and actors across different maritime sectors, as well as researchers and students

Key messages

Marine spatial planning is a useful and cost-effective tool that can assist development of integrated marine management. While currently most planning of a given marine area is directed toward individual sectors, marine spatial planning (MSP) aims at balancing the multiple human activities by integrating policies and objectives across different sectors and addressing multiple and potentially conflicting uses of the sea, whilst also considering environmental protection. Marine spatial planning aligns with Integrated Coastal Zone Management (ICZM) and is useful tool to develop comprehensive ecosystem-based marine management. Initiatives towards systems of marine spatial planning are already under way in several European countries and marine spatial planning is central in several recent regional and EU resolutions and recommendations.

Cross-sectoral marine spatial planning serves to ensure longterm ecosystem function and sustainable marine resource use. Marine spatial planning aims at sustainable development via implementation of the ecosystem approach to marine management. There should be further collaborative efforts to development of cross-sectoral frameworks for MSP and development of operational tools and capacities for marine spatial management. Guidance can benefit from terrestrial experiences plus recent decades of coastal management, as well including various activities taking place across Europe and other global regions.

Marine spatial planning should be adaptive and inclusive. Marine spatial planning should be a continuous and adaptive activity organized to make adjustments when needed. A key aspect is timely and direct stakeholder engagement; broad participation is essential via open information sharing and transparent and inclusive decision making.

There is a need for information sharing, enhanced mapping of marine areas and human activities, and the development of common tools to use this information in spatial management. Despite considerable research activities in Nordic countries, gaps in information and data still exist. Enhanced mapping of marine habitats and species is required as well as data on social and socio-economic issues. User-friendly tools are needed to relate habitats and species distributions to human uses, and to priority-setting and decision-support. However, despite more detailed information is needed for full implementation, adequate information exists today to initiate comprehensive marine spatial plan-

ning work in the Nordic region.

Cross-sectoral pilot initiatives can advance common principles in marine spatial planning. The Nordic region holds many advantages and could serve as a pilot area to demonstrate transboundary approaches to marine spatial planning. Future pilot projects could test different approaches and be developed at different scales (local, national or regional through Nordic Council or EU support). An important challenge is to address larger-scale transboundary planning issues. Pilot projects could be established in the Northsea, Skagerrak/Kattegat area, the Barents Sea, and the Baltic Sea. Existing regional fora and conventions (such as OSPAR, HELCOM, North Sea RAC, Baltic RAC) can serve to further advance the cross-sectoral marine spatial planning, emphasising much closer dialogue between sectors. The Nordic Council of Ministers could serve an essential role in facilitating such regional dialogues and pilot initiatives.

Climate change poses additional challenges to marine spatial planning. Climate change will affect ecosystems in many ways, for example in the redistribution of species, in the utilization of marine resources and in coastal development. Adaptive marine spatial planning systems should monitor such changes and revise management made accordingly. The possibilities and prospects of adaptive MPAs in a larger MSP framework should be further explored. In the Arctic region where climate change effects are expected to be most pronounced close monitoring and adaptive measures are regarded particularly essential.

Enhanced Nordic cooperation can facilitate the development of common Nordic approaches to marine spatial planning and management. Transboundary cooperation is regarded essential for successful larger-scale management and common Nordic approaches to marine spatial planning would further the implementation of integrated marine management, although the principles developed should be general and overarching. A number of characteristic features across the Nordic region can facilitate transnational cooperation on marine spatial planning, while a number of specific issues could drive cooperation on MSP in the Nordic countries, e.g. climate change, as it calls for urgent international cooperation and planning to protect valuable resources, species and habitats. Other transboundary and urgent issues include fisheries and shipping

Summary

Increasing competition for marine space and resources in the Nordic region calls for more coordinated and integrated planning and management of the marine environment. A particular marine area may represent different values to different users and thereby potential conflict among marine sectors and activities. As a consequence, a growing number of marine spatial management efforts are developing in the Nordic region.

To address a set of key questions relating to marine spatial planning in a Nordic context, the ad-hoc “Nordic Forum on MPAs in Marine Spatial Planning” was established in order to integrate and disseminate knowledge from recent and developing Nordic research and management activities. In the summer of 2007, the Nordic Forum hosted a large Nordic Workshop on Marine Spatial Planning which brought together more than 100 researchers and managers to present new research findings, review regional case studies and discuss the characteristics and challenges of the Nordic region in relation to implementation of marine spatial management. The discussions and presentations of the workshop deliver the basis for the information and conclusions within this report, but are supplemented with background information and recent developments.

The problems affecting the marine environment cannot be solved through a single-sector or single-discipline approach and there was wide agreement at the Nordic Workshop that comprehensive marine spatial management is an important tool to deliver ecosystem-based management of uses of the marine environment and to solve conflict between different interests. Regional examples presented at the workshop highlighted how conflicts are being addressed through marine spatial planning: In Norway, for instance, an Integrated Management Plan of the Barents Sea has been implemented to resolve conflicting objectives of the oil industry, shipping, fisheries and nature conservation. In Limfjorden, Denmark, aquaculture and mussel fishing interests have been balanced against nature con-

servation to facilitate zoning of various marine activities through e.g. the development of user-friendly GIS mapping tools.

Recent spatial planning activities in the Nordic region and internationally have resulted in the development of guidelines for plan development, implementation and monitoring. A further development and testing of operational guidelines is however needed and similarly is the use (and further development) of tools such as advanced GIS applications and decision-support tools required. Elements that might be included in a system of MSP include spatial information and data, objectives and targets for the relevant sectors, uses and values, and a national framework or policy statements to support sectoral integration and allocation. Marine protected areas (MPAs) are increasingly used as a tool for both protection of marine biodiversity and management of natural resources, and should be taken into consideration within a spatial plan.

Across the Nordic region there is a need to promote and implement spatial planning locally and nationally; however, increased transnational cooperation is required in order to address large-scale connectivity between habitats and species, ecological coherence of MPA networks as well as cumulative effects of marine installations and activities. A number of unique traits common to the Nordic region, such as common cultural backgrounds, similar languages and a high level of regulation and regulatory compliance are identified as advantageous in the facilitation of transboundary marine spatial management in this region. Furthermore, the Nordic countries have a long history of cooperation as well as a large public sector and a comprehensive legal framework.

Effective and integrated marine spatial management is regarded crucial for the mitigation of evolving conflicts and further degradation of the Nordic marine environment as well as for proactive planning to avoid future potential conflicts, including some of those associated with climate change.

1. The concept of marine spatial planning

An ocean of conflict

The ocean is the scene for a vast range of human activities and uses – from oil and gas exploration and development, wind farms, shipping and fishing, to recreation and nature conservation. It provides important resources for human utilization and consumption, vital ecosystem services, as well as a place for human leisure and well-being. However, the exploitation of marine resources and other demands on the marine ecosystem are increasing, compromising the future viability and use of the oceans.

The level of human use and activity is often not compatible with maintaining and preserving important ecosystem functions, and threats to the marine ecosystem as a result of anthropogenic activities are numerous, including eutrophication, biodiversity loss, habitat damage, and proliferation of invasive (non-native) species. The marine ecosystem is influenced by activities taking place in the ocean and along the coasts, as well as on land. Furthermore, the utilization of marine resources is often unsustainable, compromising the future exploitation of resources. The demand for ocean space has also resulted in competition and conflicts among users.

The Nordic region covers some of the most intensely exploited marine areas in the world. The North Sea, the Norwegian Sea, the Barents Sea, and the Baltic Sea are heavily impacted by human activity, and are all utilized and partially managed by the Nordic countries. In recent scientific publications, the North Sea has been ranked as one of the marine areas in the world most impacted by human activities (Figure 2)⁴⁶ and the Baltic Sea is an area of global concern with regard to the intensive pollution from human activities⁶¹.

Figure 1. The ocean is a place of many human activities
(Source: T.K. Sørensen, DTU-Aqua)

Need for integrated management approaches

Management of ocean resources in the Nordic region is currently characterized by a sector-by-sector or case-by-case approach. Specific areas of the ocean may be designated for specific activities, but the effects of new developments are often considered only in relation to the objectives within that specific sector, without a clear overall vision for the use of ocean space and its resources. This conventional sector-by-sector approach is not always adequate for the management of the many human activities impacting marine areas, as it does not take into account the interactions, conflicts or trade-offs among activities, cumulative effects over space and time, or how the activities affect the delivery of ecosystem services⁴⁵.

Lack of a common vision and integrated planning of the use of ocean space and resources is a root-cause of intensified conflicts between different user interests and fragmented environmental protection, leading to a risk of decreased environmental quality and ecosystem productivity. The problems are aggravated by weak regulations, fragmented jurisdiction and ambiguous policies³¹. New management initiatives for rational marine use and mitigation of conflicts in the Nordic marine environment are therefore needed. Integrated marine spatial planning and management serve this purpose.

Figure 2. Map of cumulative human impacts on the marine ecosystem in the Northeast Atlantic region (Source: Halpern et al. 2008 ⁴⁶)

What is marine spatial planning?

Marine spatial planning (MSP) is an approach to assist integrated planning of human activities and the protection of the marine environment. While marine and coastal planning often directed toward an individual sector rather than a variety of sectors, MSP considers a region as a whole and integrates policies and objectives across different sectors, addressing the multiple and potentially conflicting uses of the sea.

Marine spatial planning works through the allocation of space, utilizing the ecosystem approach and integrating all available relevant datasets, and forms the basis for decision-making. MSP has been defined by the Intergovernmental Oceanographic Commission (IOC) of UNESCO as a process of analysing and allocating parts of three-dimensional marine space to specific uses, to achieve ecological, economic, and social objectives that are usually specified through the political process; the MSP process usually results in a comprehensive plan or vision for a marine region. MSP is an element of sea use management³¹.

In many ways, the concept of MSP resembles the better-known concept of terrestrial land-use planning. Spatial allocation is today a vital component of land-use planning, which requires an overall vision to be shaped for an area and into which any subsequent development projects should fit⁵⁴. Planning in relation to marine areas today is in many respects similar to very early land-use planning, without a clear spatial vision or planned approach, resulting in a lack of certainty for users and developers.

The key characteristics, concepts and further development of guidelines were continuously discussed at the Nordic Workshop, and will be dealt with in further detail in Chapter 3. It is important to appreciate the difference between terms: Marine spatial “planning” is a component of marine spatial “management”, which is considered the overall, area-based management of a marine area over time⁹.

Ecosystem-based management via marine spatial planning

Ecosystem-based management (EBM) covers a range of approaches to develop environmental management that focuses on the ecosystem and is based on the application of scientific methodologies. An ecosystem approach to management places human needs within biodiversity management, aiming to create a management system based on the multiple functions that ecosystems perform and the multiple uses that are made of these functions⁵². Ecosystem-based management is a key objective of several international agreements such as the Convention on Biological Diversity (CBD) and the declaration of the World Summit on Sustainable Development (WSSD)^{64, 65}. Steps have been taken towards implementing an ecosystem approach in several European Union (EU) policies, such as the new EU Maritime Policy and the Common Fisheries Policy^{35, 36}.

Comprehensive marine spatial planning is regarded as an important tool for the delivery of ecosystem-based management of the marine environment.

Multiple human activities may be interactive and have cumulative and/or possibly synergistic impacts on the marine environment⁴⁵, causing unpredictable responses in ecosystem function and productivity. Such interactive effects are rarely taken into consideration in current management approaches, but ecosystem-based marine spatial planning may provide a framework for addressing this problem by applying a more integrated approach.

Zoning the Ocean

Marine spatial planning is expected to include a system of zoning, to at least some degree. Ocean zoning is used in many countries to delineate specific areas for human activities, for example, licensing of marine aggregate extraction or oil and gas exploration.

In a marine area, different zones may be prioritized for vessel traffic, security zones in ports and wa-

terways, safety zones around maritime installations, military exercise zones, dredging sites, critical habitat designations or aquaculture areas – to name just a few⁴³. In multiple-use zoning schemes, which are often used within Marine Protected Areas (e.g., the Great Barrier Reef Marine Park in Australia)²⁷, zones may be designated with regard to the degree of general use permitted. Zones may operate across geographical areas or time periods to minimize conflicts in areas when different activities compete on either a spatial or a temporal basis¹⁹.

Zoning schemes may be part of a marine spatial planning system, although it must be emphasized that zoning and MSP are not synonymous⁴³. While zoning is the mere designation of a site for a specific purpose, marine spatial planning provides a framework for systematic, integrated zoning of competing activities, aiming to solve current as well as future potential conflicts.

Box 1: Integrated coastal zone management and marine spatial planning

Integrated coastal zone management (ICZM) has long been considered key for maintaining coastal ecosystems, both terrestrial and marine. Similar to marine spatial planning, ICZM is a management process that requires cross-sectoral cooperation, stakeholder participation, knowledge-based decision-making, and adaptability of approaches as understanding improves. ICZM generally includes the

terrestrial component of the coastal zone and can be an important tool in bridging the gap between land- and sea-based spatial planning systems, i.e., ensuring that the two systems are complementary at the coast and enabling wide stakeholder engagement and cross-sectoral consultation in areas of high activity, which tend to be inshore areas such as bays and estuaries.

Current status of marine spatial planning

In recent years, several countries have started to develop and apply MSP systems to reduce user conflicts and promote the sustainable use of marine resources. Examples include the Great Barrier Reef Marine Park, the Florida Keys National Marine Sanctuary in the USA, and the Eastern Scotian Shelf Management Initiative in Canada. In many cases, these efforts have been driven by nature conservation interests, in particular, the establishment of marine protected areas.

In Europe, several countries have recently taken steps towards developing MSP in a broader context, either on their own initiative or driven by EU policy and legislation. In the United Kingdom, a 'Marine Bill' was published in April 2008 for public consultation, and is in 2009 being examined by parliament. The Marine Bill aims to deliver a declared vision of "clean, healthy, safe, productive and biologically diverse oceans and seas" and to improve coastal access. An important part of this process is to create a strategic marine planning system to ensure more efficient, sustainable use of the UK's marine resources^{11, 56, 65}.

In the Netherlands, an "Integrated Management Plan for the North Sea 2015" has been developed (a new spatial planning framework for the Dutch part of the North Sea will be finalized in December 2009)⁶⁶, while in Germany a framework for spatial planning has been prepared, including a draft spatial plan and environmental assessment of the German Exclusive Economic Zone (EEZ) aiming at ecologically and economically viable use of German waters⁶⁶.

Belgium is among the first countries to start implementing an operational, multiple-use planning system covering both the territorial sea and the EEZ with objectives on a wide range of marine interests. The plan was adopted in 2003 and has been implemented incrementally since then (Figure 3).

In the Nordic region, Norway has moved towards large-scale integrated, area-based management of marine ecosystems and resources, mostly aiming at balancing conflicting biodiversity, fisheries, and oil exploitation objectives. An integrated management plan was adopted for the Barents Sea – Lofoten area in 2006, a plan for the Norwegian Sea is in the final stage of development, and a plan will subsequently be developed for the North Sea – Skagerrak (Chapter 8 and

Case Study 10). In other Nordic countries, examples of integrated area-based management have been more localized and not applied in a broad maritime context.

Figure 3. The Belgian MSP policy framework includes objectives on offshore industrial sectors, marine protected areas, prevention of pollution and the management of relevant land-based activities. These objectives have provided the basis for a Master Plan, which has been

implemented incrementally since 2003. The first two phases – spatial delimitations for sand and gravel extractions and delimitation of marine protected areas – are now operational

(Source: Douvere et al 2007²⁹).

2. Scope, targets and legal basis for marine spatial planning

Marine spatial planning should be based on statutory requirements, and legal and policy frameworks underpinning MSP are found at the international, regional, and national levels. These frameworks have developed progressively over the past two decades, based on the growing need for sustainable development and protection of marine areas and resources.

International frameworks

The international legal and policy framework for MSP includes^{64, 65, 66}:

- The UN Convention on the Law of the Sea (UNCLOS), which provides the overall legal framework for ocean activities, thus covering also the use of marine space;
- Chapter 17 of Agenda 21 of the 1992 UN Conference on Environment and Development (UNCED), which contains a programme of action for integrated management and sustainable development of coastal areas as well as marine environmental protection;
- The Convention on Biological Diversity, adopted in June 1992, formally endorsed the ecosystem approach to management; the Parties to the Convention have committed themselves to achieve a significant reduction in the current rate of biodiversity loss by 2010. A programme of work on protected areas was adopted in 2004 and, for the marine area, a representative network of protected areas should be established by 2012.
- The 2002 World Summit on Sustainable Development (WSSD), which encouraged the application of the ecosystem approach to marine management, particularly in relation to sustainable management of fishery resources, integrated coastal area management to maintain productivity and biodiversity, and the establishment of marine protected areas and networks.

Regional frameworks

Relevant regional conventions in the Nordic area are the 1992 Convention for the Protection of the Marine Environment of the North East Atlantic (OSPAR Convention)⁵⁸ and the 1992 Baltic Marine Environment Protection Convention (Helsinki Convention)⁴⁷. Work under these Conventions in relation to marine spatial planning began with commitments to the development of marine protected areas (MPAs).

Under the Helsinki Commission (HELCOM), countries around the Baltic Sea adopted a common political statement in 1990 with the intention of establishing a network of “protected areas representing the various Baltic ecosystems and their flora and fauna”⁴⁷. This commitment was included in the 1992 Helsinki Convention, and recommendations concerning basic protection measures were adopted in 1994 for a system of coastal and marine Baltic Sea Protected Areas (BSPA). BSPAs must be designated according to a set of criteria and legal protection must be assured by means of national legislation by the country with legal jurisdiction over the designated area⁴⁷. A total of 99 areas currently have received designation as BSPAs under national legislation.

In 1998, OSPAR Contracting Parties adopted a statement at a Ministerial Meeting of the OSPAR Commission that included a commitment to promote the establishment of a network of marine protected areas. This commitment was realized in the adoption in 2003 of OSPAR Recommendation 2003/3 on a Network of Marine Protected Areas, which also included guidelines for their designation and management⁵⁸. The aim is to ensure that the OSPAR Network of Marine Protected Areas will comprise an ecologically coherent network of well-managed marine protected areas by 2010; the establishment of the OSPAR Network will also contribute to Contracting Parties’ obligations under other international conventions. Since 2004, OSPAR has also coordinated work on marine spatial planning to exchange information on the further development of this policy tool⁵⁸.

A joint declaration between OSPAR and HELCOM in 2003 resulted in a HELCOM-OSPAR Work Programme on Marine Protected Areas between Baltic Sea countries and North Sea countries, with the objective of ensuring consistent protection of marine areas in both seas and establishing a joint network of well-managed marine protected areas that are ecologically coherent^{48, 58}. However, currently there is often no enforcement associated with HELCOM and OSPAR protected areas.

A HELCOM Baltic Sea Action Plan was adopted in November 2007, under which HELCOM Contracting Parties committed themselves to develop by 2010, and test, apply and evaluate by 2012, broad-scale, cross-sectoral marine spatial planning principles based on the ecosystem approach⁴⁸. The importance of this activity was underlined by HELCOM Recommendation 28E/9 on development of broad-scale marine spatial planning principles⁴⁸.

The EU Framework

Within the EU, a communication on “An Integrated Maritime Policy for the European Union” (the Maritime Blue Book) was published in October 2007 together with an Action Plan proposing actions to attain the key objectives of this policy^{35, 36}. The Maritime Blue Book establishes the foundation for the governance framework and cross-sectoral tools necessary for an EU Integrated Maritime Policy and indicates the main actions to be taken, which are to be guided by the principles of subsidiary and competitiveness, the ecosystem approach, and stakeholder participation. Three important tools for integrated policy-making were identified: maritime surveillance, maritime spatial planning, and a comprehensive and accessible source of data and information. Maritime spatial planning is considered a fundamental tool for the sustainable development of marine areas and coastal regions and the restoration of environmental health in the sea and will build upon

the use of ICZM that EU Member States have already begun to implement³⁶.

In June 2008, the EU Marine Strategy Framework Directive entered into force³⁶. This directive requires Member States to develop and implement strategies for their marine waters, to protect and preserve the marine environment and to prevent or reduce inputs with a view to phasing out pollution, so that there will be no significant impacts on marine biodiversity, marine ecosystems, human health, or legitimate uses of the sea. These marine strategies must apply an ecosystem-based approach to the management of human activities. Member States must also establish a comprehensive set of environmental targets and associated indicators for their marine waters and implement monitoring programmes to assess whether these targets are being met.

The Directive requires the establishment of programmes of measures that “shall include spatial protection measures, contributing to coherent and representative networks of marine protected areas, adequately covering the diversity of the constituent ecosystems, such as special areas of conservation pursuant to the Habitats Directive, special protection areas pursuant to the Birds Directive, and marine protected areas as agreed by the Community or Member States concerned in the framework of international or regional agreements to which they are parties”. The Habitats and Birds Directives together constitute the legal basis for the Natura 2000 network, which is a network of protected areas covering both land and sea areas⁸⁴.

Decision-making competence in this area lies with Member States, but common principles and guidelines will be developed at a European level to facilitate the process in a flexible manner and ensure respect for regional marine ecosystems. In November 2008, the Commission adopted a roadmap on maritime spatial planning³⁷. This roadmap will facilitate the development of spatial planning for both marine and coastal

Box 2: EU Common Fisheries Policy

The EU Common Fisheries Policy (CFP) is the main instrument for the management and governance of European fisheries and aquaculture. To ensure that the fishing pressure is not higher than the stocks can sustain, the measures under the CFP establish common rules among Member States such as total allowable catch (TAC), limitation of fishing effort, technical measures (in relation to gear and landing sizes), and obligations to record and report catches and landings.

A reform of the CFP in 2002 opened for a more long-term approach to fisheries management and aimed to ensure the sustainable development of fishing activities on an environmental, economic and social basis. To achieve

this, the CFP applies a precautionary approach to conserve living marine resources and to minimize the impact of fishing activities on marine ecosystems. This involves the establishment of multi-annual recovery plans for stocks outside safe biological limits, and the progressive implementation of an ecosystem-based approach to fisheries management. It also includes measures to protect non-target species such as marine mammals, birds, turtles, juvenile fish, and vulnerable fish stocks. As an outcome of the 2002 reform, Regional Advisory Councils (RACs) and are made up of representatives of the fisheries sector and others affected by the CFP; scientists are invited to participate in the meetings as experts.

spaces, in order to realize the growth potential of EU maritime sectors in a sustainable way.

Cross-sectoral national systems of MSP

For marine spatial planning to be effective on a national or local level, enhanced cross-sectoral planning and coordination among relevant national sectoral agencies is essential, and the responsibility for national or

local marine management planning should be made clear. Ideally, the planning process should be led by one single cross-sectoral planning body, which would regulate across all sectors based on input from relevant bodies, government departments, and agencies. This could be assisted by the establishment of inter-ministerial task-forces and ultimately marine planning agencies at the local, regional, or national level.

3. Marine spatial planning in practice

Key principles of marine spatial planning

The concepts and characteristics were the topic for many discussions and presentations at the Nordic workshop. A short-term view of the goal of MSP is that it is intended to avoid conflict in maritime use, while a longer-term goal is the overall sustainable use of the ecosystem. Planning is intended to anticipate problems so that they do not become crises.

Much of the benefit of MSP arises from looking ahead, identifying objectives, and using them together with relevant information to assess spatial interactions and cumulative impacts; alternative measures to manage those interactions are then analysed and appropriate measures implemented to reduce any impacts and deliver sustainable use. One important aspect of marine spatial planning is its ability to be adaptive to changing conditions and interests. Marine spatial planning should be seen as a continuous and flexible process that is carefully organized to generate information, assess interactions, the environmental state, and the effects of previously implemented measures, and make adaptations when needed.

The purpose of a system of marine spatial planning must be clearly stated. MSP should build upon the principles of sustainable development and work towards implementing the ecosystem approach and adopting the precautionary principle¹¹. To avoid conflicts, MSP should occur as early as possible in a given area, allowing early evaluation and priority setting for different potential interests before industry has discovered valuable resources and initiated activities.

Key principles of marine spatial planning include:^{11, 42}

- A statutory system with a clear purpose. The purpose will clarify the objectives and priorities for sustainable use and protection of marine resources; when this is statutory, it has a key influence on decision making.
- The scope should cover all marine interests: all natural resources, features, and processes; all sectors including fisheries; and all existing and future marine uses and developments.
- There should be a hierarchy in spatial dimension

from the national level (policy statement and strategic planning) to the sub-national level (integration and comprehensive planning) to the local level (where the actual use occurs).

- Planning “units” will need to be designated based on agreed criteria (e.g., ecosystem or administrative boundaries), but the landward boundary should preferably extend over the intertidal area; an overlap with land-use planning will also facilitate integrated coastal zone management.
- The temporal dimension should extend over a number of years (20–25 years) with a forward look for forecasting and planning, but with regular review (e.g., every five years) to ensure that the process remains dynamic and takes into account new data, uses, etc. The long view (50–100 years) should take account of climate change.
- Economic objectives will need to be identified, covering targets, policies, scenarios for future space requirements, exploitation of renewable energy resources in a sustainable manner, and integration with other objectives to address and avoid conflicts.

The planning process

In the spatial planning process, three phases are generally recognized: planning and analysis; implementation; and monitoring and evaluation^{31, 56}. These phases comprise a number of related elements and activities, all of which are necessary in order to achieve the desired goals. It is also necessary to consider the development and use of advanced software planning tools such as geographical information systems (GIS) and other mapping applications. Other factors regarded as crucial for a successful implementation of a spatial plan include stakeholder engagement and adequate financing.

Figure 4. The plan production process and stakeholder engagement based on work from the Irish Sea and the UK Marine Spatial Planning Pilot
(Source: Gilliland & Laffoley 2008⁴², DEFRA 2006⁵⁶).

The planning and implementation process has been outlined in several spatial management projects, such as the Great Barrier Reef Representative Areas Program process^{27,28}, the Irish Sea Pilot Project^{11,19,20}, na-

tional planning in Belgium and Norway^{9,17,29,55} (see Figures 4, 5, and 6). The BALANCE project³² in the Baltic Sea (Case study 5) has also considered marine spatial planning templates (Figure 6). All of these activities utilized compatible planning procedures involving a series of linked steps. Different principles and elements of planning were further discussed at the Nordic Workshop on Marine Spatial Planning.

The elements and activities to produce a spatial management plan should include:

- Defining goals and objectives
- Collecting (and scoping) spatial information and data
- Forecasting
- Analysis
- Generating and assessing alternative spatial options
- Participation of stakeholders and outreach
- Defining outcomes and outputs
- Adoption of the plan

The first step in the development of a marine spatial plan is the clear identification and definition of goals and objectives for the plan, which are considered essential for a plan's success¹¹. The setting of goals and objectives is discussed in more detail below.

Figure 5. The three major phases in the development of the management plan for the Barents Sea, 2002–2006. The work was led by rep-

resentatives from four ministries and analyses and assessments were carried out by government directorates and research institutes

(Source: Erik Olsen, Institute of Marine Research ¹⁷).

Fig. 5. The BALANCE framework for marine spatial planning and management (Source: Ekeboom et al. 2008)

The collection of information, including ecological surveys and mapping, is the next step as the plan should be based on the best available information (the quality of the plan will depend on the quality of the data collected¹¹), although the amount of data needed will vary with site and policies. During analysis, information and data are brought together to identify any conflicts or demands on space and evaluate the natural resources of the management area. This process involves specialized tools and models. Alternative spatial options considering the costs and benefits of various alternatives and options for action within the area should also be generated^{11, 31, 42}. The involvement of stakeholders at a time when they can genuinely influence the plan is critical for the development of successful strategies; this aspect is discussed in Chapter 5.

A spatial plan should be produced within a framework of overall goals and clearly articulated management objectives, together with identification of marine ecosystem services, essential ecological features or important human activities. Objectives should be established early in the planning process and developed for different management levels. A clear articulation of the desired outcome for each objective is essential for subsequent practical interpretation of that objective¹¹. It is important to realize that the pursuit of one objective may take place at the expense of other objectives, but one of the main benefits of spatial planning is that it may be possible to combine objectives and balance the benefits and costs over a specific geographical area.

Goals for status of the marine environment are often included in government policies, which can be used as a starting point for the marine spatial plan and translated into more specific objectives and targets. For example, targets related to the industrial sectors (e.g., national objectives for renewable energy), as well as targets for sustainable development and ecological quality indicators (e.g., Biodiversity Action Plans or Water Quality Plans) often exist in policy documents. The planning process can also help identify the contribution that can be made by the planning area to national objectives¹¹. Another fundamental aspect in goal and objective setting is the consultation of all relevant stakeholders.

At the outset of developing goals and objectives, it is important to consider the characteristics (bathymetry, currents, biodiversity, etc.) of the marine system under consideration; for example, Norwegian deep-water systems require a different assessment of what is at risk compared with shallow Danish waters, even though the overall goals may be the same.

As discussed at the Nordic Workshop on Marine Spatial Planning, industry has in many places been in the forefront with regard to utilizing marine space, particularly offshore activities driven by private sector interests. However, it was highlighted that in the USA, setting management objectives in the coastal zone is largely determined by government ICZM objectives, and industry and other stakeholders have had trouble influencing the process. However, in offshore areas,

industry (oil and gas, fisheries) has mainly taken the lead over governmental objectives⁴. This should not be the way forward. Decisions regarding spatial planning should be in the public interest and not only benefit industry, and proposals should be made transparent to the public. The issue of who obtains the benefits from the economic value of the sea brings up questions of the equity of decisions and their consequences, and the setting of clear objectives, also for the offshore area, would prevent industry from having the upper hand in the use of marine spatial resources. Often, it is not until the environmental situation becomes very serious that people become active and engaged, with the Baltic Sea mentioned as an example.

Implementation

The process of implementation will depend on the goals and objectives of the plan, the spatial coverage and the stakeholders involved, and the legal setting. Implementation will often occur stepwise or in different phases (see, e.g., Figure 5 & 7) while time required for implementation is highly variable. The expected time frame for implementation can be very dif-

ferent for the parties involved; for example, politicians usually have a different time frame than planners or scientists, as they often wish to see results from plan implementation within their term of office. Scientists and planners, on the other hand, may propose solutions to problems that extend far beyond such a time frame^{11, 56}.

Experience with marine spatial planning in the Irish Sea has resulted in a suggested time frame for plan production, implementation, and evaluation (Figure 7) whereby implementation, management, and monitoring are continuous processes to be reviewed every five years¹¹.

Given the need for MSP now and certainly in the future, operational guidelines for the conduct and implementation of marine spatial planning are required. Such guidance can build on guidelines for land-use planning and marine guidelines in various sectors. The development of marine spatial planning under the IOC/ UNESCO project (Case Study 1) and in the UK for the Irish Sea (Case Study 2) has also resulted in the formulation of guiding principles, which may be consulted in future work.

Figure 7. Time frame of a marine spatial planning programme developed under the UK Marine Spatial Planning Pilot. Spatial planning is

an adaptive and continuous process which should undergo periodic review

(Source: Gilliland & Laffoley 2008)

Monitoring and evaluation

The processes of monitoring, evaluation, and reporting are fundamental components of effective spatial management as they provide insight into the effectiveness of the plan and facilitate adaptive management. Monitoring can help assess the ecological state of ecosystems and the services they provide, the impact of human disturbances, and responses to restoration efforts.

For monitoring purposes, indicators are often used to describe observations. Indicators are measured or observed parameters (quantitative or qualitative) used to describe current situations and to track changes; they should be chosen so that they reflect changes on a temporal and spatial scale. Monitoring programmes should be appropriate and cost-effective, and conducted at temporally and spatially relevant scales. The results of monitoring, including performance indicators, should be reported regularly, and in a manner that is understandable and usable to stakeholders, managers and other decision-makers.

Figure 8. Monitoring is an essential part of marine spatial management. Here, a video-platform with high resolution video camera and sensors enabling quantitative estimates epibenthic megafauna.

Science-based policy and management

Decisions in marine spatial planning are ultimately political, but they must be informed by science and by society. Workshop participants discussed how an iterative process linking policy-making, science, and political decisions is needed. It is necessary for scien-

tists and managers to look at the issues on a broader basis and develop a shared vision for the future. Scientific information given to decision-makers should be usable and public participation and education on marine spatial issues, e.g., in universities, should be encouraged.

At the Nordic Workshop, it was noted that cases where research and management have worked well together include the Great Barrier Reef in Australia and Koster Marine National Park in the Skagerrak (Case Study 7), where there was a good working relationship between the scientists and the county boards. Funding can also be a factor in the role of science in management, and experience (e.g., in Australia and England) has shown that a better connection can be established when management has provided money for research issues and management groups have guided the use of the money.

Transboundary cooperation and management

Case studies presented at the Nordic Workshop (e.g., interconnected sandeel habitats throughout the North Sea in Case Study 14) have shown that enhanced transboundary cooperation is essential for successful management of the marine area on a larger scale. It was discussed how activities on marine spatial planning increasingly are taking place across Europe, but they are often conducted independently and the approaches and activities often differ, even between neighbouring countries. To develop and showcase the value of transboundary marine management, there is a need for demonstrating that countries can work together and the Nordic region (in particular the Baltic Sea) is a good region to start initiatives of cooperation. The Northeast Atlantic (the OSPAR area) is also a good region for cooperation, particularly in relation to Iceland and Norway. Nordic cooperation on marine management is further discussed in Chapter 8.

Cooperation may be approached differently in different geographical areas: an EU-wide approach may be relevant in some areas – for example, the Baltic Sea is an “EU sea” except for Russia – while a more global approach is necessary in other areas, such as in relation to Iceland. Workshop participants also discussed how a number of specific issues could drive transboundary cooperation on MSP. A recent topic that has not yet been adequately addressed in the Nordic countries is ecological coherence. This does not relate to the individual country’s ecological coherence, but to the wider picture across countries to provide a sufficient representation of habitats or species. Cooperation among neighbouring countries is necessary to maintain or restore ecological coherence and connec-

tivity. Moreover, ecological coherence is particularly relevant when considering climate change, which is having a large impact on marine ecosystems, calling for urgent international cooperation and planning to protect resources or vulnerable species and habitats

(see Chapter 7 for more details). This makes climate change an integrating issue for improved cooperation, while other integrating issues include fisheries, navigation, and shipping.

CASE STUDY 1:

Common principles for Implementing Ecosystem-based Marine Spatial Management

By Fanny Douvère and Charles Ehler, UNESCO Intergovernmental Oceanographic Commission.

Throughout the world, marine spatial management is gaining considerable importance as a constructive step to make an ecosystem approach to ocean management a reality. The fact that ecosystem-based management is place-based and needs a spatial and temporal approach is generally accepted, but what is missing is a clear demonstration of how it can be implemented.

UNESCO's Intergovernmental Oceanographic Commission (IOC) and the Man and the Biosphere Programme (MAB) have taken the initiative to move marine spatial management beyond its conceptual level and develop comprehensive, operational guidelines that outline the steps to implement ecosystem-based marine spatial management. Aspects of the guidelines will include:

- Approaches to establish the authority that allows the development of marine spatial management in a participatory manner and that enables an integration of issues across sectors;
- Setting up planning and analysis for marine spatial management that allows proactive, future-oriented management of oceans and coasts. Many spatial management plans that have been developed so far only take stock of the issues or problems today and do not look further than a few years ahead. The Netherlands and Canada, among others, have started to take initiatives to bring a longer-term, proactive approach to spatial management by projecting alternative visions of where they want to go with their ocean space in the future; Identifying the types of research, data and information essential to conduct marine spatial management that addresses both important ecological and socio-economic concerns;
- Indicating incentives, institutional arrangements, and other considerations for successful

- implementation of marine spatial management;
- Processes to conduct practical stakeholder involvement in the pre-planning, planning, implementation and evaluation phases of marine spatial management. Good practices from Australia, Europe and North America will be integrated to illustrate how stakeholders can be involved in a way that is manageable and effective; and
- Methods for the adaptation of marine spatial management plans to changing circumstances, including climate change, new political priorities or economic conditions.

A series of international examples of marine spatial management from Australia, Belgium, the Netherlands, Germany, the United Kingdom, Norway, Canada, and China are being analysed and documented to provide the necessary information for the guidelines.

The guidelines is directed to resource managers and decision-makers in national governments, international organizations, and NGOs. The final guidelines will be published by summer 2009.

The basic elements of marine spatial management
(Source: Fanny Douvère, UNESCO IOC).

CASE STUDY 2:*Marine spatial planning in the Irish Sea – A pilot study*

In working towards defining possible new legislation in the UK, as part of the government's Marine Stewardship initiative, the Department of Environment, Food and Rural affairs has commissioned a consortium to research options for developing and implementing marine spatial planning in UK waters. The study included a literature review to identify international experiences of marine spatial planning and their applicability to the UK and a Marine Spatial Planning Pilot (MSPP) project in the Irish Sea to simulate the development of a regional and local plan. The project was commissioned in 2004 and reported in 2006. The MSPP project built on the output of an earlier project, the Irish Sea Pilot (ISP).

The ISP aimed to test a proposed framework for marine nature conservation, including goals and objectives; data collection; analysis; generation of spatial options; evaluation; plan production; and participation. It also collated geophysical, hydrographical, nature conservation, ecological and human use data and used GIS analysis to identify spatial conflicts. The ISP further investigated and tested a range of concepts and objectives, e.g. marine landscapes, criteria for identification of important marine features, the concept of ecologically-coherent networks of marine areas, formulation of operational conservation objectives, and measures and mechanisms for management.

The MSPP project provided a useful source of information for consideration of future marine spatial planning frameworks. In particular, the project highlighted the important links to other planning processes both on land and at sea, and the range of relevant policies at national and international level. In bringing together the wide range of existing information the MSPP project was able to effectively simulate the plan production process and to demonstrate how such information might play a part in decision-making and ongoing management.

The key inputs required to undertake the plan-

ning process is illustrated in Fig 3. The planning process should cover a plethora of issues, but the interaction between objectives and setting priorities is a fundamental step in the planning process, encompassing integrated assessment, and generating scenarios and evaluating options. For project outputs, see <http://www.abpmer.net/mspp/>.

The results of the MSPP informed subsequent proposals for marine spatial planning in UK legislation (see <http://www.defra.gov.uk/marine/legislation/index.htm>). The Irish Sea Pilot project concluded that marine spatial planning provides the mechanism to deliver management integration in a spatial context, and at a scale that can be understood by stakeholders. Based on its findings, it made eight key recommendations:

- Marine spatial planning should be implemented as a statutory system;
- Marine spatial planning should be implemented at a regional scale, with co-operation between devolved administrations, particularly in boundary areas. Plans should apply out to 200 nautical miles, and landward to either Mean High or Low Water Mark
- A plan-making body should have responsibility for co-ordinating the spatial plans;
- Strategic Environmental Assessment (SEA), Sustainability Appraisal and public participation should be integrated into the process;
- Marine spatial planning should seek to plan for a 20 year period, subject to review every five years. The plan-making body should take a long-term view on issues such as climate change;
- A planning framework should be established within which plans would be created and co-ordinated;
- Plans should identify preferred locations for particular future maritime activity, but should be applied flexibly to take account of uncertainties and rapidly changing technology;
- SEA should be used to collect additional data to reduce key uncertainties
- in planning and policies.

4. Information, mapping and spatial management tools

Use of data and mapping in marine spatial management

A central element of ecosystem-based spatial management and delivery of integrated marine management is a proper understanding of the distribution and dynamics of species, habitats, environmental features, and ecosystem processes. Similarly, it is necessary to identify and map all human uses of an area, like it for example has been done in some Danish waters (Figure 9). Without such knowledge, it is difficult to develop and implement appropriate management measures and detect changes to the system as a result of management interventions.

The type of information needed for habitat mapping and modelling include environmental features, e.g., hydrography, bathymetry, habitats and species distribution, and human uses such as shipping lanes, extraction activities, fishing grounds, recreational areas, etc.⁶. For mapping seabed features, the main data types include slope, substratum, light penetration, depth, bottom temperature, wave-base, and tidal currents; addition

al data types cover tidal range, oxygen, nutrients, pH, salinity, and wave exposure.

Figure 9. Mapping provides insight into marine activities and resource use. In Denmark, the multiple human uses and activities have implica-

tions for the designation and management of Natura 2000 sites (map shows the status of provisional area designations as of June 2007) (Source: DTU-AQUA / Kerstin Geitner).

In the Nordic region, retrieval of data and information on the seabed and natural features has been the aim of some large-scale national projects such as the Norwegian MAREANO project (Case Study 3) and the Finnish Marine Underwater Nature Inventory Programme – VELMU (Case Study 4). The data generated in those projects has been applied to the use of large-scale mapping tools.

The Interreg-funded BALANCE project in the Baltic Sea conducted mapping (including marine landscapes, Figure 10) and spatial planning concepts in the Baltic Sea (Case Study 5). BALANCE also developed a planning template (Figure 6), which identifies the use of the various types of data in the initial assessment that precedes the planning process for marine spatial planning³². The MESH-project (also Interreg-funded) has worked with data collection and habitat data for the use of seabed mapping in environmental management in the North Sea.

The EU Marine Strategy Framework Directive includes a number of requirements to collect information on habitats and pressures impacting on them, including physical and chemical characteristics as well as predominant seabed and water column habitat types and special habitats that merit protection. Much effort will be required to ensure comparability of spatial data, so marine spatial planning need to address the harmonization and spatial dimensions of data. Furthermore, data should be ranked and prioritized according to their overall objectives.

The distribution and intensity of human activities need to be mapped onto the marine environment, and areas and activities most likely to conflict with the long-term quality of the marine environment can then be managed (i.e., a risk-based approach). Priorities include areas where spatial pressures are high (implying greater degradation) and habitat features that are rare or sensitive. Ecosystem components be linked to ecological quality elements, OSPAR strategies, or Marine Strategy Directive Annex II categories. The degree of impact can be classified according to no or low impact, possible impact, or likely impact. This process provides for the strategic management of resources, allowing a balanced use of the resource while minimizing impact and avoiding conflict.

Figure 10. As part of the mapping undertaken in the BALANCE project, the marine landscapes of the Baltic-Sea were mapped. Marine landscapes is a broad-scale characterization of the seafloor.

The distribution and intensity of human activities need to be mapped onto the marine environment, and areas and activities most likely to conflict with the long-term quality of the marine environment can then be managed (i.e., a risk-based approach). Priorities include areas where spatial pressures are high (implying greater degradation) and habitat features that are rare or sensitive. Ecosystem components be linked to ecological quality elements, OSPAR strategies, or Marine Strategy Directive Annex II categories. The degree of impact can be classified according to no or low impact, possible impact, or likely impact. This process provides for the strategic management of resources, allowing a balanced use of the resource while minimizing impact and avoiding conflict.

Diverse sources of data and information

European waters are relatively well-studied and many baseline data exists, but continued regular monitoring and collection of information from relevant stakeholders is required. It is important to consider that, in addition to government authorities, industry, and research institutions, important sources of data also include stakeholders and users of the area ¹¹. Potential sub-regions within the area may be identified and spatial coverage evaluated during the process of scoping and data collection. Gaps in information still exist despite the many research activities in Nordic countries, although workshop participants agreed that we have enough information at present to move forward.

More knowledge and data on marine features are

desirable, and there is a need for enhanced mapping of marine habitats and species as well as more knowledge about ecosystem processes and impacts, e.g., the extent and impact of noise in the marine environment on marine animals. Conservation programmes often emphasize biodiversity as a major criterion for identifying priority regions, and mapping of marine biodiversity has recently received substantial attention. There is also a need for high-resolution data on maritime activities, in particular detailed information about shipping (traffic patterns, type of ships and their destinations), leisure boats and data on fishing. There is also a lack of data on social and socio-economic issues, and on the costs and benefits of different marine uses.

Figure 11. An often occurring problem when retrieving and comparing existing data is the multiple classification systems in use (top two

figures). Harmonization of data to EUNIS classification (bottom figure) was an issue addressed within the MESH project (Source: David Connor 6)

In terms of enhancing the quantity of information, some data such as the distribution of important species and habitats may be difficult or expensive to collect, while other data, such as bathymetry or precise fishing areas, may be restricted for military or commercial reasons. To increase the quantity of information, there is a need for more funding but also for an increased use of existing sources, such as the fishing industry or commercial vessels. Potential shortcuts in the collection of data could include the use of ferry boats to collect seawater information or fishing vessels for data collection and monitoring of fish. There may also be a lack of awareness and knowledge of data sets that are available, owing to a lack of metadatabases. The quality of data is also important, indicating the need for quality assurance and validation of data.

One barrier to obtaining and sharing data is the lack of appropriate infrastructures for mapping data. In the MESH (Mapping European Seabed Habitats) project, existing data were difficult to find and access, and there were many organizations involved, with no central repository⁶. Furthermore, the data were in multiple formats, using multiple classification schemes, and without standards for data interpretation or an indication of quality (Figure 11). As a result, MESH established a framework for mapping the marine habitats in Northwest Europe through the development of internationally agreed protocols and guidelines for seabed habitat mapping and the generation of compiled marine habitat maps. There may be similar problems for other types of data relevant to MSP.

MESH is a consortium of 12 partners, funded by Interreg, aiming to establish a framework for mapping the marine habitats of North Western Europe. This is done through the development of internationally agreed protocols and guidelines for seabed habitat mapping and the generation of the first compiled marine habitat maps for the northwest Europe Interreg III B area. The MESH project has as one of its outcomes produced "A guide to marine habitat mapping"⁶.

Legal and political obstacles also often hinder data exchange between countries, although not sharing data could prove quite costly (in terms of conflicts, double work, etc.), and Nordic countries are therefore encouraged to facilitate enhanced sharing and harmonization of data. Some current and forthcoming initiatives at the EU level may improve data collection and sharing. For Nordic countries that are members of the EU, the Marine Strategy Framework Directive will encourage the provision of, e.g., oceanographic data layers, to enable a holistic approach to MSP. The Water Framework Directive and Habitats Directive are also driving forces for data sharing. The EU has a new Directive INSPIRE that will facilitate the availability of data that are useful to MSP, e.g., data on depth of

the seabed. A major constraint for, e.g., Finland is the absence of statutory access to depth data, but the EU INSPIRE Directive on data access will eliminate such obstacles. Nordic countries outside the EU should also be encouraged to follow this example.

The European Environment Agency (EEA) could also play a role in the harmonization and management of spatial data. The EEA could propose a standard to be used across Europe as a whole. The European Marine Monitoring and Assessment (EMMA) process has been designed to support the European Marine Strategy with data and information.

Tools for spatial management

Development and use of a range of different spatially explicit tools is a necessary step towards future marine spatial planning and management. Much like the construction of a building requires the use of hammers and saws, challenges in area-based management can be resolved using appropriate tools. A broad range of tools exist, ranging from computer-based scenario and decision-support systems and models to assist mapping, evaluation of management trade-off's, and ultimately priority setting among human activities in a given area. Tools can assist marine spatial planning by³⁰:

- Providing maps and models of species and habitat distribution, key ecosystem processes, and ecosystem variability;
- Resolving difficult issues when, for example, considering complex data;
- Assist decision support in MPA network design;
- Scenario-development illustrating consequences of different management decisions on natural resources and economies;
- Quantifying local information and expert opinions which can be used as input layers for GIS-tools;
- Guiding stakeholder involvement in planning processes.

A vast array of tools are relevant to ecosystem-based marine management and the marine spatial planning process, including data collection and management tools, data processing tools, modeling and analysis tools, scenario visualization tools, decision-support tools, project management tools, stakeholder communication and engagement tools, and monitoring and assessment tools³⁰. The use and development of decision-support tools are considered particularly relevant for spatial planning, as they facilitate the exploration of different objectives and options.

Decision-support tools

Decision-support tools and planning scenarios can support various stages in the process to explore different options and evaluate how well each option meets conservation and socio-economic objectives, thereby facilitating the exploration of trade-offs¹. These decision-support tools were initially developed for use in conservation planning in the selection and design of protected areas.

One of the commonly used tool for decision support in the design of MPA networks is the software Marxan (Case Study 6). Marxan can be used for a variety of purposes at different stages in the conserva-

tion planning process, e.g., to identify areas that for a minimal cost can meet user-defined biodiversity and conservation targets. Cost can be considered as the direct monetary cost but can also be set to any other relative social, economic or ecological measure. Marxan can also highlight sites that occur in a large number of solutions, which can help set priorities for conservation action⁵⁹. It is important, however, to understand that decision-support tools such as Marxan will not result in the production of a final network of reserves and the options generated must inevitably be fine-tuned to yield a plan that considers the full range of political, socio-economic and practical factors⁵⁹.

CASE STUDY 3:

Large-scale marine mapping for management – the MAREANO programme in Norway

By *Lene Buhl Mortensen*, Head of MAREANO, Institute of Marine research, Norway

The project MAREANO (Marine AREA database for Norwegian coast and sea areas) aims to map marine benthic habitats and biodiversity on the Norwegian shelf. The project was launched in 2005 as an inter-ministerial financial collaboration among the ministries of the Environment, Fisheries and Coastal Affairs, Trade and Industry and the Research Council of Norway. By 2010, selected parts of the Barents Sea will be mapped to provide information for the revision of the management plan for the Barents Sea (see map).

MAREANO is a multi-disciplinary programme, bringing together biologists from the Institute of Marine Research and geologists from the Geological Survey of Norway and the Hydrographic Service. In addition to fieldwork activities, the partners will collate existing information and present it integrated in the project web portal (www.MAREANO.no). The database will also be open to contributions from external sources of knowledge in the public and private sectors.

The ultimate aim of MAREANO is to provide a tool that will give industry, authorities, researchers and the general public direct access to reliable knowledge. This will give planners access to useful charts that combine different types of data to display potential conflicts between vulnerable spawning grounds and planned offshore activities in the Barents Sea. The data will also be useful in the selection of MPAs and the identification of sensitive species and nature types and will thus support sustainable marine management.

The MAREANO programme documents topography, bottom substratum, and fauna. In the areas mapped, high-resolution bathymetric maps are produced and the substratum is analysed using multi-beam back-scatter interpretation. With this information, stations for documentation of fauna and bottom substratum are selected to ensure representative sampling of likely different habitats. Fauna and the bottom environment are documented using a suite of sampling-gears (video, multi-corer, grab, box-corer, beam-trawl, and epibenthicsled) to obtain a thorough documentation of sediment (including pollutants) and species diversity in different environments on the continental shelf and slope. This covers habitats as different as gravelly fields, giant sand waves, coral reefs, gas seeps, and submarine canyons reaching down to 3000 m depth (see photographs).

The areas mapped by MAREANO in 2006–2008 and planned area for 2009. The areas have been mapped with multi-beam echo-sounder,

and are selected based on requests by the management relating to the Barents Sea management plan (source: MAREANO).

Preliminary results indicate that a few easily visible key species are related to specific bottom communities and bottom habitats and that these species can be used as indicators of that environment and its associated biodiversity. It is also clear that different gears collect different parts of the bottom fauna and that the uniqueness of the fauna sampled is

70% for each gear. The diversity pattern revealed by different gears is not similar but the general trend is an increase in species number with increased bottom complexity or rugosity. These trends will also be compared with trends in dominance of functional groups and production.

Examples of different habitats with their dominant organisms on the continental margin in the Nordland VII area off Andøya Island,

a proposed marine sanctuary
(source: MAREANO)

CASE STUDY 4:

Habitat mapping for marine spatial planning – the VELMU project in Finland

In Finland, there is insufficient knowledge of what lies beneath the surface of the sea, and it was therefore decided to conduct a baseline inventory of the Finnish underwater environment. The “Finnish Marine Underwater Nature Inventory Programme” (VELMU) is studying marine features in Finnish waters over a ten-year time period, producing information on several scales and formats, ranging from raw data to interpreted data and thematic maps. VELMU is a cooperative programme involving seven government ministries and with inventories carried out by various research institutes, universities, regional environmental centres, and consulting companies. The main aim is to produce a satisfactory

inventory of benthic marine habitat distribution and biodiversity and work towards accomplishing the following objectives:

- to obtain an overview of the most important biotopes in the marine and coastal areas and the distribution and the ranges of different species by 2014;
- to store biological, geological and physical underwater information in a way that it can easily be utilized;
- to increase knowledge and awareness relating to the underwater marine environment;
- to build a cooperation network, which will guarantee the continuity of the inventories after the programme.

The programme is being implemented in Finland's marine area from 2004 to 2014, where existing data will be collated and knowledge gaps filled through surveys of the Archipelago Sea, the Quark area, the Gulf of Finland, the Bothnian Bay and the Bothnian Sea. The inventories will focus on physical, geological and biological variables relating to the seabed, and a range of methods will be applied, including sonar, seabed sampling, flow measurements, underwater video photography, transect diving, and sampling of the bottom fauna. The areas of fish reproduction are surveyed using seines, aerial photo interpretations as well as diving.

The end users of the data gathered range from scientists, government officials and advisors, NGOs, and the general public. A database system will be created for the field survey results and

the geographical data-sets that will be accessible through an open information service containing a map user interface. The information will be of central importance for the management and protection of natural resources with expected practical uses including ICZM, marine spatial planning, management of protected areas and education.

CASE STUDY 5:

Mapping and planning in the Baltic Sea – the BALANCE project

BALANCE, or in full “Baltic Sea management – Nature conservation and sustainable development in the marine ecosystem through marine spatial planning”, was an international project co-financed by the BSR INTERREG IIIB Neighborhood Programme and ran from 2005–2007. It was developed by a consortium consisting of 27 governmental agencies, research institutes, universities, regional authorities and NGOs in seven countries surrounding the Baltic Sea as well as from Norway and USA.

The BALANCE project aims at improving management and planning of human activities in the marine environment within the multinational Baltic Sea Region and developing tools for promoting an informed, transnational and cross-sectoral approach to spatial planning.

This aim has led to a wide range of activities within BALANCE, which started off with collation, harmonization and validation of cross-sectoral and transnational data to provide a cost-effective use of existing data. These data were then used to characterize marine landscapes and their distribution in the Baltic Sea, Kattegat and Skagerrak, while a wide range of habitat mapping efforts was performed in transna-

tional pilot areas. These maps were also used for to demonstrate and evaluate the ecological coherence and representativeness of the Baltic network of marine protected areas. Another effort has been the development of the “Blue Corridors” concept which brings marine biogeographic principles into management tools.

An important question and activity within BALANCE has been effective strategies for bringing data and information into management, which led to the development of a management template for informed MSP. This template was built around existing and planned international initiatives and legal obligations such as e.g. the EU INSPIRE Directive, the EU Habitats Directive and the EU Marine Strategy Framework Directive. It also includes a regional zoning approach adoptable by all sectors and nations around the Baltic Sea.

A key message of Balance and the Balance template is that MSP needs to be based on sound science and build around transnational and cross-sectoral cooperation in order to contribute to a long-term sustainable development within the Baltic Sea Region. The BALANCE products have been published in a range of Interim reports, available at www.balance-eu.org, where interested readers can learn more.

Marine seabed map of the Baltic region produced within Balance

CASE STUDY 6:

Developing good practices in the use of planning tools: the example of Marxan

By Jeff Ardron, Vicepresident of PacMARA and Director of the High Seas Program, Marine Conservation Biology Institute.

When considering the use of planning tools, the first question is whether the problem can be answered well without the tools. There are still many instances where the planning problems are not computationally difficult, and the real issues are social- and/or governance-related. However, with more than five considerations (e.g., data layers), our ability to develop spatially efficient solutions becomes very limited, and the older methods of paper maps and “horse trading” style negotiations will, more often than not, lead to poor decisions.

Among several good tools available, Marxan is likely the most popular software tool used in marine spatial planning. It identifies efficient collections of candidate areas for protection that meet pre-defined conservation objectives. Its wide-

spread use is a clear testament to its usefulness. Nonetheless, when learning to apply a new tool or new approach, it is inevitable that mistakes will be made and difficult lessons learned. Since Marxan was developed, much experience has been gained in how best to apply it to different situations and it was decided that information on user experience should be collected to determine preferred approaches – good practices.

In autumn 2006, the Pacific Marine Analysis and Research Association (PacMARA) began to research good practices in the use of Marxan. Beginning with an online questionnaire, Marxan users could express what they saw as its strengths and weaknesses, as well as areas where they would have liked further guidance. One result was a clear need for better materials to get users started; this led to the re-writing of the Marxan manual (a collaboration between PacMARA and the University of Queensland), which was released in February 2008. The questionnaire results also highlighted other issues requiring consideration. To review these, PacMARA organized two back-to-back workshops in Vancouver, Canada, in April 2007, with participation of over 100 interna-

tional users and experts, to discuss the proper use of tools like Marxan in conservation planning, share good practices, and draft chapter outlines.

One year later, in June 2008, through the collective efforts of 25 authors and three editors, after many edits and internal reviews, an external review draft of the handbook was published on the internet. One clear result was that in addition to devel-

oping good practices for scientific and technical issues, good practices for dealing with social issues also need to be addressed if a planning process is to be successful. The handbook, workshop results and revised Marxan manual are all available on the Marxan (University of Queensland Ecology Centre) and PacMARA websites (www.uq.edu.au/marxan/ and www.pacmara.org).

5. Stakeholder participation

Why stakeholder participation in MSP?

There are many human dimensions in relation to the marine area – cultural, economic, social, and institutional – all of which should be considered in marine spatial planning. Some commercial and recreational users of marine areas are likely to face restrictions following the implementation of a marine spatial plan and this should be taken into consideration^{11, 56}. Marine management will only work with the understanding and consent of the people that will ultimately implement the plan. Often authorities cannot fully control and monitor marine activities, emphasizing the need for public awareness and understanding of the underlying reasons for regulations^{11, 32, 56}.

One of the important aspects of stakeholder participation is the integration of local knowledge, which can be a difficult issue¹¹. Biophysical and ecological data should be supplemented with societal information to balance the environmental and biological aspects; relevant societal knowledge for the area may include human values and goals, historical and current human uses, and social, economic, and institutional considerations, e.g. important fishing areas. Furthermore, individuals may possess a unique understanding of the natural and social environments based on their own observations, experiences or perceptions²¹.

In the context of a spatial plan, a large number of stakeholders are usually involved, although the identification of stakeholders in an area is not always straight-forward. Stakeholders include the planning authority, the full range of affected sectors and disciplines, relevant organizations, the adjacent local and regional community and residents, and other user groups¹¹.

Legally, public participation is often a mandatory part of environmental decision-making and most countries maintain legal systems that allow citizens to participate in decision-making processes. At the EU level, there are two general provisions for informing the public in environmental issues: the Århus Convention and the Directive on Public Access to Environmental Information. Furthermore, the EU ICZM recommendations, the EU Water Framework Directive, and the EU Marine Strategy Framework Directive also stress the need for stakeholder integration³².

Methods for stakeholder participation

There are several ways of including stakeholders in planning, and many terms are used to describe them. The term “integration” is used for the (rather technical) aspect of integrating stakeholder elements into the planning procedure, while “engagement” is used as an overarching term covering both involvement and participation. Stakeholder involvement is a consultative top-down approach, while participation can be characterized as a cooperative approach that offers more possibilities for the engagement of stakeholders and can include the mutual exchange of information and knowledge³².

The pathways of communication will differ with the purpose and extent of engagement; for example, one-way communication may be used for announcing and informing about the planning procedure, while two-way communication facilitates interaction and discussion between the planning body and stakeholders (see Box 3 for methods of engaging stakeholders)³².

Participatory MSP processes

Engaging relevant stakeholders should be considered from the beginning of plan development. Stakeholder engagement should occur early in the process and at key stages in the production of the plan and during its implementation. Previous projects have identified such key stages, as indicated in Figures 4 and 6 and Case Study 2 and 5.

The model and process of stakeholder participation can be highly variable, and will depend on geographic location, the desired goals, situation, and planning bodies. In some cases a very top-down method is used, while in other cases a more elaborate bottom-up approach is followed. Participation should occur at a time when the public can genuinely influence the plan³¹. The draft plan could be made available to the public along with relevant reports such as environmental reports and surveys; however, the degree to which all stakeholders are involved at different points in the process will vary and it may not be helpful to involve all stakeholders in all aspects or at all times.

Box 3: Methods for stakeholder engagement

Stakeholder surveys. These are useful for assessing stakeholder awareness and obtaining local knowledge. Standardized survey formats, e.g., questionnaires or interviews, are recommended.

E-participation. A web-based tool which will allow more people to participate regardless of space and time restrictions (although it should not replace face-to-face engagement). Public meetings. All relevant stakeholders may be

invited to informal open meetings, with information and discussions, to initiate important face-to-face engagement.

Voluntary agreements. If the legal basis is not in place or is insufficient, voluntary agreements can be established between different partners, and may be an efficient tool for strengthening the responsibility and cooperation of all parties.

In the establishment of the first marine national park, Kosterhavet, in Sweden and the bordering national park Hvaler in Norway, public participation played an important part in the designation and proposed regulations for the parks (Case Study 7). The experience from Kosterhavet and Hvaler recognized two general models for public participation: a model for continuous participation and an information-veto model. The work with

national parks in Sweden and Norway also highlighted that in the Nordic region, there is often a mix of support and suspicion amongst the public, stemming from a wish to improve conservation and management, but also a fear of interference and increased regulations and especially reduced economic gain for those depending on resources in the area¹⁵.

CASE STUDY 7:

Making room for everyone – Stakeholder participation in Kosterhavet and Hvaler

Kosterhavet is located on the west coast of Sweden and will be Sweden's first Marine National Park. The marine environment in Kosterhavet is highly representative of the marine habitats found on the Swedish west coast, but it also contains plant and animal species found nowhere else in Swedish waters, including deep-ocean species of brachiopods, sponges and corals. It is also an important nesting area for rare seabird species, and serves as a nursery and feeding ground for several fish species. The area around Kosterhavet is also home to a large human population: nearly 24 000 people live in the Kosterhavet district and 1000 people live within the area proposed as a national park. The local population is in many ways dependent on utilizing the resources of the sea (e.g., fisheries) and the area also supports many recreational activities and a large tourist industry.

The multiple uses of Kosterhavet and the many residents have made the development of park regulations a complicated process. The national park is therefore being created through extensive consultation with residents, community groups, fishermen and other users. A Koster committee was established to set up and coordinate a number of working groups related to the uses of the area, with relevant stakeholders being represented in all working groups, which have held open meetings on a regular basis. Information has also been provided continuously through public meetings and internet sites,

and reports and proposals have been circulated for comment. A particular point of focus has been the maintenance of local important fisheries while also protecting the sensitive benthic habitats. Fisheries were discussed from early in the process and resulted in a joint agreement between fishermen and local authorities (the "Koster-Väderöfjord Model").

Bordering Kosterhavet is the Norwegian sea area Hvaler, where a proposal for a marine national park has also been submitted. The proposed area constitutes 354 km² and covers an extensive sea area including the large Hvaler islands. Initiatives for enhancing the protection status of the area have been under way for several years, and the proposal for the national park was finally submitted in 2007. Following the initial proposal of a national park and the identification of natural values and important human uses, impact assessments and studies were carried out, the results of which were incorporated into an overall proposal. Stakeholders were informed about the process, and the park proposal was submitted to all relevant stakeholders (e.g. homeowners, local authorities, organizations, and unions) and subjected to comments and a public hearing. Based on comments at the public hearing, the proposal is now undergoing revision.

The two cases are examples of very different stakeholder engagement processes: an elaborated version of an information-veto process (Hvaler), and a continuously consultative process (Kosterhavet). A number of advantages and disadvantages in using the extensive consultation process in Kosterhavet were identified. Disadvantages included high

costs in terms of time and resources (although the long-term costs should be considered); unexpected issues that became important; and an outcome that may be very different from what was expected (e.g., less or more stringent protection). Some stakehold-

ers also found the process “fuzzy” and the actual consequences unclear. The advantages were identified as a facilitation of a long-term commitment from local people and politicians, which may prove the most effective in the long run.

6. Marine protected areas in wider marine spatial planning

What are Marine Protected Areas?

Marine protected areas (MPAs) are increasingly regarded as a tool for both the protection of marine biodiversity and the management of natural resources. However, the MPAs are not synonymous with marine spatial planning: MSP has a broader remit and provides an overall framework for managing activities, whereas MPAs are one of the management tools within that planning framework, providing a means for specific protection of given features and processes of marine ecosystems.

In recent years MPAs have become an increasingly common management concept in the Nordic region, e.g., for the protection of cold-water corals in the North-east Atlantic and EU's wider Natura 2000 network⁶³. Numerous terms and definitions have been applied globally to describe the various configurations of MPAs, but the prevailing international definition is the one formulated by the World Commission on Protected Areas (WCPA) under the IUCN⁵²:

“An area of intertidal or subtidal terrain, together with its overlying water and associated flora and fauna, historical and cultural features, which has been reserved by law or other effective means to protect part or all of the enclosed environment”.

MPAs may be established for ecological and conservation purposes, social, recreational or economic purposes, preservation of historical or archaeological sites, reference areas for science or as a tool for enhanced resource management^{43, 44}. Additionally, safety zones established around marine structures may act as de facto reserves.

In most cases, however, MPAs are established to achieve objectives in relation to either protection of sensitive habitats and species for conservation of biodiversity, or in association with fisheries management aiming to restore commercially valuable fish stocks to a highly productive state. In some cases, however, these conservation and fisheries objectives may overlap in situ; for example, a stone reef, sandbank or coldwater coral reef may be home to a number of sensitive invertebrates or floral species while at the same time constituting an essential habitat for commercially important species such as cod or sandeel.

Figure 12: Corals in the Nordic region. To the right: Remains of a *Lophelia* reef that has been heavily trawl-ed. A way of protecting the corals of the Nordic region can be through the establishment of marine protected areas (Pictures: Lene Buhl Mortensen, MAREANO, IMR)

The establishment of MPAs for conservation purposes is provided for by international agreements such as the Ramsar, World Heritage, OSPAR, and Helsinki Conventions, and is also addressed under the Convention on Biological Diversity (CBD)⁶⁵ and the World Summit on Sustainable Development (WSSD)⁶⁴. Within the EU, MPAs are established under the Habitats and Birds Directives as part of the Natura 2000 network⁸⁴, while MPAs established as part of a fishery management regime are provided for in the EU Common Fisheries Policy.

Other types of MPAs are Marine National Parks, which are usually established based on national or international goals of increased conservation of natural heritage. A few marine national parks have been established in the Nordic region (e.g., the Bothnian Bay in Finland) and more are under way. In Kosterhavet on the Swedish west coast, planning is under way for Sweden's first marine national park (Case Study 7),

while Norwegian authorities also are planning a national park in the nearby area of Hvaler¹⁵.

Types and design of Marine Protected Areas

MPAs exist in many forms and vary according to size, objective, scope of protection (from local to international), legal authority, restrictions on use, and management approaches. There is great variation in the levels of protection applied for different MPAs. Some MPAs are closed areas in which all activities are totally prohibited, while in others, a strict no-take policy may be applied. Most MPAs, however, are so-called multiple-use, where varying levels of protection are allocated to designated zones^{43, 44}. MPAs established for fishery management purposes occur in a number of different forms, e.g., as permanent or seasonal closures or for specific types of fishing gear, although it is not clear whether protection zones established under the CFP can be regarded as true MPAs if they are implemented purely as a fisheries management tool without providing long-term protection for the wider environment⁵⁰.

The size and location of an MPA will depend on the nature, behaviour and biology of the species it is designed to protect. While it is possible to determine boundaries for an MPA established to protect stationary species, the issue is more difficult for migratory species. For the protection of highly mobile or oceanic species, MPAs would likely need to be correspondingly large or, alternatively, placed around the most critical habitats for these species, such as feeding grounds, nursery areas, breeding grounds or migration corridors⁵⁰.

An emerging approach for the protection of highly mobile species is the concept of adaptive (or flexible) MPAs. Adaptive MPAs have dynamic boundaries that follow the shifting distributions and migration patterns of certain species, i.e., a no-take zone designed to change location and size in accordance with features associated with species movement. There is general agreement that the use of adaptive MPAs would hold many benefits for migratory species and would also be a promising tool for managing target species and their changing distributions in response to climate change effects⁶⁷. However, the implementation of dynamic and adaptive MPAs carries substantial practical and legal challenges, especially since they are difficult to incorporate in a forward-looking, integrated marine spatial planning perspective.

Transboundary networks of MPAs

MPAs are efficient tools for the protection of specific local features, but to provide a coherent protection of the ecosystem, efforts to maintain ecological connectivity between different MPAs are necessary on a global scale. An efficient transboundary network of MPAs should focus on representative and sensitive species, habitats and ecological processes, while also providing protection for the full range of biodiversity and large-scale marine ecosystems^{43, 44, 50}. Coordinated MPA networks can be beneficial for the protection of highly migratory species, if placed strategically around feeding areas, nursery grounds, breeding grounds or migration bottlenecks.

Networks of MPAs within the Nordic region are currently established under OSPAR, HELCOM and the EU Natura 2000 network (see Box 4). In many cases, the designations for Natura 2000 sites, OSPAR MPAs and Baltic BSPAs are overlapping or identical to each other, with most countries currently adhering to the Natura 2000 criteria. The provisions for creating a Natura 2000 network, however, have often been criticized for having a number of shortcomings, including limitations on the habitats and species included in the directives and also the fact that the definitions of the Natura 2000 criteria are open to interpretation⁵⁰. In addition, the selection process for designating Natura 2000 sites has not included the targeting of sites that add to ecological coherence⁵⁰.

MPAs in fisheries management

MPAs can be established as a tool for fisheries management, with obvious implications for fishing activities. The legislative basis for this is embedded within the EU Common Fisheries Policy (CFP), under which areas can be closed to reduce fishing effort, for a period of time, for certain vessels fishing for certain species, or even permanently to protect certain vulnerable species³³; examples include the Plaice Box and the Shetland Box in the North Sea. To be most effective, and to avoid negative effects of displaced fishing effort, the use of marine reserves as a fisheries management tool should be combined with other measures such as effort reduction, more selective gear, etc.⁶⁸. Global technical guidelines on the use of MPAs as a tool in fisheries management are being prepared by FAO under the Code of Conduct for Responsible Fisheries (Case Study 9). MPAs and real-time fishery closures has been implemented as part of the fishery management system in e.g. Faeroe Islands (Case Study 13)

Box 4: Networks of protected areas

A range of legal instruments and policies at international and European level recommend the establishment of large-scale MPA networks. The World Summit on Sustainable Development in 2002 and the Parties to the Convention on Bio-logical Diversity have made international commitments to establish a global system of representative MPA networks by 2012. Both OSPAR and HELCOM have adopted recommendations for the creation of networks of MPAs, including a joint declaration aimed at establishing ecologically coherent and well-managed MPA networks.

Within the EU, networks of protected areas are being established as part of the Natura 2000 network and the Emerald network. The objective of the Natura 2000 network is to protect the most seriously threatened habitats and species in the EU, under the legal basis of the EU Habitats and Birds Directives. The EU Habitats Directive the establishment of important high-quality sites that will make a significant contribution to conserving habitat types or plant and animal species identified to be most in need of conservation within Europe, as listed in Annexes 1

and 2 of the Directive. This is done by the designation of Special Areas of Conservation (SACs). The EU Birds Directive enables the classification of sites as Special Protection Areas (SPAs) and bird species for which special protection measures must be taken are listed within Annex I of the directive.

The SACs and SPAs will jointly form the Natura 2000 sites. The designation of marine SACs is however still in progress, a delay caused by uncertainties regarding whether the Habitats Directive covers only the 12-nm territorial waters or extends to the 200 nm border of the EEZ. This has now been resolved by a decision that the EEZ is covered, so the process of designating marine SACs is again under way.

In addition, the Council of Europe has established the Emerald network of Areas of Special Conservation Interest as part of work under the Bern Convention (Convention on the Conservation of European Wildlife and Natural Habitats). The network of Emerald sites is based on the same principles as Natura 2000.^{84, 47, 48, 58}

The establishment of MPAs for nature conservation purposes (e.g., Natura 2000 sites) will also have implications for the exploitation of natural resources, particularly fisheries, in the area. These MPAs represent a challenge to the management of fisheries in the area which is an issue that needs to be addressed. In the Swedish Kosterhavet National Park, an agreement was reached with fishermen to limit the impacts of fishing within the National Park (Box 5)¹⁵. Also, in preparing management plans for Natura 2000 sites, site-specific fisheries management plans need to be developed

with a view to meet conservation objectives and minimize negative impacts on the fishing industry. In an attempt to resolve the implications of the Natura 2000 network on future fisheries management, a research project, Environmentally Sound Fishery Management in Protected Areas (EMPAS), has collected and analysed available information on the ecological status and fisheries activities inside and around German Natura 2000 sites with the aim of developing fisheries management plans for each of the ten German sites (Case Study 8).

Box 5: Key elements of the fishing agreement in the Kosterhavet Marine National Park

Fishing is only allowed using small, light-weight trawl doors (maximum 2.7 m² and 350 kg) to reduce impacts on the seabed.

Aluminium grids in the trawl should reduce the by-catch of fish and other large species by up to 85%.

Trawling is banned in highly sensitive areas.

Discussion forums have been established between fishermen, researchers and authorities; There is continued development of environmentally sensitive fishing gear.

The use of MPAs in the Nordic region

The management of MPAs should be based on scientific understanding of the ecosystem and practical management experience. The Nordic Workshop emphasized that MPAs must be based on clearly articulated goals, measurable objectives, and a long-term management vision in order to evaluate the effectiveness of the MPA. MPAs should be based on solid science, but consultation with stakeholders, who are necessary for successful implementation and who can contribute valuable knowledge to the planning process, is also important.

Experience with MPAs and the discussion of case studies at the Nordic Workshop revealed some scepticism among stakeholders, particularly the fishing industry. For MPAs to be effective, better justifications need to be presented for their use together with a demonstration of the possibilities and advantages that they present. Improved knowledge and information are required from scientists and decision-makers concerning what to protect and this knowledge should be made available to the public.

The Nordic Workshop proposed a network approach to MPAs for the Nordic region. This approach should consider not only conservation and habitats, but also other aspects such as socio-economic issues, management regarding commercial fish species, and ecosystem processes. Networks of MPAs and fishery closures could be a step towards a system of broader-scale marine spatial planning that considers the as-

pects of ecological coherence, multiple uses of the marine area, and reconciliation between ecosystem conservation and fishery management. One advantage of designating marine protected areas within the broader context of MSP is that MSP could provide a comprehensive audit of the costs and benefits incurred from area closure.

CASE STUDY 8:

Development of fisheries management plans within Natura 2000 sites – the EMPAS project

In order to investigate the effects of Natura 2000 designations on fishing activities, the German Federal Agency for Nature Conservation and the Federal Ministry of Environment, Nature Protection and Nuclear Safety commissioned the EMPAS (Environmentally Sound Fisheries Management in Marine Protected Areas) project, which was undertaken by ICES starting in 2006.

Assessments of the fishing impacts on Natura 2000 sites require fundamental data on the conservation status of the individual habitats and species, as well as data on fine-scale distributions of ongoing fishing activities. The focus of EMPAS was initially to collect new information and bring together existing information in a consistent and integrated way. During the course of the project, EMPAS has analysed and evaluated potential conflicts in terms of the extent to which specific fishing activities represent a significant threat to achieving the conservation objectives of the Natura 2000 sites, and mitigation measures to determine which management measures would reduce these conflicts and how effective they would be at ensuring favourable conditions in these sites.

Three main issues with regard to potential conflicts in the German Natura 2000 sites were identified: 1) impacts of bottom-contacting fishing gears on features covered by the Habitats Directive (reef and sandbank benthic habitats, and their typical benthic species) at sites in the North Sea; 2) by-catch of sea-birds in static gears, especially bottom-set gillnets, at sites in the Baltic Sea; and 3) by-catch of harbour porpoises in static gears, mainly bottom-set gillnets, at sites in the North Sea and Baltic Sea.

The EMPAS project has hosted three ICES Workshops on Fisheries Management in Marine Protected Areas, in 2006, 2007, and 2008. ICES advice derived from the results of the EMPAS project is based primarily on the 2008 workshop report, which incorporates the results of the two earlier workshops.

The ten nominated Natura 2000 sites in the German EEZ. North Sea: 1. SCI Doggerbank; 2. SCI Sylt Outer Reef; 3. SCI Borkum Reef Ground; 4. SPA Eastern German Bight. Baltic Sea: 1. SCI Fehmarn Belt; 2. SCI Kadet Trench; 3. SCI Western Rønne Bank; 4. SCI Adler Ground; 5. SCI Pommeranian Bay with Odra Bank; 6. SPA Pommeranian Bay. The SPAs of the Birds Directive together with the SACs of the Habitats Directive constitute the elements of Natura 2000. The SCIs are to become SACs when approved by the EC. More information at www.habitatmare.de.

Source: International Council for the Exploration of the Sea (ICES)

CASE STUDY 9:

FAO Technical Guidelines on Marine Protected Areas as a Fisheries Management Tool

By *Jessica Sanders*, Fisheries Officer, UN Food and Agriculture Organization

The increasing call for the use of MPAs and MPA networks on an international basis has brought about efforts to clarify the role of MPAs in fisheries management and conservation, as well as where and in what situations such a tool can be most useful. In 2006, at the FAO Committee on Fisheries (COFI) meeting, Members expressed their support for the use of MPAs as a tool for conservation and fisheries management and requested FAO to develop technical guidelines on MPA design and implementation. In summer 2006, an expert workshop on MPAs in a fisheries management context was held in Rome, Italy, at which a group of experts came together to characterize MPAs as a fisheries management tool.

Rather than adding another global definition of an MPA to those which, though diverse, are generally consistent, participants felt that it would be more useful to build on the consistencies. The resulting points characterize an MPA as a fisheries management tool, in that they:

- are intended to contribute to achieving the conservation and sustainability objectives of fisheries management, while contributing to biodiversity and habitat conservation;
- are temporally and geographically specified in three dimensions for a portion of the geographic range of the fishery management unit;
- would afford fishery resources a higher degree of protection within the geographic boundaries of the MPA than the resource is afforded else-

where within the geographic range of the fishery management unit;

- are established through legally binding mechanisms and/or other effective means;
- are usually expected to have resource conservation and sustainability benefits, other ecological benefits, and/or social benefits, beyond the boundaries of the MPA.

Technical Guidelines under the FAO Code of Conduct on Responsible Fisheries are being developed based on the need for further information on the application and utility of MPAs for fisheries management, and also the linkages between the various objectives under which MPAs are established. Reconciliation of objectives as well as the creation of link-ages between agencies, departments and organizations working on different but convergent goals are crucial to the effective use and implementation of MPAs. The Guidelines will also address the importance of embedding MPAs and other spatial management measures within broad management frameworks such as integrated coastal management, an ecosystem approach to fisheries, and marine spatial planning. A set of global case studies on MPAs led by FAO will focus on governance issues in MPA policy and management, as well as examine institutional link-ages.

Although MPAs constitute only one tool within fisheries management or conservation, they are important as they represent one of the few management tools that address the activities of multiple sectors. If today the major threat is considered to be fishing, tomorrow other threats such as bio-prospecting, mining, energy development or CO₂ sequestration may arise. Implementation of spatial management measures will have to be considered in a broader context, rather than solely that of fisheries.

7. Planning for uncertainty: A changing climate

Ecosystem vulnerability to a changing climate

Marine ecosystems are vulnerable to the current and future changes in climate, and changes in the marine ecosystem have already been observed. As a result of changes in key atmospheric parameters, ocean water temperature will increase and there may be alterations to ocean chemistry (particularly the ability to absorb CO₂ leading to acidification), changes in ocean circulation and currents, and changes in cloud cover and sea ice affecting light supply to the ocean surface³⁸. Furthermore, may there be changes in wind patterns and increased precipitation at high latitudes that will lead to more runoff from land to sea, which can cause eutrophication and oxygen depletion in coastal areas. All such changes can have a variety of effects on marine ecosystem functions and marine life, including the distribution of marine species and their robustness in relation to other sources of stress, as well as implications for human activities and utilization of marine resources³⁸.

Changes to Nordic marine life as a consequence of global warming can have pronounced impacts on marine resource exploitation, in particular capture fisheries. For commercial fish stocks, climate change effects can act directly on physiology and alter growth, development, reproductive capacity, mortality, and distribution; or indirectly through effects on the productivity, structure, and composition of the ecosystems on which the fish depend⁷¹. The distribution of fish and plankton may change significantly as a consequence of climate change, as fish species associated with temperate waters may migrate further north, while animals usually associated with warmer waters may become established in the Nordic region⁷¹. Climate change can also affect the aquaculture sector as warmer waters induce the growth of new bacterial species and toxic algae, while acidification can impede the ability of shellfish to grow and maintain their shells. This can threaten the production of fish and shellfish as well as the safety of food products.

Implications of climate change for management in the Nordic temperate region

Given the complexity and regional variability of marine ecosystems, and the uncertainties of climate change projections and responses, it is necessary to develop management systems for natural resources that are adaptive and flexible. At the Nordic Workshop, suggested attributes of management include flexibility, adaptability to new information about the marine ecosystem, reflexivity (i.e., continuous evaluation of the consequences of management), and transparency in the use of information and in governance. It will be necessary to evaluate current regulations and advisory and management systems to determine whether they are suitable and sufficiently flexible to account for the impacts induced by climate change. This will require a suite of multidisciplinary management evaluation tools as well as management methods that will maximize the capability of marine ecosystems to withstand climate-induced stressors and changes.

The changes required for ecosystem-based management in the face of climate change cannot be achieved by one sector alone but require an integrated cross-sectoral effort, and marine spatial planning could provide a framework for an integrated effort. A possible approach in association with climate change is the development of area-based management methods, e.g., adaptive MPAs that consider changes in the distribution of traditional and new species and their interactions.

A changing Arctic

The Arctic region was identified by the Nordic Workshop on Marine Spatial Planning as being of particular concern in relation to the effects of climate change. The ice covering the Arctic Ocean is melting at a rapid rate. In 2007 the scientists on the UN Intergovernmental Panel on Climate Change (IPCC) 69 projected that summer ice in the Arctic may completely disappear by the end of this century, although recent observations

indicate that this may happen as soon as 2030 if the current rate continues. In 2008, both the Northeast and Northwest Passages in the Arctic were open for the first time in 125,000 years. The changing climate

will have pronounced effects on Arctic ecosystems, accompanied by indirect social, environmental, economic and health impacts.

Figure 13. The melting of pack-ice in the Arctic region opens up waterways

Human activities and exploration for natural resources are expected to increase greatly in the Arctic region as melting packice opens up the waterways; in particular, oil and gas exploration, shipping, and fisheries are expected to increase. The large reduction in the ice covering the Arctic waters, along with developments in technology and high energy prices, will make it possible as well as commercially attractive to establish more oil and gas production facilities in the Arctic. The opening of waterways has also sparked interest within the shipping industry, and shipping companies and governments are already getting ready to exploit the Northeast and the Northwest Passages⁷³. This increase in human activities may compromise the sensitive Arctic environment.

A framework for planning and integrated management could be used to decrease the problems associated with global warming. Integrated and spatial planning could be used to address the potential problems of the Arctic before they arise by, for example, identifying valuable or vulnerable natural areas, establishing protected sites, addressing sites of shipping activity and oil and gas exploration, and undertaking cumulative risk assessments. It could also help prepare for more general human influence in areas currently covered by ice and assist in maximizing the resources for local populations and hunters. However, such integrated management efforts call for a high degree of coordination and cooperation among all countries involved. Various possibilities for addressing the problems facing the Arctic region are included in Chapter 8 (Nordic Perspectives and Opportunities

8. Nordic perspectives and opportunities

Nordic MSP activities

The implementation of an ecosystem approach to the management of marine resources and spatial planning in the Nordic region has largely followed regional or international initiatives, such as OSPAR, HELCOM, EU strategies or initiatives, strategies within ICES, or other political processes for specific sea areas (e.g., the North Sea Conferences). However, despite the measures taken in the North Sea and the Baltic Sea, there has been a continued and widespread degradation of habitats, loss of biodiversity and depletion of resources.

In some of the Nordic countries, steps have been taken towards implementing a more ecosystem-based

approach to marine management. For example, in Norway a 2002 governmental white paper⁵⁵ took a significant step towards implementing an integrated and ecosystembased management approach, which so far has resulted in the Barents Sea-Lofoten Integrated Management Plan (Case Study 10)¹⁷ and recently in a similar plan for the Norwegian Sea. In Sweden, a recent Marine Environment Inquiry has recommended an environmental policy that should entail a holistic approach⁶².

The possibilities for further implementation of integrated, spatial planning within the Nordic countries and in particular increased transboundary planning among the Nordic countries were topics of discussion at the Nordic Workshop on Marine Spatial Planning.

Box 6: New approaches to marine management in Norway and Sweden

Marine Management in Norway: In Norway, a significant step towards integrated, ecosystem-based management was taken in a governmental white paper in 2002, based on the parliamentary report “Protecting the riches of the Sea”. This paper gave rise to a long-term, comprehensive policy for the protection of the marine and coastal environment, and has so far resulted in the Barents Sea-Lofoten Integrated Management Plan. A similar project has been conducted for the Norwegian Sea, for which a management plan is scheduled to be adopted in 2009. The Norwegian Institute of Marine Research (IMR) has been leading the process of developing integrated management plans and including the ecosystem approach into marine research and management^{55, 74} (see further details in Case study 9).

Marine Management in Sweden: In Sweden, a Marine Environment Inquiry was appointed by the Government in 2006 to look into ways in which Swedish marine environmental efforts can be improved nationally and together with other countries. The official report of the inquiry was released in June 2008 stating that it is time for a third-generation environmental policy that should entail a holistic approach and full integration of environmental issues into all policy areas, stronger political leadership and, to a much greater extent, an international focus⁶². However, as of yet, no official steps have been taken to put these recommendations into practice.

Nordic characteristics in relation to marine spatial management

The Nordic Workshop participants identified a number of important characteristics shared by the Nordic countries that may be of importance in relation to the implementation of marine spatial planning – both on a national level as well as for the establishment of a common Nordic approach. The Nordic region is in many ways homogeneous and has a unique unity, with commonalities such as languages, culture and history. It is fairly environmentally conscious, highly developed regarding technology and also has a high level of financial and educational wealth. Such factors will

help facilitate transboundary cooperation and the establishment of regional agreements.

There is a history and a relatively high level of regulation and compliance in all of the Nordic countries. A high level of compliance will make MSP easier; however, there is also a strong public reaction to poor planning, which means that planning authorities must be careful to do things properly from the outset (for example, in Kosterhavet in the Skagerrak, there has been scepticism because people still remember old management failures)¹⁵. In contrast to some other areas, the regulatory traditions in the Nordic countries operate slowly, as new approaches are tested before becoming too ambitious¹⁵.

The Nordic region is characterized by strong climate gradients, both in term of seasonality as well as the large latitude gradient (Figure 14). This seasonality and the different climatic conditions of Nordic regions need to be taken into account in marine spatial planning, as they affect the biological, chemical, geological, and physical processes. For example, the accumulation and degradation of pollutants are affected by light and temperature, with, among others, oil taking longer to degrade in the cold and dark. Also, the ice cover may change from year to year. Some of the Nordic seas are very heterogeneous, and have strong biological or biophysical gradients over short distances, for example, the gradient in salinity in the Baltic Sea and other such factors also need to be taken into account.

Figure 14. The Nordic region encompasses a strong seasonality and many different climatic conditions, as well as different habitats and nature types – a fact which must be considered in the establishment of marine spatial planning (Pictures: TK Sørensen, DTU-Aqua. Nordbil, Norden).

Common Nordic approaches?

For reasons relating to e.g. legal issues, data compatibility, and cumulative effects, it is important that individual nations in a region strive towards coordination in their respective MSP processes. In light of the characteristics shared by the Nordic countries, the Nordic Workshop on Marine Spatial Planning recognized that the Nordic countries possess a unique opportunity to begin large-

scale, transboundary marine spatial planning.

The level at which a common Nordic approach to MSP might occur and its feasibility need to be considered. Even if a common Nordic approach could be agreed upon, no current political means exists to implement it, because most cooperation currently occurs through the EU, or through networking of public servants. A way forward could be through the establishment of common principles; however, priorities and differences between countries, ecologically and in exploitation of resources (e.g., fisheries are organized very differently), need to be considered, so the principles would need to be fairly general and overarching but based on the same philosophy. The implementation would likely be quite different.

The Workshop participants felt that planning approaches in the Nordic area should be developed for specific regions rather than countries, as areas are very different and there are often many commonalities within specific sea areas. This could result, for example, in different Baltic and OSPAR approaches. This also corresponds well with the regional approach of the EU's Marine Strategy Framework Directive. Some of the ecosystems within the Nordic region are also influenced by other countries; for example, the Baltic as a whole receives influences from a large number of culturally diverse countries. It is important that cooperation with Russia is prioritized as that country plays an important role both in the Baltic Sea and in the Arctic.

Institutional frameworks for marine spatial management in the Nordic region

At the Nordic Workshop on Marine Spatial Planning, participants noted that the establishment of marine spatial planning on an international or regional level requires the enhancement of formal and legal frameworks. The regional seas conventions (OSPAR for the Northeast Atlantic, HELCOM for the Baltic) as well as the Arctic Environmental Protection Strategy (AEPS) for the Arctic are important in relation to marine spatial planning. Existing regional conventions and organizations should be used for furthering the work on marine spatial planning rather than creating a new organization, and work under the regional conventions could be conducted that would then feed into EU activities. However, the remits of the regional conventions and Regional Advisory Councils (RACs) may be considered too narrow to fully represent all issues, such as tourism. A complementary approach is to support future work through large-scale collaborative development projects. A good example is the recently completed EU Interreg project BALANCE, a regional project which,

among others, has advanced the knowledge-base for future MSP through comprehensive marine landscape modelling and mapping in Baltic Sea³².

The Workshop discussions noted that OSPAR has expressed enthusiasm for MSP and has been proposed as a route of cooperation. However, progress in OSPAR can be slow and there is a strong reliance on the Contracting Parties to put effort into its projects and actively pursue them. OSPAR is currently preparing a Quality Status Report for its Convention Area and in this context needs information on fisheries and other human activities, again highlighting the need for spatial planning and data collection. To be more effective, there is a need to increase national support for OSPAR.

The EU has recently taken an important step in relation to marine spatial management, as the EU Maritime Policy has identified maritime spatial planning as one of three tools of major importance for integrated policy-making and also as a key planning tool for sustainable development of marine areas and coastal regions (Chapter 2). However, Workshop participants noted that the EU should not commit countries to specific actions, but should rather focus on coordinating its own policies and use MSP as a means to develop cross-sector integration. It should also establish where EU-level activity can add to national value and to the regional conventions. Many Workshop participants felt that the EU can facilitate the environment in which MSP can flourish, but the ideas should come from individual countries. It is important that socio-economic, environmental as well as safety issues are incorporated into a marine spatial plan, and in a future consideration of MSP at an EU level, participants at the Workshop recommended that the European Commission Directorates General work in a more coherent manner.

Not all Nordic countries are members of the EU, which is a situation that needs to be respected and considered. However, as non-EU countries are clearly affected by EU legislation, the Workshop agreed that it is important that they can have a role in the development of ideas within the EU; they also may have relevant experience or interesting ideas. Nordic non-EU countries (Norway and Iceland) are contracting parties of regional conventions, and the conventions should consider the issue of how to feed into the EU; for example, OSPAR could be used to channel ideas into EU legislation.

Arctic opportunities

The Arctic parts of the Nordic region are facing a number of serious challenges, including pollution, opening of waterways and enhanced resource exploita-

tion (e.g. oil and fisheries), many of which are associated with a changing climate. Planning rather than mitigation is regarded as essential for the Arctic region, however, as of yet, no management initiatives are in place to sufficiently enable Arctic communities (e.g., in Greenland) to deal with these issues proactively. In Greenland, some initiatives are taking place for the long-term sustainable management of wildlife, but the resources available for management are very limited in comparison to the vast geographical range to be covered. This is highlighted in a management plan for Greenland's living resources (Case Study 11). Furthermore, such initiatives only cover selected aspects of Greenland's natural resources, and not the broader Arctic.

In November 2008, the European Commission adopted a Communication on "The European Union and the Arctic Region"⁷⁰, highlighting the effects of climate change and human activities in the Arctic. Apart from setting out EU interests and policy objectives, the text proposes a systematic and coordinated response to rapidly emerging challenges, and also proposes enhanced Arctic-related cooperation between the EU and Greenland. In relation to fisheries, the Communication stresses the importance of establishing a regulatory framework for the part of the Arctic high seas not yet covered by an international conservation and management regime. The Communication⁷⁰ also underlines the need to explore the possibility of establishing new, multi-sector frameworks for integrated ecosystem management, which could include the establishment of MPAs, navigational measures, and rules for the sustainable exploitation of minerals. The Communication⁷⁰ is the first step towards an EU Arctic Policy as it aims to provide a basis for implementing the EU's strategic initiatives, including the Integrated Maritime Policy, in the Arctic region.

Because a significant segment of the Arctic is under the influence of the Nordic countries, the Nordic Council should play a stronger role and promote management activities in this area through, for example, strengthened cooperation with the Arctic Council. An Arctic Marine Strategic Plan, released by the Arctic Council in 2004, provides a good start in that it recognizes the need for integrated ecosystem-based approaches to management. The Nordic Council could promote integrated management in the Arctic region by drawing upon the knowledge and integrated management activities already present within the Nordic countries (as identified and presented at the Nordic Workshop on Marine Spatial Planning) and the strong institutional support for Nordic Council activities.

CASE STUDY 10:

Development of an integrated management plan for the Barents Sea – Lofoten area

An integrated management plan has been developed for the Norwegian part of the Barents Sea, covering a total of 1.4 million km² and including the Barents Sea within the Norwegian EEZ, the sea areas off the Lofoten Islands, as well as the fishery protection zone around the Svalbard archipelago. The plan was developed through a broad, multi-faceted process involving a number of government directorates. To coordinate the process for the development of the plan, a Steering Committee was established, chaired by the Ministry of the Environment and in collaboration with five other ministries.

The overall goal of the integrated management plan is to safeguard marine ecosystems and to ensure a safe and sustainable use of resources in the area. The main activities covered by the plan include coastal and offshore fishing, shipping, and petroleum activities, while aquaculture and coastal zone development are not covered. Work on the plan began in 2003 with the preparation of the scientific basis for the plan, followed by sectoral studies in 2004, and ultimately integrated studies of the overall pressures in 2005. The integrated management plan was completed in 2006 (after consideration at a stakeholder conference) and implementation was subsequently initiated. It is a dynamic plan, with the first revision scheduled for 2010. International cooperation occurs on a regional level to ensure management in relation to the entire ecosystem.

The plan development followed a three-step process: Phase 1 consisted of the preparation of status reports and included the collection of all relevant information. Phase 2 represented an analytical phase and included four extensive environmental impact assessments covering the impact of fisheries, shipping, hydrocarbon extraction, and external pressures.

Management objectives were also established. Phase 3 entailed the determination of aggregated impacts and spatial considerations, focusing on the total impact of all human activities combined, both for the current situation and up to 2020.

The plan aims at a sustainable use of the ecosystem within acceptable levels of pollution, a reduced risk of accidental spills with a sufficient capacity to deal with accidents, and seafood that is safe for consumption, while maintaining biodiversity at all levels. More specifically, the plan calls for:

- The hydrocarbon industry to operate under a zero-emission policy;
- Shipping lanes outside territorial waters to reduce the risk of collision;
- Further preventive measures against pollution;
- Ecosystem-based fisheries management and the implementation of ecological measures in fishery management based on an increased use of multispecies assessment tools;
- Reduced by-catch of fish, seabirds and mammals, and fewer effects on bottom fauna;
- Measures against illegal, unregulated, and unreported (IUU) fishing;
- Closer cooperation with the EU and Russia to enhance surveillance, and the prosecution of fishers violating existing rules;
- Prevention of the introduction of alien species;
- The protection of valuable and threatened habitats.

The plan development identified the main impacts on the Barents Sea area up to 2020, which includes the petroleum industry, fisheries (in particular IUU fishing), long-range transport of pol-

lutants, alien species, and climate change. In addition, valuable and sensitive areas that are important for biological production or processes such as spawning were identified.

CASE STUDY 11:

Management plan for Greenland's living resources

An action plan for the management of Greenland's living resources is being developed by the Department for Fisheries, Hunting and Agriculture. The work was initiated in 2006 in recognition of unsustainable harvest levels, to preserve a hunting tradition that is deeply rooted in Inuit culture and ensure reasonable living standards for the population, which is largely dependent on the utilization of wildlife resources for its welfare. The plan will cover the living resources in all of Greenland and the surrounding coastal areas.

The resource action plan focuses on three main areas of work:

- Development of management aims for the species concerned, including the desired distribution and population size of the species in relation to carrying capacity, and development of a regulatory mechanism to fulfil these aims;
- Changes in the management system, covering measures necessary to ensure sustainable access to resources and regulations relevant in a local context (geographical distribution of quotas, access to hunted species, local involvement in management and monitoring, etc.);
- Initiatives to improve economic revenue from living resources, including product development, improving access to markets, and local retention of revenue.

The initial phase of the work focused on problematic species in relation to sustainable use, covering six species of mammals and four species of birds. Biological data (e.g., historic and current distribution data, carrying capacity levels, maximum sustainable yield, human activity levels and catch statistics) were collected from existing scientific sources. Local stakeholders were involved through a national questionnaire and interviews with authorities, organizations, hunters, tourist operators and industries in selected communities. It was decided to conduct two types of monitoring: species monitoring, to ensure that management aims from the planning process are achieved, and monitoring of the functioning of the management system. Results of the implemented plan are not yet conclusive and biological data collection is still ongoing.

The Greenland action plan is an example of a small management unit that uses integrated spatial planning for a large geographical area, taking into account both biological and social issues in one integrated plan. Based on presentation by Elmer Topp Jørgensen¹⁸

9. Application of spatial planning for different maritime sectors

The marine environment is the scene for a vast number of industrial activities, representing major sectoral economies, including oil and gas production, shipping, military areas, extraction of aggregates, disposal of dredged material, commercial fishing, wind farms and mariculture. The sectors are of vital socioeconomic importance and/or provide important resources for human consumption or utilization, but competition for space and resources may have detrimental environmental impacts or compromise future resource use.

Spatial management is based on the identification of current and future activities involving marine space and resources and the needs of users, as well as the ability to take measures to avoid or resolve conflicts. This section focuses on specific issues and opportunities pertaining to marine spatial planning in relation to six maritime industries that represent major economic interests, are undergoing major growth, or have particular socioeconomic or environmental impacts. They were also addressed in several discussions throughout the Nordic Workshop on Marine Spatial Planning. These sectors are:

- Fisheries
- Wind energy
- Oil and gas production
- Shipping
- Aquaculture
- Marine aggregate extraction.

Fisheries

Fisheries in the Nordic region

Extensive fisheries take place in Nordic waters and is an important economic sector for many Nordic communities and a provider of important resources. However, many commercial fish stocks are overexploited and outside safe biological limits which has resulted in declining landings in the fishing industry – an industry already under pressure from increasing competition with other sectors. Furthermore, fishing practices may cause damage to habitats, mortality of non-target species, and changes in the structure and function of ecosystems. In recognition of the need for more sustainable fisheries, ecosystem-based management of

fisheries (EBMF) has been embraced as a viable management approach. Marine spatial planning is considered one tool to assist EBMF and reconciling fisheries management and ecosystem conservation.

Institutions and regulations have been established at international, European and national levels to regulate and manage fisheries and there are increasing attention to the possibilities of EBMF. The concept of sustainable and ecosystem-based fisheries has been addressed in a number of international treaties and non-binding instruments such as the 1995 FAO Code of Conduct for Responsible Fisheries³⁹ and the FAO 2001 Reykjavik declaration⁴⁰. The sustainable management of fish stocks on the high seas has been addressed in the UN Fish Stocks Agreement and by the establishment of Regional Fisheries Management Organizations (RFMOs). Sustainable development of fishing activities was also included in the 2002 reform of the EU Common Fisheries Policy (CFP)^{33, 40}.

Figure 15. Trawlers at sea
(Source: T.K Sørensen/E. Hoffmann, DTU-Aqua)

Concerns of the fisheries sector

A topic which frequently surfaced at the Nordic Workshop was the requirements and concerns of the fisheries sector in relation to marine spatial planning and the implementation of EBMF. Although the industry recognizes the interdependence of fisheries and healthy marine ecosystems⁶³, it fears that spatial planning will be used to limit fishing activity still further and will result in a restriction of access to important fishing grounds. While sectors utilizing the sea-bed can derive benefit from an allocated use of space, the

issue is more difficult for the fishing industry which, with its more dynamic spatial use, is dependent on an extended range of operation and free access to European waters⁶³.

Two spatial conflicts currently cause particular concern within the fishing industry: the increasing construction of wind farms, which may result in damage to critical habitats, loss of access and displacement of fishing effort; and the creation of marine protected areas, which may result in the establishment of permanent (or at least long term) exclusion zones⁶³. At the Nordic Workshop, fishing industry representatives expressed concerns about how socioeconomic considerations are applied in the site designation and spatial allocation process of protected areas, because, for example, socioeconomic implications are not considered in Natura 2000 designations.

Integrating fishermen's knowledge in spatial management

In order for fisheries to achieve conflict resolution with other uses and activities at sea and achieve environmental protection, increased knowledge of fishing areas is needed¹⁰. For fisheries managers and advisors, resources for enforcement have often been inadequate and, in particular, knowledge about fishing activity and fishing grounds has been insufficient.

The fishing industry has been reluctant to map important fishing grounds and identify priority areas, owing to natural difficulties in anticipating future spatial needs and the potential for translation into MPAs or use for the benefit of competitors. The fishing sector has also been one of the last to embrace the process of marine spatial planning although it is beginning to engage – as signalled by the decision of the North Sea RAC to establish a Working Group on Spatial Planning (Case Study 12). The objective of the working group has been to protect fishing space by developing a comprehensive programme to map areas of fishing interest¹⁰.

More joint and transboundary projects and programmes on data collection and fisheries mapping are recommended, as well as facilitation of improved industry-science cooperation and establishment of a working relationship. The RACs play a key role in promoting better communication and cooperation among fishermen, scientists, and decision-makers. The RACs could, for example, inform DG Mare, DG Environment, OSPAR, and EU Member States about how they would like to be consulted concerning off-shore MPAs; they should also explore how the fishermen's knowledge could assist the coexistence of fishing and site protection. In addition, a common set of guidelines and management measures should be identified for different types of MPAs¹⁰.

At the Nordic Workshop, the use of Fishing Vessel Monitoring Systems (VMS) data was also discussed. A VMS is a programme of fisheries surveillance, where equipment permanently installed on fishing vessels provides information about activity and locations. The security of VMS data is an important issue because the position of fishing vessels is sensitive commercial information, and many precautions are taken to protect the data from damage or unauthorized use. However, VMS data holds many advantages and possibilities for fisheries management, although they are not currently used to their full extent.

Figure 16. The catch of the day

Towards spatial and ecosystem-based management of fisheries in the Nordic region

Using the ecosystem approach implies using our knowledge of ecosystems to improve fisheries management for the maintenance of commercial fish stocks and replacing the instruments of total allowable catches (TACs) and quotas with more finely tuned technical measures⁶³. The vast amount of scientific knowledge of ecosystems and fisheries that already exists creates an opportunity for the application of a range of ecosystem-friendly spatial management tools. Alternative approaches are already present within the Nordic countries; for example, fishery management systems with spatial requirements have been successfully implemented in Iceland and the Faeroe Islands (Case Study 13), where dynamic management using technical and spatial regulations is employed.

Scientific knowledge on commercial fish stocks, fish ecology, and fishing fleet behaviour is essential in furthering ecosystem-based management of fisheries, and the importance of scientific research for fisheries management is highlighted, for example, by a study of the recruitment of the North Sea lesser sandeel (*Ammodytes marinus*) (Case Study 14). Increased knowledge on nontarget species, habitats, habitat connectivity, and ecosystem processes is also necessary, as well as knowledge on the effects of different fishing practices and fishing gear. The implementation of

EBMF will also require the inclusion of a wider range of scientific knowledge across fields.

There is a clear need to place fisheries management within a broader marine management strategy, and the challenge for fisheries is to make managers and planning authorities fully aware of their spatial requirements⁶³. The North Sea RAC has stated that there is an urgent need to clarify the rules of engagement between fishermen and developers at the North Sea scale, as well as a need to develop a protocol of minimum standards and best-practice guidelines¹⁰. The regulatory framework for a sustainable ecosystem-based fishery should also be strengthened, and decision-makers should incorporate fishermen into the planning and become aware of the consequences of management initiatives to the fisheries.

Transboundary agreements and adaptive integrated management efforts across borders should be an integral part of implementing ecosystem-based management of fisheries and introducing marine spatial planning on a regional scale. The distribution of fish may be highly variable, as fish occupy different habitats throughout their life and between seasons, and may migrate across vast distances. Fish stocks are also connected over vast distances through ecosystem processes. For example, in the study of North Sea lesser sandeel (Case Study 14), a key species in the North Sea ecosystem, it was found that the abundance of sandeels in one sandbank habitat can be influenced by changes in fishing pressure or hydrography occurring far away – a spatial transboundary aspect that could be addressed through large-scale marine spatial planning.

CASE STUDY 12:

Resource management and mapping – North Sea RAC activities

By Euan Dunn, Chair of NSRAC Spatial Planning Working Group

The North Sea Regional Advisory Council (NSRAC) was the first of the RACs to engage with the issue of spatial planning. In May 2005, the Spatial Planning Working Group (SPWG) was established to address conflicts for NSRAC stakeholders arising from the rapid growth of human activity in the North Sea, not-bly wind farms, aggregate extraction, and MPA networks. The fish producer sector, in particular, perceives these developments as putting a “squeeze” on fishing space and fishing effort. Although the fishing sector comprises two-thirds of the RAC, this issue was of equal importance to the other stakeholders, especially the environmental NGOs and the recreational anglers. The NGOs were concerned about balancing fisheries with protecting biodiversity, and promoting an ecosystem approach.

The NSRAC has a special role to play in spatial planning. Firstly, it facilitates cooperation by stakeholders on transboundary issues of common concern. Secondly, it represents a unique forum for capturing and distilling the knowledge of fishers, previously missing from the decision-making arena. The SPWG is a platform for defining NSRAC positions, both reactive and proactive, in relation to those of the European Commission, Parliament, Member States, and OSPAR.

The SPWG has so far focused on three areas of activity:

- **Mapping fishing activity:** Maps of areas of fishing interest are being produced, based on VMS and other data and validated by fishermen’s knowledge, to help integrate fishing with other uses of the North Sea. The SPWG developed a methodology which was a precursor to mapping pilot fisheries by an EU-funded joint data collection project between the fishing sector and the scientific community in the North Sea, led by CEFAS (Centre for Environment, Fisheries and Aquaculture Science, UK).
- **Interaction between fisheries and wind farms:** The NSRAC recognized an urgent need to clarify the rules of engagement between wind farm developers/operators, fishers and other stakeholders. The fishing sector is often the last to be consulted on renewable energy developments which exclude fishing and displace effort, fuelling a loss of trust between the two sectors. To help address these concerns, the SPWG has developed a protocol of minimum standards and best-practice guidelines for assessing all the potential impacts of wind farm development on fisheries.
- **Facing up to offshore MPAs:** With EU Member States required to submit their initial list of Natura 2000 sites by September 2008, there was an urgent need for the NSRAC to address the challenges for fisheries management arising from the designation of sites. However, because this challenge faced all the RACs, in 2008 the NSRAC led a meeting co-hosted and attended by several other RACs, to explore these issues with DG Mare, DG Environment and other practitioners. Critical areas of concern were explored, assisting the Commission with designation of the Natura 2000 network and enabling better-informed engagement by the RACs.

CASE STUDY 13:

Dynamic real-time fisheries management in the Faroe Islands

In Faroese waters, the use of closed areas has been a key aspect of the effort quota system regulating the demersal stocks (cod, haddock and saithe). The Faroese fisheries management regime (the so-called Fishing Days System), covering all Faroese waters, is a purely effort-based management system devoid of quotas or TACs. Instead, it uses extensive technical regulations and spatial measures, concerning gear type, effort and season. One of the aims of the system has been to separate the fleets (longlining, pair trawl, deep-sea trawl) geographically, and selected areas have therefore been designated as trawling exclusion zones (either year-round or on a temporary basis). Furthermore, all-gear closures may be imposed during the spawning season. There is also a system of real-time closures where fishing can be banned temporarily (1–2 weeks) if the number of small cod, haddock, and saithe in the catches exceeds 30% of the total catch.

The current status of closures and spatial regulations around the Faroe Islands

It is worth noting that the current management system has been developed largely by the fishing industry as a response to the ineffectiveness of the quota system. The management system seems to be effective (the cod stock has not shown a long-term decrease, although it is unknown whether this is due to the fishing closures) and is popular within the fishing industry.

Based on presentation by Luis Ridao Cruz⁷

Spatial distribution of fishing effort by some of the major fleets around the Faroe Islands.

CASE STUDY 14:

Towards area-based management of sandeels in the North Sea: The role of large-scale connectivity

The process of recruitment and population dynamics of the North Sea lesser sandeel (*Ammodytes marinus*) were investigated in a large-scale multi-disciplinary study under the PROTECT project, and the importance of hydrography and habitat connectivity was considered. Sandeel habitats in the North Sea comprise numerous adjacent, elongated sandbanks, formed by tidal currents. By studying ocean currents it was demonstrated that recruitment in some areas is entirely dependent on larval supply from eggs spawned in other areas, while other areas are self-recruiting, i.e., the sandeel larvae settling in the area are produced locally. Ocean currents are thus crucial for the connection of areas and the recruitment of sandeel larvae in some areas, and strong spatial and interannual variability in oceanic transport can affect recruitment of sandeels in these areas.

The study showed that habitats are connected over vast distances, and that the abundance of sandeels in one area may be influenced by changes in fishing pressure or environmental parameters taking place in other areas. This emphasizes that sandeel biological models must be spatial, and that hydrography must be included in biological models.

Habitat connectivity is also important for assessing the optimal size and numbers of sandeel management units in the North Sea. The sandeel fishery is currently managed according to ICES rectangles, but analyses of the North Sea sandeel fishing banks reveal that in many cases ICES rectangle definitions artificially divide habitats that are naturally connected. The study showed that sandbank habitats can be divided into areas of approximately 50 km, so there are 50–100 habitats in the North Sea. However, these primary habitats are not optimal from a stock assessment perspective: they are too small and too numerous to be well-suited as management units. Therefore, some level of primary habitat aggregation is needed for management purposes. Analysis has divided the habitats into five major regional aggregations (see figure below), although transport distance scaling analysis indicated that an optimal habitat definition for North Sea sandeels is preferably around ten bank systems; this would also be feasible from a management perspective.

This study emphasizes that habitat connectivity at a large scale is an important issue in fisheries management and such transboundary aspects can be addressed through large-scale marine spatial planning. The study also highlights the importance of improved scientific understanding of the natural systems for improving the management of natural resources.

Based on presentation by Asbjørn Christensen⁵

Offshore wind energy

A growing industry

Offshore wind energy has become an attractive option for efficient production of renewable energy and is a growing sector across Europe. Several European countries utilize wind for renewable energy production and countries such as the Netherlands, Denmark, Sweden, Germany, United Kingdom, and Ireland are currently installing vast amounts of wind power capacity around the North Sea and Baltic Sea. In the Nordic region, Denmark and Sweden are investing large resources in utilization of offshore wind energy.

Figure 17. Offshore wind farms are becoming a common acquaintance in the Nordic region
(Source: Euan Dunn¹⁹)

The increased utilization of wind energy is seen as a positive development for the environment as there are no harmful emissions associated with wind energy, thereby contributing to the mitigation of climate change¹⁴, although the construction and operation of offshore wind farms can have other pronounced effects on the natural environment.

Construction of turbine foundations and placement of cables can cause the resuspension and deposition of sediment, alter the physical benthic habitat, and potentially kill benthic plants and animals. There may also be chemical pollution from foundation coatings or accidental spills from the operating vessels. Noise pollution is, however, considered the main impact during construction and can increase stress levels and change the distribution and migration of fish and mammals^{23, 24}. During operation, fish and porpoises may lose access to habitats and be exposed to noise or electromagnetic fields, while birds may collide with wind turbines, or they may occupy important foraging or breeding areas. Wind farm structures also have visual implications as they protrude in the natural landscape and, therefore, are often not popular among local residents^{23, 24}.

A potential positive effect of wind farms is their function as artificial reefs, as the hard substrate provided by the foundations expands the living area for several invertebrate and fish species associated with reef structures²³. Also, wind farms can function as de facto marine reserves, as other activities are usually greatly reduced inside a wind farm area.

Conflicting interests in wind farm site selection

The assessment of sites suitable for the construction of wind farms must balance a number of factors, including technical requirements (hydrology, substrate, and depth), wind conditions, grid connection opportunities, nature and landscape as well as other users of marine resources²². Placement must also consider environmental protection and the presence of valuable habitats and species; thus, an Environmental Impact Assessment (EIA) must be prepared²².

The placement of wind farms must also consider other users of marine resources, e.g., fisheries¹⁴. Wind farms may impact the fishing industry directly when overlapping with important fishing grounds or indirectly through effects on fish ecology. During construction, fishing is usually prohibited in the area and after construction fishing activity is regulated by the wind farm owner; in most cases, all towed gear is prohibited, while gillnet fisheries are sometimes allowed²⁵. For that reason, the increasing placement of offshore wind farms has also been an issue raised within the NS RAC. The NSRAC Spatial planning working group has therefore stated that there is an urgent need to clarify rules of engagement between fishers and developers at North Sea scale, and to develop a protocol of minimum standards and best-practice guidelines¹⁰ (Case Study 12). Potential conflicts between wind farms sites and fisheries were also mapped as part of the Irish Sea Pilot study, as shown in Figure 18 42.

Marine spatial planning provides an important tool for the effective planning of wind farm construction and the limitation of potential negative impacts. An evaluation of the basis for offshore wind farm sites will also be a necessary part of a national strategy for increased production of offshore wind energy, as has been the case in Denmark (Case Study 15)^{14, 25}.

Figure 18. Hypothetical example from the Marine Spatial Planning Pilot in the Irish Sea showing interaction between fishing interests and

areas suitable for windfarms (latter shown in solid purple)
(Source: Gilliland & Laffoley 2008 ⁴³)

Need for regional cooperation

The European Commission recently released a communication ("The Renewable energy Roadmap")⁷⁵ stressing that wind energy will play an essential role in meeting the EU target of 20% renewable energy by 2020; it also highlighted the need for more cross-

border cooperation. However, a number of challenges still face the wind power industry in Europe, including technological performance, competition for space with other marine users, compatibility with the European power grid infrastructure, and becoming fully competitive in the liberalized European electricity market. At

the EU policy seminar Copenhagen Strategy 2005 on European Offshore Wind Power Deployment, many of the challenges facing European wind power were addressed⁷⁶ and in relation to key environmental issues, the strategy recommended the establishment and use of marine spatial planning instruments to achieve the best site selection.

At the Nordic Workshop, the challenges facing marine management in relation to the expanding wind energy industry were also a topic of discussion. The rapid expansion of offshore wind energy in many countries gives rise to concern about cumulative impacts of wind

farms; for example, the construction of multiple adjacent wind farms could result in an increasing displacement effect on marine animals or effects on hydrology. Cumulative effects have not as yet been investigated, and potential effects are therefore unknown. In the Baltic, Kattegat and North Sea, the potential wind farm sites of different countries are in such close proximity that coordination of placement will be necessary, in particular in relation to cumulative effects and nature conservation, as well as coordination between different transmission system operators.

CASE STUDY 15:

Selecting sites for the expanding Danish wind energy industry

Denmark has a long history of harnessing wind for energy production. The first projects with offshore wind turbines were carried out in the 1990s and since 1991 eight offshore farms have been constructed in Denmark. In 2004, the Danish Energy Authority called for tenders for construction of two new large offshore wind farms at Horns Rev and Rødsand, and in August 2008 it was further decided by Danish energy authorities to build a 400 MW wind farm in the Kattegat, which will be the world's largest wind farm to date.

The Danish process of constructing offshore wind farms is based on a number of policies and strategies. In 2005, the Danish Government submitted the "Energy Strategy 2025", which formulated a long-term policy for energy production and, as a follow-up, 'A Visionary Danish Energy Policy' was submitted in 2007 to introduce some more specific targets, including that "the share of renewable energy must be increased to at least 30% of gross energy demand by 2025". It was also decided to reassess the basis for selecting potential areas for wind farm placements.

To initiate the process of finding suitable sites for this ambitious target, a committee was appointed to assess the options and interests in relation to grid transmission conditions, navigation, nature, landscape, and other marine uses and activities, while also considering scenarios for future technological developments. The resulting report "Future Offshore Wind Power Sites – 2025" was released in April 2007, charting a total of 23 sites where offshore wind farms could possibly be built. In the short term, however, not all sites will be economically attractive or equally suitable in relation to nature or landscape interests.

The plan for the 23 new offshore sites has been subjected to discussions with industry and authority representatives, a public hearing, and also a Strategic Environmental Assessment (SEA), which concluded that the plan indicates a number of positive as well as negative effects. The positive aspects consist of mitigating climate change through reduced emissions of greenhouse gases, stability in energy supply, and most likely no continuous or long-term effects on biodiversity. The negative aspects relate to the occupation of large marine areas and an increased pressure on the coastal area, the generation of waste, visual aspects, biodiversity loss (particularly in the early stages), and navigation and safety at sea. The SEA, however, concluded that the positive impacts that are of a more global nature outweigh the more local negative impacts.

The future potential for placement of offshore wind farms in Danish waters. Assessment of current and future marine activities has given rise to suggestions of 23 specific sites.

Based on presentation by Steffen R. Nielsen¹⁴

Oil and gas exploitation in Nordic waters

Oil production activities

Exploration for oil and gas is taking place in several parts of the North Atlantic and Arctic Ocean, and oil production is a large economic sector in several Nordic countries, in particular Norway and Denmark. In the North Sea, significant oil and natural gas reserves were discovered during the 1970s, and by the late 1990s, the North Sea represented nearly 9% of world oil production. However, the outputs of oil and gas from the North Sea have entered a period of decline^{77, 78}, and improved oil recovery technologies and high oil prices can only temporarily delay the decline of the industry. For this reason, many oil companies are looking towards exploring new areas and finding fields in other parts of the ocean.

Norway already has a significant oil production in the Barents Sea but is also exploring for oil in other parts of the Arctic and Atlantic Ocean, while Denmark and Greenland are exploring the waters around Greenland for oil. Iceland and the Faeroe Islands are also actively searching for oil.

The construction of oil and gas platforms and extraction of oil and gas at sea are not without problems, as there may be pronounced effects on the natural environment. The threats include physical disturbance to the seabed during construction, noise during construction and operation, emission and spillage of chemicals and crude oil, dumping of drill cuttings, increased transportation activity, and construction of cables and pipelines. Discharges of oil, chemicals and drill cuttings are considered some of the most hazardous effects of oil extraction on the marine environment. Oil-producing

countries in the North Sea have committed to reducing the harmful discharges from oil platforms to the marine environment through the OSPAR Convention⁵⁸.

Planning and integration of oil exploration

The continuous production and search for new oil reserves at sea call for improved management of activities; marine spatial planning and integrated management provide an opportunity to further address the threats of oil exploration to the marine environment as well as any spatial conflicts. Integrated planning and assessment can improve risk assessment by taking into consideration cumulative effects, identifying vulnerable areas and environmental assets on a larger scale, and providing a framework for coordination with other sectors. Transboundary cooperation is deemed necessary components for an integrated oil industry, particularly in the sensitive Arctic areas.

An example of integrated area-based management that has addressed the problems of petroleum activities at sea is the Norwegian ecosystem-based management plan for Barents Sea (Figure 19 and Case Study 10), where extractive oil and gas activities have taken place for several years^{17, 55}. According to this plan, the exploitation of oil resources in the area must not result in unacceptable levels of pollution, and steps must be taken to reduce the risks of accidental spills. The risks and effects of acute oil pollution were assessed in the plan, and particularly valuable and vulnerable areas were identified^{17, 55}. In some areas, no petroleum activity will be permitted at all, in other areas no new activity will be permitted, and in some areas seasonal restrictions will be applied.

Figure 19. Area designations in relation to oil activities in the Barents Sea – Lofoten area during the period 2006–2010 under the Barents

Sea integrated management plan.

Shipping and maritime transport activities

Marine transport activities pose a number of threats to the marine environment, e.g., oil spills, leakage of hazardous substances, ballast water, underwater noise, sedimentation, and introduction of non-native species; they also create issues of safety at sea. In addition, marine transport may be in conflict with other sectors.

A framework for regulation is provided by a number of international laws and several global conventions adopted under the International Maritime Organization (IMO)⁷⁹, although it is the responsibility of national administrations to set regulations, ensure compliance with standards, and implement damage-reducing measures and response systems.

Area-based management and planning provide an opportunity for resolving conflicts, enhancing safety and minimizing the risk of pollution⁵⁵. The identification and assessment of risks associated with maritime transport may also be performed as part of a manage-

ment plan, improving the understanding of accident scenarios, their consequences and appropriate emergency response systems. Risks may change over time but a planning framework incorporating continued risk analysis could track such changes⁵⁵.

Figure 20. Maritime transport is another activity which can be addressed within marine spatial planning (Picture: Johannes Jansson / norden.org).

Box 7: Shipping in the Arctic

The onset of global warming and melting of pack ice in the Arctic has created new possibilities for international shipping. For the first time in 125,000 years, two North Pole shipping routes, the Northwest and the Northeast Passages, were ice-free in 2008. Shipping companies are already getting ready to exploit the new routes: the Bremen-based Beluga Group has announced that it will send the

first ship through the Northeast Passage⁷³. Disputes of the rights to the Northwest Passage have already occurred in Canada and the USA. As the Arctic Ocean mainly constitutes international waters, and because the issues of North Pole shipping are unprecedented, the issue of regulating this shipping activity has not yet been addressed⁸².

Aquaculture

Global catches of wild fish have been in decline since the 1970s and a concurrent increase in the global demand for and consumption of fish has caused a tremendous growth in aquaculture production⁴¹. In the Nordic countries, aquaculture has shown the same tendency for growth as in the rest of the world, and particularly Norway has a large aquaculture sector⁴¹.

The prospects for continued growth of the aquaculture industry in the Nordic region are promising, as there is a strong market for seafood, advanced scientific research, modern technology, and well-established and qualified fish farmers. However, the sector also faces a number of challenges, including limitation of space and water of good quality, environmental protection, high required standards for food quality, as well as a number of economic challenges owing to increasing competition and saturation of the market for some species^{26, 41}.

The progressive development of aquaculture as a commercial industry has the potential to exert a number of effects on the environment. The intensive production methods of aquatic animals invariably involve the expansion of cultivated areas and an increasing need for feed resources⁴¹. While impacts were previously considered to be mainly local, the expansion of the industry means that aquaculture practices can have an aggregated effect at the ecosystem level, with effects including nutrient and organic enrichment of sediments and recipient waters, genetic pollution of wild fish stocks, competition for resources, and the discharge of chemicals or pharmaceuticals²⁶.

To overcome the problems associated with continued growth and intensification, an application of the ecosystem approach and implementation of strategic planning are needed for aquaculture, with key aspects of such planning including the development of policies and regulations, a clear definition of an ecosystem approach to aquaculture, the application of risk

analysis, the development of relevant tools, the facilitation and definition of ecosystem boundaries for management and a clarification of administrative and legal jurisdictions^{26,41}. In Denmark, work has been ongoing for identifying all potential marine aquaculture sites in Danish waters (Figure 21)²⁶. The application and design

of aquaculture management zones is a useful tool, particularly in relation to integrated aquaculture/fisheries initiatives. Many of these issues require the development and use of sophisticated planning tools such as advanced GIS software (Case Study 16)⁸.

Figure 21. Map identifying areas in Denmark with a possibility for increased aquaculture production based on the number of restrictions associated with the marine area, as conducted under the Danish Com-

mittee for Aquaculture production. Can be viewed at <http://gis.dfu.min.dk/website/Havbrug/viewer.htm>. (Source: DTU-AQUA/Kerstin Geitner)

CASE STUDY 16:

Integrated management of mussel culture and fishery in the Limfjord, Denmark

The Limfjord is classified under the EU Shellfish Directive as one of the areas in Denmark suitable for shellfish production. The main shellfish species in this area, for both aquaculture and fishery in the wild, are blue mussels and flat oysters. In addition to the shellfish, there is also a fishery for edible fish, particularly herring and sprat. However, the biomass of wild blue mussels has been decreasing in recent years, while flat oysters have increased sharply since 2001. Given this recent decrease in the native blue mussels, there has been growing interest in mussel aquaculture using long-lines.

With the purpose of developing a plan for the integrated management of shellfisheries and aquaculture in the Limfjord, a Committee for Shellfish Production was established by the Danish Minister of Food, Agriculture and Fisheries, and including a number of Danish research institutes and authorities. A classification system of production areas for mussels was set up with three categories:

- Areas not available to mussel production;
- Areas available for various forms of mussel production;
- Areas with fishing grounds (i.e., not available for production).

In order to apply the above classification, the locations of a number of specific characteristics and

human uses that would be of concern in relation to mussel aquaculture were identified and mapped. These included areas regulated by national and international nature protection rules, commercial or leisure-related human uses, areas with eelgrass and macroalgae, fishing areas for herring and sprat, areas closed to mussel dredging, areas with sediment extraction, and polluted areas.

The biomass of blue mussel at a large number of stations (monitored from 1993–2003) was also mapped. All data were overlaid on maps and the number of regulations and activities for each location was summed to produce totals. This resulted in an overall map showing the concerns covering a particular area and thereby potential shellfish production areas. Using these maps, it is easy to determine where there are few or no concerns regarding

the placement of long-line aquaculture production of mussels and which areas should be avoided.

Possible production areas for mussels in the Limfjord, Denmark, based on the total number of existing regulations and activities covering the area.. Can be viewed at <http://gis.dfu.min.dk/web-site/Limfjord/viewer.htm>.

(Source: DTU-AQUA/Kerstin Geitner)

Based on Presentation by Kerstin Geitner⁸

To meet the challenges facing the future growth of the industry, some countries have developed strategies or plans for the sector – in Denmark, for example, a committee was appointed to make suggestions for the future sustainable development of the industry. At the European level, the European Commission presented in 2002 a strategy for the sustainable development of the European aquaculture industry and aquaculture was one of the Commission's strategic priorities for the Common Fisheries Policy in 2008³⁵. The potential as well as the challenges of the aquaculture industry are also addressed within the FAO Code of development^{39, 41}.

Extraction of marine aggregates from the seabed

Raw materials such as sand, gravel, and rocks are extracted from the seabed and used in coastal development and coastal protection, for example, as filling in the construction of ports, harbours, and artificial islands and for coastal defense systems, or for the production of concrete⁸¹. Large-scale extraction of sand, rock and gravel take place in the North Sea and in the Baltic Sea, and current plans for coastal development in the Netherlands and Denmark will require significant sand extractions in the North Sea coastal zone. The extraction of marine aggregates has taken place under long-term zoning and licensing practices⁸¹ that have been carried out in complete isolation from other sectors.

Extraction of raw materials has a number of effects on the marine environment, such as the creation of furrows or pits, alterations in the composition of seabed sediments, or an interference with the sand balance of the coast⁸⁰. It may also influence the ecological functions of the seabed, e.g., as a habitat for benthic flora, fauna, fish and seabirds.

Raw material extraction is not always compatible with other maritime sectors; for example, fisheries interests may be negatively affected when commercially exploited species are removed or their habitats destroyed, while the construction of offshore installations (e.g. wind farms) usually will cause the dredging of materials to become near marine installations. Marine spatial planning provides an opportunity for integrating the needs and activities of the different sectors and coordinate development.

10. Conclusions and Recommendations

The multiple maritime activities impacting the marine environment and its long-term delivery of ecosystem services cannot be effectively managed through a single-sector or single-discipline approach. The Nordic Workshop on Marine Spatial Planning expressed firm consensus on the role of comprehensive cross-sectoral marine spatial planning as a central approach to implement ecosystem-based management of the Nordic marine environment and competing human activities. Marine spatial planning offers an effective step towards both environmental protection and sustainable development considering issues of social equity and economic prosperity, and thus can assist fulfilling related national and international targets and commitments.

Cross-sectoral marine spatial planning can assist mitigating and resolving conflicts between competing maritime interests and activities. Marine spatial planning is particularly useful for integrating diverse types of information, mapping ecological features and maritime interests, consider stakeholder views and visualise scenarios and management options and assist planning of user-zones and interventions.

Different human activities may have long-term cumulative and synergistic negative impacts on the marine environment. This may cause unpredictable responses in ecosystem function and productivity. Today, such synergistic effects are rarely taken into consideration in marine management, which primarily deals with issues sector by sector. A better understanding of longterm cumulative human impacts on marine ecosystems is needed. Meanwhile, cross-sectoral ecosystem-based marine spatial planning offers a precautionary approach to this problem.

Marine spatial planning can further assist building preparedness towards unpredictable long-term changes in ecosystems, species distribution and associated relocation of maritime activities due to climate change and other ecosystem drivers by factoring in uncertainties in bufferzones between human activities in zoning processes.

Implementation of spatial planning offers tangible advantages not only at local and national levels, but also increased Nordic cooperation and integrated marine management are beneficial. Joint transboundary

agreements and management are essential for maintaining large-scale connectivity between habitats and species as well as to address up-stream/down-stream effects of maritime activities on ecosystems. To this end, a number of international and regional agreements, such as WSSD, CBD, OSPAR, and HELCOM, and EU directives require the implementation of networks of marine protected areas, which in turn require effective marine spatial planning, also supporting development of ecosystem-based fisheries management.

Key elements of joint MSP frameworks include spatial information and data on ecosystems, main drivers of ecosystem change, understanding of ecosystem service delivery, management and legislative systems at various levels, key objectives and targets for different sectors, and a common planning processes, and policy commitment to support sectoral integration and joint allocation of marine space. For marine spatial planning to be effective, it is essential that it occurs as early as possible in management design and is based on clearly defined and measurable goals and objectives. These should take into account economic, social and environmental issues and decisions should be made in communication with relevant stakeholders.

Decisions regarding marine spatial planning are ultimately political, but they should be based on solid science and take into account societal values. An iterative process linking information gathering, science, and policy making is needed to develop a shared vision for the future uses of marine space and resources.

Countries in the Nordic region share a number of characteristics that can facilitate transboundary marine spatial planning and management. This includes for example related cultural backgrounds and languages, well-developed communication systems and infrastructures, and similar approaches to regulation and regulatory compliance. The Nordic region have a long history of cooperation, including comprehensive legal frameworks and the collective Nordic experience and know-how, coupled with shared cultural and societal values provide a good platform for transboundary marine spatial planning in the Nordic region.

Key issues and recommendations

Future needs, challenges, and perspectives of marine spatial planning were discussed at the Nordic Workshop on Marine Spatial Planning. Based on these discussions and presentations, the following key issues and recommendations on marine spatial planning and management in the Nordic region were identified:

Development of common principles and guidelines for regional marine spatial planning should be continued.

- Marine spatial planning should be a process building upon the principles of sustainable development and work towards implementing the ecosystem approach to marine management.
- There should be common development of principles and guidance for MSP and further development of operational tools for spatial management. These principles can build on terrestrial “landuse” practices and marine pilots taking place around Europe.
- An important aspect of a marine spatial planning framework is that of adaptivity; spatial planning should be a continuous and adaptive activity carefully organized to generate information and make adjustments when needed.
- Stakeholder engagement is essential in the management of various human uses at sea, and their participation should be promoted throughout the planning process via transparent, open and inclusive information and decision-making – this means bottom-up approaches, involving relevant stakeholders early and in subsequent key stages in the planning process, despite being costly and time consuming. The long-term benefits will probably outweigh the initial investment.
- A better understanding of cumulative effects of different human activities on marine ecosystems is required to sufficiently plan, coordinate, and assess the various maritime uses.

There is a need for mapping of marine ecosystems and human activities and the development of tools to effectively use such information in spatial planning.

- Despite comprehensive marine research and environmental monitoring in Nordic countries, gaps in information still exist and there is a need for increasing the quantity and quality of environmental information.
- Enhanced mapping of marine habitats and species is required as well as data on social and socio-economic uses and ecosystem services. More high-resolution data on maritime activities, in particular

about shipping, recreational activities, and commercial fishing, are required.

- Existing sources of information, for example from the fishing industry or commercial vessels, could be used more effectively and sharing of information across borders would enhance the availability of data; all Nordic countries are strongly encouraged to facilitate enhanced sharing of relevant data.
- User-friendly tools are needed to provide composite maps of habitats and species distributions in relation to the many human uses of the area and appropriate decision-support tools should be developed to apply this information in a management context.
- Harmonization of spatial information is required, and aspects of common spatial dimensions and formats of data should be included in the development of guidelines
- Regardless of certain incomplete types of data, there is adequate information to initiate marine spatial planning in the Nordic region.

The Nordic region can serve as a pilot area for demonstrating transboundary marine spatial planning.

- Large-scale regional planning issues (e.g. management of “stop-over” sites for migrating species) should be addressed by joint pilot projects involving several countries. There is an opportunity to show-case how countries can work together and the Nordic region is considered a suitable region for comprehensive maritime cooperation. Pilot projects could be established in the Skagerrak/Kattegat area, the Barents Sea, North Sea and the Baltic Sea.
- Pilot projects could test different approaches and be developed at different scales (local, national, or regional, through nation, Nordic Council or EU support). There is also a need for pilot projects to test new ideas, refine key principles and provide solutions for planning between countries. Broader regional project could be advanced through smaller national initiatives. At the EU level, an overview of MSP initiatives at local and national levels should be compiled along with lessons learned, which could provide better dialogue and exchange of experience.
- Legal provisions and appropriate fora and agencies are needed at national, European, and international levels for the implementation of marine spatial planning. Existing regional conventions (OSPAR, HELCOM) and sector organisations, such as the Regional Fisheries Management Organizations and EU Regional Advisory Councils, can advance marine spatial planning through closer cross-sectoral dialogues.

- Work under the regional conventions could feed into EU activities and the regional conventions could also channel ideas and experiences from non-EU countries into EU activities.
- Funding schemes for future spatial planning work should be approached so that pilot work can be initiated and further the development of good practices. Relevant funding possibilities include EU 7th Framework Programme and EU Interreg, as well as national sources.

Enhanced Nordic cooperation can facilitate the development of common Nordic approaches to marine spatial planning.

- Transboundary cooperation is regarded essential for successful larger-scale management through coordinated management planning and implementation among between countries.
- A common Nordic approach to marine spatial planning is feasible, although the principles developed should be general and overarching. A number of unique traits common to the Nordic region should prove advantageous in facilitating transnational marine spatial planning.
- There is a need to demonstrate that countries can work together on transboundary spatial planning and management and the Nordic region is considered a good area to initiate this type of cooperation as the Nordic countries are interconnected, for example, via the Skagerrak or the Baltic, and have a long history of cooperation.
- A number of specific issues could drive cooperation on MSP in the Nordic countries. Climate change is an integrating issue and calls for international cooperation and planning to protect valuable resources, species and habitats. Other integrating issues include fisheries, navigation and shipping.
- Cooperation among neighbouring countries on policies and legal instruments is necessary to maintain or restore ecological coherence and connectivity in the marine environment. Ecological coherence is a topic that will need to be more adequately addressed in the Nordic countries.
- Climate change poses additional challenges to marine spatial planning.
- Climate change will affect ecosystems in different ways, causing changes in habitats and distribution of species and thereby utilization of marine resources, maritime activities, and coastal development.
- The possibilities and prospects of adaptive MPAs should be further explored in light of the impending changes in species distribution associated with climate change.
- Climate change effects in the Arctic region are exposing currently inaccessible marine habitats and resources to fishing, shipping, and oil exploration. More comprehensive and proactive planning and management are regarded essential for long-term viable and sustainable development in the Arctic region. It would be advantageous for the Nordic countries if the Nordic Council and the EU cooperate with the Arctic Council and play a larger role in planning human uses of the Arctic

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13. Dansk resume

Den tiltagende konkurrence om marine ressourcer og plads i de nordiske havområder har skabt et behov for en mere koordineret og integreret forvaltning af det marine miljø. Et enkelt havområde indeholder mange forskellige værdier og muligheder for forskellige brugere, hvilket kan føre til konflikter mellem de forskellige aktiviteter. Af den årsag har de senere år set et stigende antal tiltag indenfor marin areal-baseret forvaltning i den nordiske region.

For at undersøge en række spørgsmål relateret til brugen af marin areal-baseret planlægning i en nordisk sammenhæng, blev ad-hoc forummet „Nordic Forum on MPAs in Marine Spatial Planning“ etableret, med det formål at indsamle og formidle viden omkring nuværende og igangværende nordiske forsknings- og forvaltningsaktiviteter. I sommeren 2007 arrangerede det Nordiske Forum en stor nordisk workshop for areal-baseret forvaltning, hvor 100 forskere og forvaltere blev samlet. Forskningsresultater og regionale case studies blev præsenteret og gennemgået, og mulighederne og udfordringerne ved marin areal-baseret forvaltning i den Nordiske region blev diskuteret. Præsentationerne og diskussionerne afholdt ved denne workshop danner baggrund for indholdet og konklusionerne i denne rapport, som dog også er suppleret med relevant baggrundsinformation samt informationer vedrørende seneste udvikling.

De miljømæssige udfordringer for havmiljøet kan ikke blive løst via en enkelt sektor eller en enkelt disciplin men kræver en integreret tilgang, og der var ved workshoppen stor enighed om at arealbaseret forvaltning er et vigtigt værktøj til at opnå en økosystem-baseret forvaltning af det marine område, og til at løse konflikter mellem forskellige brugere. Regionale case studies gav eksempler på hvordan integreret forvaltning kan bruges til at løse problemer: I Norge er en Integreret Forvaltningsplan for Barentshavet eksempelvis blevet implementeret for at opnå konfliktløsning mellem olieindustri, skibstrafik, fiskeri, og naturbeskyttelse. I Limfjorden i Danmark er udviklingen af muslingefiskeri og akvakultur blevet holdt op imod andre målsætninger for området inklusiv naturbeskyttelse, ved hjælp af gennemgribende dataindsamling og kortlægningsværktøjer.

Et system indeholdende areal-baseret planlægning vil inkludere rumlig information og data, målsætninger for de relevante sektorer og brugere, samt en politisk ramme eller lovgivning til at støtte op om sektoral integration. Marine beskyttede områder bliver i stigende grad brugt til naturbeskyttelse og bevarelsen af marin biodiversitet samt i forvaltningen af havets ressourcer, og kan indgå som et værktøj i en bredere forvaltningsplan. Arealbaserede forvaltnings-tiltag, både i Norden og internationalt, har skabt baggrund for udviklingen af guidelines for planudvikling, implementering og monitorering. En videreudvikling samt test af mere operationelle guidelines er påkrævet, og ligeledes brugen og udviklingen af avancerede kortlægningsværktøjer (f.eks. GIS) og modeller.

Der er i den nordiske region et behov for at udbrede og implementere areal-baseret forvaltning på både lokalt plan og nationalt plan, men der er også et behov for øget transnationalt samarbejde over grænserne, for at være i stand til at adressere sammenhængen mellem habitater og økosystemer over store afstande, samt de kumulative effekter der kan være fra marine installationer. De unikke træk ved de Nordiske lande blev diskuteret, og der var enighed om at de fælles kulturelle baggrunde, beslægtede sprog, samt et generelt højt niveau af offentlig regulering, forvaltning og overholdelse vil være fordelagtig ved en indførelse af transnational marin areal-baseret planlægning. De nordiske lande har også en lang tradition for samarbejde, samt en stor offentlig sektor og en omfattende lovgivning.

Effektiv og integreret planlægning af de marine områder er anset som fundamental for håndteringen af den eskalerende konkurrence og konflikter samt en yderligere forringelse af havmiljøet i Norden. En mere proaktiv planlægning kan medvirke til at løse konflikter, inklusiv nogle af dem der knytter sig til forandringen af klimaet.

Annex 1. Workshop programme and Objectives

Nordic Workshop on Marine Spatial Planning, 6–8 June 2007, Copenhagen - Agenda

Time	Wednesday 6 June	Time	Thursday 7 June	Time	Friday 8 June
08:30	Registration & refreshments	08:30	Refreshments	08:30	Refreshments
09:00	Welcome -Introduction to workshop	09:00	Stuart Kininmonth: Considerations of MPA design in a scale-free small marine world	09:00	FAO MPA Technical Guidelines: Multiple objectives in MPA implementation and management
09:30	Paul Gilliland & Dan Laffoley: Marine Spatial Planning - principles and characteristics	09:45	Jeff Ardron: Designation of managed areas in MSP, introduction to decision-support tools		IOC/UNESCO: MSP - From concepts to practice
10:30	David Connor: Habitat mapping - an essential tool in spatial planning in context of European policies	10:30	Coffee	10:00	Coffee
11:15	Coffee	11:00	Euan Dunn: Marine Spatial Planning and natural resource management perspectives	10:30	Group session 3 MSP planning - Integration across disciplines
11:30	Chris Caldwell: Mapping the distributions marine habitats - applications in MPA siting	11:45	Plenary Key points & questions from morning sessions		
12:15	Lunch	12:15	Lunch	12:15	Lunch
13:30	Martin Isæus: Nordic habitat mapping as a tool for integrated management	13:30	Luis Ridao Cruz: Closed areas in the fisheries management system of the Faroe Islands	13:30	Plenary: Report back from Group discussions
14:00	Anna Nöjd: Application of marine habitat mapping in MSP - developing thoughts from the VELMU project	13:50	Erik Olsen: Development of integrated management for the Barents Sea and Lofoten area, Norway	14:00	Group session 4 Practice and Policy - Identifying opportunities and processes for transnational and cross-sectoral spatial planning. Do we need a common approach?
14:20	Kerstin Geitner: Integrated management of aquaculture and fisheries in Limfjorden, Denmark	14:10	Lene Buhl Mortensen: Applications of habitat mapping, Norway		
14:35	Asbjørn Christensen: Modelling sandeel habitat connectivity	14:25	Per Nilsson: Participatory MPA planning in Skagerrak		
14:50	Steffen R. Nielsen: Windfarm siting in Danish coastal waters	14:45	Elmer Topp-Jørgensen: Ressource management, Greenland	15:15	Coffee
15:10	Coffee	15:10	Coffee	15:45	Plenary: Report back from Group discussions
15:40	Plenary: Key points & questions from morning sessions	15:40	Group session 2 A & B: Mapping and modelling as tools for MSP C: MPA designation, zoning and MSP D: MPAs and fisheries in MSP	16:15	Round-table discussion: Integration & synthesis Priorities and recommendations on how to proceed in marine spatial planning in a Nordic context
16:30	Group session 1 Key challenges to marine spatial planning - Nordic cases	17:30	Plenary: Report back from Group discussions		
18:00	Socialiser	18:00	Boat to dinner	18:00	Wrap-up and closing

Workshop Objectives

- Can we manage multiple marine interests through common approaches?
- What information is required to develop area-based management solutions across sectors and interests?
- How is this information effectively supporting marine management planning and implementation?
- Can we identify areas and case studies that offer lessons and synergies within and outside the Nordic region?

Workshop lectures and case studies:

- **Jeff Ardron** (Bundesamt für Naturschutz, Germany): Designation of managed areas in MSP, introduction to decision-support tools.
- **Alexis Bench & Jessica Sanders** (FAO, Fisheries Dept): New FAO MPA Technical Guidelines – Multiple objectives in MPA implementation.
- **Lene Buhl-Mortensen** (Institute of Marine Research, Norway): Applications of the large-scale marine mapping program MAREANO in management planning, Norway.

- **Chris Caldwell** (National Oceanographic and Atmospheric Administration, USA): Mapping the distribution of marine flora, fauna and habitats: Applications in MPA siting.
- **Asbjørn Christensen** (Danish Institute for Fisheries Research): Modelling sandeel habitats and their connectivity for area-based management in the North Sea.
- **David Connor** (Joint Nature Conservation Committee, UK): Habitat mapping – an essential tool in spatial planning in context of European policies.
- **Luis Ridao Cruz** (Faroese Fisheries Laboratory): Closed areas in the fisheries management system of the Faroe Islands.
- **Per Dolmer and Kerstin Geitner** (Danish Institute for Fisheries Research): Integrated management of fisheries and aquaculture in Limfjorden, Denmark.
- **Fanny Douvere & Charles Ehler** (IOC/UNESCO): Moving from concept to practice: Global perspectives on ecosystem-based marine spatial planning.
- **Euan Dunn** (BirdLife International, UK, Chair, North Sea RAC Working Group on Marine Spatial Planning): Marine Spatial Planning and natural resource management perspectives.

- Paul Gilliland (Natural England, UK) & Dan Laffoley (IUCN): Marine Spatial Planning – principles and characteristics.
- Martin Isæus (Aqua Biota, Sweden): Nordic habitat mapping as a tool for integrated management.
- Stuart Kininmonth (Australian Institute of Marine Science, Aus): Considerations of MPA design in a scale-free small marine world.
- Steffen R. Nielsen: Identification of potential wind-farming sites in Danish coastal areas.
- Per Nilsson (University of Gothenburg, Sweden): Participatory MPA planning in Skagerrak, Sweden.
- Anna Nöjd, Henna Piekäinen & Saara Bäck (Finnish Environment Institute): Application of marine habitat mapping in marine spatial planning – developing thoughts from the VELMU project, Finland.
- Erik Olsen (Institute of Marine Research, Norway): The Norwegian ecosystem-based management plan for the Barents Sea.
- Elmer Topp-Jørgensen (Greenland Home Rule): Management planning of Greenland's living resources.

Group sessions and plenary

- A series of focused group discussions were organised, seeking to bring together lessons from Nordic case studies and to consider different practices:
- Wednesday Session 1: Key challenges to marine spatial planning – Nordic cases
- Thursday Session 2A & 2B: Mapping and modelling as tools for marine spatial planning
- Thursday Session 2C: MPA designation, zoning and marine spatial planning
- Thursday Session 2D: MPAs and fisheries in marine spatial planning
- Friday Session 3: MSP planning aspects
- Friday Session 4: Practice & Policy
- Friday Plenary session Final round-table discussion

Group Session 1 – Wednesday 6 June. Theme: Key challenges to marine spatial planning – Nordic cases

Topics to consider:

- Please identify the overall key challenges to marine spatial planning in the Nordic setting.
- Please identify synergies and/or incompatible interests and activities at sea - Nordic cases and current management solutions.
- Please list any potential incompatibilities as well as synergies (“win-wins”) between interests and activities that are known to occur in the Nordic region (using a cross-table, see below).
- For each specific pair of potentially conflicting or

incompatible interests, please describe briefly any specific Nordic cases and the management solutions that are currently in place to solve them.

Group session 2 – Thursday 7 June. Theme, group A and B: Mapping and modelling as tools for MSP

A: Chair: Chris Caldow, rapporteur: Ulrik Berggreen

B: Chair: Martin Isæus, rapporteur: Grete Dinesen

Topics to consider:

- Which scientific information is needed for informed MSP?
- Identify cases in which management and science complement each other to facilitate MSP – and briefly describe the lessons learned.
- Identify any gaps that exist between management needs and current mapping and modelling practices based on specific cases, as well as ways forward to bridge these gaps?
- How do we enhance the quality and quantity of area based information available for MSP?
- Identification and development of common approaches to mapping and monitoring, particularly concerning:
 - Essential fish habitats
 - Natural resources
 - Natural values, species, habitats
 - Ecological coherence and connectivity
 - Temporal changes (e.g. life cycles, climate change)
- Are Nordic countries willing to share data with one another in order to facilitate the assessment of ecological coherence and MSP decision-making?

Theme, group C: MPA designation, zoning and MSP

Chair: Jeff Ardron, rapporteur: Ole Vestergaard

Topics to consider:

- What is the role of marine protected areas in marine spatial planning? Consider the relationship between MSP and MPAs and scenarios in which they are mutually beneficial/exclusive.
- Does MSP make MPAs redundant? Does it make zoning of MPAs redundant?
- Identify and describe examples where the concept of ecological coherence has been or could potentially be taken into account in MSP in the Nordic region.
- Identify and describe examples where decision support tools/software has been utilised in MPA planning and/or zoning in the Nordic region.
- In cases where natural values are in direct “competition” with other sectors, could valuation of MPAs become necessary as a part of the MSP process?

How might this be done?

- When considering the design of networks of MPAs within marine spatial planning, to what degree can ecological coherence be compromised before it is no longer a network but rather a set of MPAs?

Theme, group D: MPAs and fisheries in MSP

Chair: Per Nilsson, rapporteur: Henrik Wickmann

Topics to consider:

- Identify illustrative Nordic activities and cases regarding existing and developing MPAs and fishing closures for fisheries management and ecosystem conservation.
- Are MSP and MPAs two sides of the same story? Describe examples of existing or potential misconceptions involving fishing, marine spatial planning and marine protected areas.
- Identify and describe Nordic examples of the use of MPAs in MSP to solve conflicts between fisheries and other marine activities. Between different fishing gears?
- What information is required in order to take into account the distribution and effort of fisheries when planning area based management measures.
- How can a marine spatial plan be utilised in connection with management of migrating fish stocks? How can MSP adapt to movement of fish stocks due to e.g. climate change?
- In the current setup, is marine spatial planning currently compatible with the EU Common Fisheries Policy?

Group Sessions 3 & 4 – Friday 8 June. Theme: Practice, planning and policy

Topics to consider:

- We have seen many examples of MSP or parts thereof in the past few days. Are there specific areas where Nordic countries can take a lead and set an example/precedent for the rest of Europe?
- How can we best go forward with MSP processes in light of current international marine management processes? Do Nordic efforts comply with e.g. EU directives and policies? (or visa versa..?) Regional conventions?
- In what way have objectives been set and priorities determined between activities in response to conflicts? On what basis? In other words, who usually has the upper hand in marine planning? Wind-farms? Oil? Fisheries? Nature conservation?
- Is it apparent that the Nordic region has unique considerations that must be addressed in MSP? For instance, in Arctic regions, are there examples where potential future reduction in ice coverage at sea has been or should be incorporated in a marine spatial plan? Indigenous communities?
- Discussions have revealed that common approaches to MSP in the Nordic region would most likely be quite useful in future. On the basis of discussions and presentations, is a common Nordic approach feasible? Why? Why not?
- What could be the most constructive way forward regarding MSP in the Nordic region? MSP Guidelines? Establishment of network of MSP-practitioners? Establishment of formal MSP processes? E.g. mapping of human activities? Others?

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Marine Spatial Planning in the Nordic region

– Principles, Perspectives and Opportunities

Increasing demands on resources in the marine area are compromising the future viability of the marine environment and in recent years the need to pursue new approaches for a sustainable use of our seas has become clear. Marine spatial planning is widely considered a promising tool for the management and protection of the marine environment, offering an integrated, eco-systembased approach to managing the multiple and potentially conflicting uses of the sea.

The “Nordic Forum on MPAs in Marine Spatial Planning” was established in 2006 with support from the Nordic Council of Ministers to synthesize and disseminate knowledge from Nordic MSP activities. The Nordic Forum also co-hosted the Nordic Workshop on Marine Spatial Planning, which brought together more than 100 researchers, managers, and NGO and industry representatives. This report presents experiences and views gained regarding key concepts of marine spatial planning in the Nordic region and beyond, the application of mapping and tools, and prospects and conflicts in relation to important maritime sectors, nature conservation and other interests.

Web: www.nordicMPAforum.org

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