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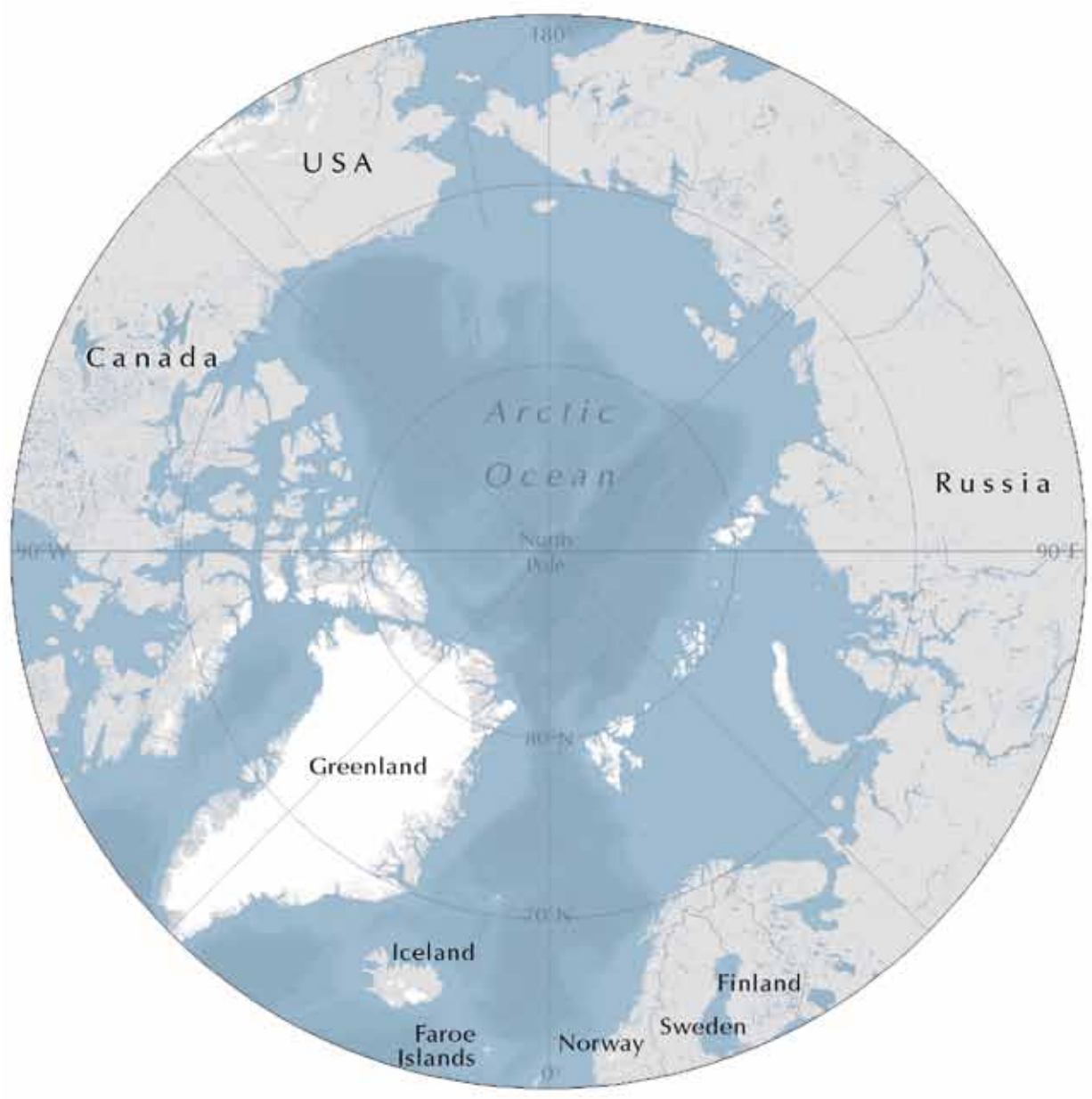

Alf Håkon Hoel (ed.)

Best Practices in Ecosystem-based Oceans Management in the Arctic

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Best Practices in Ecosystem-based Oceans Management in the Arctic

Norsk Polarinstitutt er Norges sentrale statsinstitusjon for kartlegging, miljøovervåking og forvaltningsrettet forskning i Arktis og Antarktis. Instituttet er faglig og strategisk rådgiver i miljøvernsaker i disse områdene og har forvaltningsmyndighet i norsk del av Antarktis.

The Norwegian Polar Institute is Norway's main institution for research, monitoring and topographic mapping in the Norwegian polar regions. The institute also advises Norwegian authorities on matters concerning polar environmental management.

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Foreword

Arctic communities and settlements are largely based on the use of natural resources. Traditionally these activities included hunting, fishing and reindeer herding. Commercial fisheries are now of major significance in several Arctic regions. The importance of the non-renewable resources is growing. Both onshore and offshore petroleum developments are expanding to new areas of the Arctic. Also external pressures from climate change and long-range pollution are of growing significance in the Arctic.

New economic activities may provide an important basis for welfare and economic growth. It is vital that all resource use is planned and carried out in a sustainable manner to facilitate the coexistence of activities in different sectors. Economic activities must be carried out in accordance with environmental and safety standards, to the benefit of Arctic communities. Minimizing negative impacts of commercial activities on the ecosystems and living resources of the Arctic is a particularly important task, and that has to be considered in light of climate change and pollution issues.

On the basis of the mandate given at the Salekhard ministerial meeting in 2006, the Norwegian chairmanship of the Arctic Council initiated a project on ecosystem-based oceans management. This project was undertaken as an approved project of the Arctic Council Sustainable Development Working Group and the Protection of the Arctic Marine Environment Working Group. The project report was prepared by a project team and does not necessarily reflect the policy or positions of any Arctic State, Permanent Participant or Observer of the Arctic Council.

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Introduction

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Introduction

Background and rationale

The aggregate effects of multiple uses of the oceans – fishing, transportation, petroleum development, waste disposal, etc. – call for an ecosystem-based approach to oceans management. The need for oceans management based on an ecosystem approach is now widely recognized by the international community, as reflected in calls for the application of the ecosystem approach by 2010 in the 2002 Johannesburg Plan of Implementation from WSSD[1] as well as in recommendations from the UN General Assembly.[2] In the Arctic context, the 2004 Arctic Marine Strategic Plan[3] points to challenges and opportunities in this regard, and the working map of the 17 Arctic LMEs represents a basis for further work.

The 2004 Arctic Marine Strategic Plan defines ecosystem-based management as an approach that "requires that development activities be coordinated in a way that minimizes their impact on the environment and integrates thinking across environmental, socio-economic, political and sectoral realms."[4]

The employment of an ecosystem-based approach to oceans management is critical to the protection and sustainable use of marine ecosystems. However, the form and content of the ecosystem-based approach to oceans management is context dependent and vary from case to case. An important distinction is between the ecosystem-based approach to the management as applied to oceans in general on the one hand, and its use within one sector, as e.g. fisheries, on the other.

The application of the ecosystem approach to oceans management of Arctic waters raises a number of issues with commonalities across the Arctic region: ice-covered waters, transboundary cooperation, fisheries management, exploitation of petroleum under severe climatic conditions, long-range transport of pollutants, indigenous communities, socio-economic growth and sustainability issues, and the impacts of climate change.

Objectives

Oceans management is carried out by governments, independently and in cooperation with other states. States and their practices in ecosystem-based oceans management ais therefore the basis for an analysis of the factors that contribute to sustainable use and conservation of Arctic marine ecosystems.

The objective of the project is to present the concepts and practices the Arctic countries have developed for the application of an ecosystem-based approach to oceans management. By way of reviewing how countries actually put to use such concepts and practices, lessons can be drawn on how to effectively do ecosystem-based oceans management. The project addresses both the use and conservation aspects of sustainable development.

Two sets of questions here address the substance and process of putting ecosystem-based oceans management to work, respectively: which practices and approaches have proved useful in moving towards effective protection and sustainable use of the Arctic marine environment?

What are the main obstacles, and what are the important success elements in moving towards ecosystem-based oceans management?

The issue of practices and approaches in ecosystem-based oceans management is addressed on the basis of descriptions provided by the Arctic countries on how they are actually doing this. Among the elements considered are how countries define ecosystem-based oceans management, the types of objectives that are formulated, the choice of policy instruments and organization of the work, for example in terms of how stakeholders are consulted and the geographical context for ecosystem-based oceans management, including existing transboundary agreements relevant to the management of Arctic marine ecosystems.

The question of obstacles and success elements is considered by asking the Arctic countries to describe their experiences in applying an ecosystem-based approach to oceans management. Important elements here include the *process aspects* of interagency cooperation and the organization of that, the organization and use of science, and stakeholder involvement, as well as the actual *content* of ecosystem-based oceans management, such as institutions for ecosystem-based oceans management, legislation and policy tools, geographical approaches, including LMEs, and biodiversity considerations.

The main emphasis of the project is on the analytical aspects of these issues, so that actions can be based on lessons learnt and possible *best practices* identified.

The project build on previous assessments and work under the Arctic Council, and will neither venture into new studies of the Arctic marine environment, nor address issues relating to jurisdictions and rights to resources.

The case studies

The project is built around seven case studies of how countries develop and implement ecosystem-based oceans management in the Arctic. The seven cases – Canada, Denmark/Greenland, Finland, Iceland, Norway, Russia and USA – demonstrate that the Arctic countries indeed are implementing ecosystem approaches to oceans management. In addition, there is a chapter on indigenous issues. The final chapter lays out Observed Best Practices that can be subsumed from the case studies.

International context

The growth of rule-based, as opposed to power-based, interactions among countries in oceans affairs, is a definite characteristic of the international oceans regime that developed over the last decades. Commencing with the 1958 UN Conference on the Law of the Sea (UNCLOS I), a broad framework regulating almost all uses of the oceans has emerged. UNCLOS III (1973–1982) introduced the concept of the Exclusive Economic Zone (EEZ), which set the stage for a major reconfiguration of rights to natural resources and the development of a coastal state based system of resource management regimes, laid down in the 1982 Law of the Sea Convention. The Convention entered into force in 1994, and is broadly considered to reflect customary international law in this realm.

In relation to living marine resources, the Law of the Sea Convention has beed elaborated upon and made more specific by the 1995 UN Fish Stocks Agreement, which obliges countries to apply a precautionary approach and a ecosystems approach to fisheries management. Also in relation to fisheries, the 1995 FAO Code of Conduct of Responsible Fisheries and the international action plans adopted to further the implementation of the code at national and regional levels are important.[5]

The United Nations General Assembly has repeatedly called for the introduction of ecosystem-based oceans management in its annual resolutions on oceans and the Law of the Sea. Also, in 2006, the United Nations Informal Consultations on Oceans and the Law of the Sea (UNICPOLOS) developed a set of "Agreed Consensual Elements" on ecosystem approaches and the oceans, that was forwarded to the General Assembly [6].

Also relevant in in relation to marine questions in general and living marine resources in particular is the 1992 Biodiversity Convention. The convention is very general in its approach, and relies on countries to develop plans for its implementation. Protected areas are a key measure in this regard. Specific measures concerning the marine environment were adopted in 1995.[7] A marine program of work has been in effect for several years, and was extended until 2010 at the meeting of the parties in 2004.

1 http://www.un.org/esa/sustdev/documents/WSSD_POI_PD/English/WSSD_PlanImpl.pdf, at para 30 (d).

2 http://www.un.org/Depts/los/general_assembly/general_assembly_resolutions.htm

3 http://arcticportal.org/pame/amsp

4 2004 Arctic Marine Strategic Plan, p 8.

Other global, marine treaties regulate shipping-related activities and pollution. The 1972 London Dumping Convention regulates the discharge of waste from vessels into the ocean, and the 1973 MARPOL Convention stipulates the standards vessels engaged in international shipping has to comply with. The International Maritime Organization (IMO) has adopted a number of global agreements to protect the marine environment from negative impacts of marine transport, dealing with certifications as well as oil pollution damage, anti-fouling systems, ships ballast water and sediment, carriage of hazardous and noxious substances etc.

Beyond these global instruments, international cooperation on the protection of the ocean environment is based on regional institutions.

In the northeast Atlantic, measures to protect the marine environment are based on the 1992 Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR Convention).[8] The work of the convention is organized under five strategies based on the five annexes to the convention: land-based pollution, dumping, ocean-based pollution, environmental assessments, and conservation of ecosystems and biodiversity. The annexes and measures adopted by OSPAR are the basis for domestic implementation. Of particular importance is to marine conservation is the work of the Biodiversity Committee, which includes ecological quality objectives (EcoQOs), assessments of species and habitats in need of protection, and marine protected areas.

For air pollution and its consequences for the marine environment, the two global treaties of importance are the 1997 Kyoto Protocol to the 1992 United Nations Framework Convention on Climate Change and the 1979 United Nations Economic Commission for Europe Convention on Long-range Transport of Air Pollution (LRTAP) and its protocols. The Kyoto Protocol specifies permitted emission levels of greenhouse gases and timeframes for achieving reductions for industrialized countries.

A number of "soft law" arrangements that supplement legally binding agreements have gained in importance over the years. These include Agenda 21, in particular chapter 17 on oceans, and the WSSD 2002 Johannesburg Plan of Implementation that provides specific guidance to governments in developing their ocean policy. The latter in particular "Encourage the application by 2010 of the ecosystem approach, noting the Reykjavik Declaration on Responsible Fisheries in the Marine Ecosystem and decision 5/6 of the Conference of Parties to the Convention on Biological Diversity;"[9]

Such soft law arrangements also exist at the regional level. In the north-east Atlantic region the most important arrangements are the North Sea Conference and the Arctic Council. Both of these bodies have emphasized the importance of the ecosystem-based approach to oceans management.

The "ecosystem approach" has been developed and incorporated in several international agreements over the past ten years and has an important place in the follow-up to the Convention on Biological Diversity. Under this Convention, general criteria have been developed for the implementation of the ecosystem approach to the management Malawi Principles).

5 International plans of action haven been developed for overcapacity in fisheries, by-catch of seabirds and sharks, and for targeting illegal, unreported and unregulated (IUU) fishing.

6 Report on the work of the United Nations Open-ended Informal Consultative Process on Oceans and the Law of the Sea at its seventh meeting. At: http://daccessdds.un.org/doc/UNDOC/GEN/N06/432/90/PDF/N0643290.pdf?OpenElement

7 The so-called Jakarta Mandate on Marine and Coastal Biological Diversity adopted in 1995. See. http://www.biodiv.org/programmes/areas/marine/default.asp (accessed 27 January 2007).

8 Convention for the Protection of the Marine Environment of the North-East Atlantic, done at Paris, 22 September 1992, entered into force 25 March 1998, 32 ILM 1069. See http://www.ospar.org.

9 Johannesburg Plan of Implementation, para 29 (d).

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Indigenous Perspectives

Henry P. Huntington and Caleb Pungowiyi

Introduction

One [whaling] captain [on St. Lawrence Island, Alaska] discussed yaayasitkegpenaan, a term describing the appropriate treatment of animals and all life surrounding the Yupik. Proper behavior includes harvesting no more than one needs, not killing an animal that cannot be retrieved, and keeping the environment clean both for the animals and for future generations of islanders. [Another] whaling captain described the impacts of moving away from yaayasitkegpenaan, sometimes by the imposition of external regulatory regimes. … This [new] regulatory system created stress, diminished happiness, and created distrust and anxiety not only towards the government but also among islanders. The conflict between traditional values and modern regulations … still remains. (Noongwook et al. 2007: 52)

For indigenous peoples along arctic coastlines, the ocean has always been a source of life. Food, clothing, building materials, tools — all these have come from the ocean and the animals that live in it. Preserving this source of well being is a theme in many traditional stories and the basis for the ethics that govern how people interact with the sea and its inhabitants. In some respects, these values are closely aligned with modern notions of conservation and natural resource management. In other respects, their views of human relations with the sea are very different, at times incompatible with western notions (Jull 1990, Morrow and Hensel 1992, Berkes et al. 2005). In this paper, we discuss the basis for indigenous beliefs and practices regarding oceans and marine resources, the significant issues today for indigenous peoples, and challenges in achieving effective oceans management from indigenous points of view. Most of the examples used here are from North America and Greenland, in large part due to the greater availability of relevant published material from those regions.

The intent of this paper is to provide a general introduction to indigenous understanding, beliefs, and values with respect to oceans management. While indigenous peoples along arctic coasts may face the same general environmental threats as everyone else, the causes and impacts may be seen and felt differently. These differences in turn affect the ways in which management actions are perceived and ultimately the effectiveness of those actions. The question is not one of finding or compelling a uniform view of management. Instead, it is a question of understanding divergent views and developing strategies that accommodate such differences in order to achieve a common goal of stewarding marine resources for this and also for future generations. Compromise and change may be required by some or all of those involved, but should be the result of mutual understanding and respect, not of unequal power or inflexibility.

The Meaning of Oceans Management to Indigenous Peoples

Although the details of beliefs and practices vary, arctic indigenous peoples share a deeply personal, spiritual relationship with the animals they know and use, a relationship built on ethics that govern who can hunt, how, and what is to be done with the animal afterwards (e.g. Bodenhorn 1989, Nuttall 1992, Fienup-Riordan 2000). Often, the animal is seen to give itself to the hunter, offering its flesh and body while its soul remains intact. The soul is then able to return to bodily form. If the body is treated properly, the animal is likely to be willing to make a gift of itself again. If not, it may remain out of reach of people. The foundation for this relationship between hunter and hunted is respect. The hunter must show respect for the animal at all times, recognizing that the decision to give itself is made by the animal, not by the hunter. Yupik bowhead whalers on St. Lawrence Island, Alaska, recognize a specific behavior of the whales, known as *angyi*, from the stem *ang*-, which refers to giving something (Noongwook et al. 2007). The whale swims alongside the walrus-skin whaling boat, on the left side of the boat, where the harpooner cannot strike. The whale may stay there for an hour, perhaps looking at each person in the boat, one after another. If the whale is satisfied, it will surface on the right side where it can be taken. If it is not satisfied, it will swim away out of reach. The failure to take a whale that offers itself would be considered as offensive as the arrogant claim that the whaler, not the whale, determines the outcome of *angyi*.

This understanding of the basis for hunting success leads to expectations of appropriate behavior by hunters (and often by their families as well). Wenzel (1991: 135) provides an example from Clyde River, Nunavut, Canada, showing the personal nature of such behavior:

> Sometimes such actions elude the most careful observation since spiritual preparation for hunting is often private and individual. Clyde harvesters often note that a man can harvest successfully only if he always seeks animals with the right thought (isuma) in his mind. By this they mean that the hunter must always think about the animal he hunts, speak correctly about it, never in a deprecating or negative way, and be generous with the product of his efforts.

The responsiveness of animals to human activity and speech is described by Morrow and Hensel (1992: 43), who analyze discussions concerning salmon management in southwestern Alaska: "By speaking of the fish positively, the Yupiit hope to assure their continuance and to prevent realization of the negative prognoses of non-Native managers." In other words, speaking of a decline in fish is tantamount to causing that decline, because the fish are aware of what is said about them. Similarly, the Yupik (and many other indigenous peoples) are appalled at the idea of catch-and-release fishing, because it is seen as just playing with or rejecting a fish that has willingly given itself to the fisherman.

In both directions, then, the essential aspects of the human-animal relationship are personal and individual. Humans as a group do not hunt animals as a group. Animals as a group do not respond to the actions of humans as a group. Neither people nor animals are interchangeable units.

One result is that notions of population management may translate poorly to indigenous conceptions of human-animal relationships. As indicated in the quote that opens this paper, management systems can be seen as interfering with traditional values and practices. In that example, the imposition of a quota on the whale harvest implied that people rather than whales had the power to determine the outcome of the hunt. Furthermore, limitations on a harvest can lead to competition between hunters, an attitude that is contrary to behavioral norms of cooperation and humility. By breaking the bond between humans and animals, harvest regulations can be seen as *causing* rather than *responding to* population declines.

Overcoming fundamental differences in worldview is not a trivial matter. Morrow and Hensel (1992) describe the lasting misunderstanding and distrust between Yupik fishermen and fishery managers, stemming in part from the fact that both groups used similar words to describe concepts and phenomena that were in fact very different. They provide an example regarding geese in the same region, concerning the impacts of biological studies that involve capturing geese or handling eggs. While Yupik concerns may appear to be closely related to biological concepts of reproductive success, "it is not reproductive success *per se* which is the issue; rather, it is the response of sentient beings who, being affronted, make themselves unavailable to humans" (p. 43). A quick appraisal of local concerns could easily frame the problem in biological rather than ethical terms, missing the scale of the divide in understanding.

Nonetheless, common ground can be found in some cases. The Alaska Eskimo Whaling Commission (AEWC), which among other things allocates and administers the quota for bowhead whales, is comprised of Yupik and Iñupiaq whalers from the ten bowhead whaling villages in Alaska. The quota has been a source of considerable and lasting controversy and bitterness, but the co-management system that has developed is also a source of considerable pride to many of the whalers (Huntington 1992). AEWC Chairman Eddie Hopson explained his views at a whaling captains' meeting in 1990:

> Man's first responsibility is his dominion over animals given by God. That means management, not wastefulness. Management agencies like the AEWC, the Alaska Department of Fish and Game, the National Marine Fisheries Service, the International Whaling Commission – they are all doing the job given to us by the Creator, so I do not object to them. (Quoted in Huntington 1992: 115)

A crucial aspect of such a view is the development of collaboration, communication, and trust over time. Huntington et al. (2002) note that

a sense of shared enterprise and a willingness to listen to one another are hallmarks of successful interactions between indigenous hunters and non-indigenous scientists and managers, and that such successes are built over time by the individuals involved. Fienup-Riordan (1999) found, in regard to goose research and management, that "research projects perceived as responsive to local concerns in all stages—planning, implementation, and review—stand a much greater chance of eliciting community cooperation and support" (p. 20).

A related aspect of indigenous perspectives on oceans management (and indeed many other topics) is the holistic or systemic way of considering a particular issue. In other words, a particular topic is typically considered in the broader context of the community or society (e.g., Jull 1990). The implications of a particular course of action may be far-reaching, with the result that a solution that appeared obvious upon first examination may not be considered optimal upon further consideration. This idea includes both a holistic view of the environment, similar in some respects to the idea of "ecosystem management," and the inclusion of human society as part of the system.

Diduck et al. (2005) provide an example concerning polar bear management in Nunavut. Estimates of the population size of the M'Clintock Channel polar bear population had decreased sharply, indicating that the harvest quota was too high. One proposed management action was to stop the hunt altogether. The Nunavut Wildlife Management Board (NWMB) opted instead for reducing the quota over two years, to avoid hardship and resentment in the affected communities. Only one community, Gjoa Haven, had no quota for another population of polar bears. Accordingly, the NWMB included a re-evaluation of the Gulf of Boothia polar bear population and a decision to allow Gjoa Haven residents a quota of three bears from that population, so that they would not lose their hunting opportunity entirely. The social dimensions of the management action were an important part of the NWMB's deliberations.

Indigenous perspectives on human-environmental relations and on the implications of management actions are a crucial factor in the development of effective and lasting conservation measures. Approaches that ignore indigenous worldviews and clash with traditional values and behavior are unlikely to gain local support, leading to continued friction and distrust. Approaches that recognize those worldviews and foster a collaborative response to conservation concerns are likely to create a lasting system based on respect and trust. Indigenous people and scientists may not always agree in the abstract, but strong personal relationships can help create mutual understanding and a recognition of shared interests. Indeed, many of the major issues in oceans management in the Arctic require a collaborative approach if indigenous voices are to be heard and indigenous concerns addressed.

Significant Issues in Oceans Management for Indigenous Peoples

In former times, the ocean provided food, clothing, materials, and other necessities for survival in the Arctic. Proper behavior and action, as described in the preceding section, were required to sustain the relationship between people and animals. This outlook was concerned with one's local area and a relatively short-term perspective. Indeed, advance planning was often regarded as unnecessary because the sea would provide at the appropriate times of the year (e.g., Briggs 1970, Natcher et al., in press).

Today, addressing local actions alone is no longer adequate. The proliferation of management institutions across the Arctic is one indication of the extent and significance of the many conservation issues facing the region today. The level of indigenous participation, from local committees and boards through to international activity in the Arctic Council and United Nations, is a similar indication of the importance that Arctic indigenous peoples place on conservation and management in general and specifically on playing an active role in what is done.

Here we consider three categories of topics and their relationship with indigenous peoples of the arctic coasts: disturbance, harvests, and self-determination. Which issues are of primary importance varies from place to place and from time to time, and even from person to person. We will not attempt to assess local priorities, or even to evaluate which of these three categories is most pressing on regional or circumpolar scales. Instead, we address the nature of the issue, its significance to indigenous peoples, and what it means for oceans management.

Disturbance

Disturbance is the broadest of the topics, covering all forms of impacts to the environment and society that result in unwelcome changes to the sea and its resources, and their relationships with humans. Climate change is the most prominent disturbance in research and in media coverage, but industrial activity, shipping, commercial fishing, and pollution are also included. Societal change is part of the equation, too, but will be addressed in more detail when we discuss self-determination.

Disturbance from any cause can upset the movements and behavior of fish, birds, and mammals. This can affect the health of the animals and also their distribution, with resulting effects on people. For example, shifts in ocean currents and climate caused a decline in cod abundance in West Greenland, while making ideal conditions for shrimp. Hamilton et al. (2003) describe how the town of Sisimiut was able to switch from cod fishing to shrimp trawling, resulting in economic growth. Paamiut, farther south, experienced the switch later, by which time there was no opportunity to enter the shrimp fishery. As a consequence, Paamiut's population declined.

Disturbance can also affect travel and other human activity, for example by creating physical barriers or by making travel on sea ice unsafe. Indigenous knowledge has been built around experience and understanding of patterns in the natural world. Such knowledge allows people to live in the rhythms of the land and sea, to know where to find what they need at any particular time. When those patterns change, it may be difficult to adjust. Huntington and Fox (2005) describe several examples from climate change around the Arctic, pointing to disruption of expected patterns and customary practices. The National Research Council (2003) describes how whalers in northern Alaska have had to go farther out to sea because bowhead whales have been deflected in their migration by offshore oil and gas activity. This change entails considerably more risk for the whalers and can affect the quality of the harvested food since towing the whale to shore may take longer, increasing the chance that the meat may spoil.

As various forms of human influence and activity become more prominent in the Arctic, disturbance becomes greater and its impacts more severe. The combination of factors is perhaps most worrisome, particularly in areas where activities are most intensive and overlaps most common. For example, offshore oil and gas activity is beginning in the Chukchi Sea (AMAP, in press), and the region will also be directly on the route of cargo ships transiting the Northern Sea Route (Brigham and Ellis 2004). The Barents Sea, at the other end of the cargo route, is already seeing large-scale oil and gas activity, together with tanker transport of oil from Russia to Europe (Bambulyak and Frantzen 2007). Commercial fisheries (Vilhjálmsson and Hoel 2005) may reach both areas, along with Baffin Bay, where more oil and gas activity is possible.

Activities on this scale within the Arctic will also add to pollution problems caused by industry and agriculture elsewhere in the world. The Arctic Monitoring and Assessment Program has documented the extent of contaminants in the Arctic and their effects on plants, animals, and people (AMAP 1998, 2004). Oil and gas activity, shipping, cruise ships, and commercial fisheries are likely to add to contaminant levels. Several large rivers in the Arctic carry contaminants from southern areas, delivering the effects of distant activity directly to estuaries and coasts that provide essential habitats for marine species and are also home to many indigenous communities. Pollution undermines the relationship between people and their environment, casting doubt on the healthfulness of traditional foods, and demonstrating a lack of respect for animals. In many communities, young hunters share their first catch with elders. If the hunters fear the animal is contaminated or unhealthy, they may be reluctant to offer it to an elder.

Invasive species are another form of disturbance, often a secondary effect from habitat change. Some arrivals may be welcomed or at least offer some benefits, such as salmon appearing in the Beaufort

Sea (e.g., Berkes and Jolly 2001). Other newcomers may be less desirable, particularly parasites and diseases (Burek et al. in press). For people dependent upon the fish and animals of their local waters, invasive species and diseases pose a substantial threat. One example is the increased prevalence of the fungus *ichthyophonus* affecting king salmon in the Yukon River (Kocan et al. 2003), harming an important source of food and income for people throughout the watershed. The increase is believed to be due to rising water temperatures associated with climate change.

Disturbance thus has many and far-reaching implications for indigenous peoples. The multitude of causes makes management a complex matter, for restrictions on one factor may have no benefit if other factors remain beyond control. Types of disturbance vary greatly, too, from the localized impacts of a single drilling rig to the global impacts of long-range pollution and climate change. Addressing the causes of disturbance and reducing its cumulative impacts will take coordinated management. For indigenous peoples, one of the key goals is effective involvement in such management, a topic to which we return later in this paper.

Harvest levels and allocations

The myth of the inexhaustible sea is persistent but illusionary (Roberts 2007). While the resources of the sea have sustained arctic coastal peoples since time immemorial, the patterns of species and harvests have also varied considerably in response to environmental shifts and the development of new hunting and fishing technologies (e.g., Krupnik 1993). Food security, the reliable ability to provide for one's family and community, has long been the goal of indigenous harvest strategies. In an uncertain and variable environment, patterns of use could vary considerably from year to year, but access to a range of resources and options was a key component of resilience (e.g., Nuttall 2005).

In more recent times, other factors have influenced harvest patterns and levels. Local and distant markets for marine products have stimulated indigenous involvement in fisheries and hunts (e.g., Bockstoce 1986, Marquardt and Caulfield 1996). The loss of those markets, from economic or political causes, has often caused hardship for those who previously had relied on income from their catches, as happened when sealskin markets in the United States and the European Union were closed by import bans (e.g., Wenzel 1991, Lynge 1992). Ecological change has also led to harvest changes, as noted earlier regarding cod and shrimp in West Greenland. Markets have also created new forms of resource use, such as the Soviet-era harvest of gray whales in Chukotka, Russia, to provide meat for fox farms along the coast (Sander 1992, Kerttula 2000).

Perhaps the most widespread factor, however, has been the development of various management regimes for fishing and hunting in the Arctic (e.g., Huntington 1992, Caulfield 1997, 2004, Klein 2005). Seasons, limits, acceptable methods, and other restrictions on hunting and fishing are not often simple to apply to traditional practices in indigenous communities in the Arctic. Designed largely for recreational uses, these regulations typically ignore important features of arctic production systems. For example, a small number of hunters in a community are usually responsible for the majority of the production of fish and meat (e.g., Magdanz et al. 2002). Restricting individual harvests in such a situation, even if the potential community-wide harvest remained the same, would make it difficult for a community to meet its needs because not everyone is able to participate equally in a hunt. Community limits, which have been used in some locations for some species, avoid this problem.

While many regulatory approaches are less than ideal in the arctic context, unregulated or poorly regulated harvests can also create problems. Beluga whales in West Greenland, for example, have declined sharply in recent years. This change is attributed by scientists and managers to overharvest (e.g., Alvarez-Flores and Heide-Jørgensen 2004), though this conclusion is disputed by local hunters (e.g., Mølgaard 2006). From the hunters' point of view, a large part of the problem is poor communication between hunters on one hand and scientists and managers on the other. Mølgaard states that communication had actually been better prior to the devolution of Home Rule status to the Greenland government (see also Sejersen 2002). As noted earlier with regard to the management of disturbance, indigenous peoples seek more effective involvement in the management of hunting and fishing. A related problem is that of allocation of harvests among various user groups. In the case of personal-use harvests, conflicts may arise between local users and those visiting from other areas. In Alaska, for example, there is considerable tension between "subsistence" users and "sport" users, with contentious definitions of each category (e.g., Huntington 1992). For indigenous peoples in Alaska, the situation is exacerbated by the fact that "subsistence" users are typically equated with rural residents, regardless of ethnicity. (The exception is the case of marine mammal hunting, which under the 1972 Marine Mammal Protection Act is limited to indigenous Alaskans, who can hunt without restriction so long as there is no waste and the stock in question is not depleted.) Participation in traditional activities may thus be reduced or impossible for indigenous persons who live in cities. Additionally, the management of fish and wildlife may favor sport users by restricting harvests to certain seasons, methods, sex, or size of fish or animals. Harvests that involve a commercial element can be, if anything, even more contentious. Fisheries allocations have long led to battles at the national and even international levels. For indigenous users, particularly in fisheries, it may be difficult to obtain recognition for traditional practices or uses when larger economic interests are involved. Cod fisheries along the North Norwegian coast are one example. Economically, large vessels fishing offshore are the most efficient means of catching fish. Culturally and in terms of local employment, however, inshore fisheries from small boats provide opportunities for coastal residents, particularly Saami who have long fished for cod in this manner (Nielssen 1986). After 1990, Norway established a quota system for cod fisheries, in which Saami fishermen were included with other small boats under a total catch limit. The Saami fishermen felt that they could not compete effectively under this system, and have been calling for regional fisheries management to prevent the disappearance of their fishing traditions (FAO 2005).

In Alaska, concern for local fishermen and communities in the Bering Sea spurred the creation of community development quotas, or CDQs, administered by six organizations that together include over 50 predominantly indigenous communities (National Research Council 1999, Caulfield 2004). The CDQ groups are allocated a portion of the harvest of Pollock, halibut, sablefish, Atka mackerel, Pacific cod, and crab. The income from the catch can then be invested in the communities, including infrastructure and equipment to support further economic development or greater participation in fisheries. While the program has not resolved all fisheries issues, it has helped create employment and new investment and opportunity derived from fisheries in the region.

A further conflict over harvests concerns use areas. Indigenous hunters and fishermen often travel over vast areas to provide for their families and communities (e.g., Freeman 1976). New activities that appear to be distant from existing settlements may still affect residents of those settlements. Use areas are at least part of the basis for land claims agreements in North America (e.g., Berger 1985). The increase in shipping, offshore oil and gas activities, and commercial fisheries all threaten to affect hunters and fishermen. Indirect effects were discussed earlier as forms of disturbance affecting the environment. Direct effects include obstacles to boat travel, such as causeways, and hindrances to hunting and fishing methods. Fishing nets can snag on industrial equipment. Firearms cannot be used at sea when many people are near, for fear of ricochets off the water. While interference with indigenous harvest activities may be unintended, that nonetheless can be the result if harvests are forced into smaller areas or hunters and fishermen must travel farther.

Self-determination

The environmental and economic dimensions of oceans management are important to arctic indigenous peoples, but spanning all such considerations is the question of self-determination. When management decisions are made elsewhere, for any aspect of society, it is difficult for local residents to retain a stake in the outcomes of those decisions. One result is passive dependence upon others for economic sustenance. Another result is the loss of traditional approaches to cultural and environmental stewardship. If a society responds to the rules created by others, it is less likely to heed the signals and indicators of opportunities and threats. If, on the other hand, a society bears

responsibility for the results of its actions, it is perhaps more likely to seek the information and ideas necessary for sound decisions.
The most alarming change over the past century has been the erosion of the ability of arctic peoples to determine for themselves what course of action to follow. However, there has been in recent decades a growing awareness in arctic communities of what is at stake, accompanied by a push for greater local involvement in all aspects of governance. While there has been some progress towards self-determination in some areas, such as the establishment of Home Rule in Greenland in 1979 and the creation of Nunavut in Canada in 1999, and greater involvement in governance in others, arctic communities often lack the resources needed to achieve their ambitions (AHDR 2004). Furthermore, national policies and international commitments are not always conducive to indigenous self-determination.

On land, land-claims settlements in Alaska and Canada, plus Home Rule status in Greenland, have provided some measure of authority and property rights to indigenous peoples and their organizations. At sea, however, national governments retain ownership of mineral and living resources and the power to make decisions about their use and development. International disputes over topics such as whether the Northwest Passage constitutes international waters have simmered for years (e.g., Jull 1990). Climate change and the retreat of sea ice have now brought sovereignty issues to the forefront, along with the prospects for increased development, shipping, and even commercial fishing (AMAP in press, Brigham and Ellis 2004, Vilhjálmsson and Hoel 2005).

For indigenous peoples, these are not necessarily positive developments. In addition to the various types of disturbance described earlier, greater economic and political attention to the Arctic may mean an influx of new and competing interests. In some areas with extensive development, indigenous peoples have become outnumbered by new migrants (AMAP 1998, in press, AHDR 2004). Geographical marginalization at least had the benefit of minimal competition for resources and the potential for being left alone. To become marginalized within one's homeland, however, is another story. In the rush to claim and exploit arctic marine resources, indigenous peoples are once again faced with the prospect of being pushed aside while others make decisions and take actions that will have far-reaching consequences for residents of arctic coasts.

Challenges in Oceans Management from the Indigenous Perspective

The overwhelming challenge for arctic indigenous peoples is the sheer scope of oceans management issues today and in the decades to come. The recurring theme in indigenous perspectives on oceans management is the desire to be involved in all phases of management, from identifying problems to evaluating response options to deciding what actions are taken to monitoring the effectiveness of those actions and making modifications as needed. Marine issues affect coastal peoples directly and personally, through traditional activities, the nutritional and cultural benefits of food from the sea, and their very identities as peoples. Simply put, they have everything at stake.

At the same time, however, many indigenous communities and peoples are few in number. Many companies or government agencies have more employees than an entire arctic ethnic group has members. There simply are not enough people to address every oceans management issue separately. Furthermore, many communities lack the resources and capacity to address even the issues they see as priorities. Many indigenous leaders are overworked already. Hiring others to help can help, but requires additional financial resources plus cultural and other training. Finally, the creation of management organizations can have unintended and unexpected social consequences. In this section, we look at three topics: capacity, organizational structure, and societal change. Together, these topics point the way to more effective oceans management practices from the indigenous point of view.

Capacity

Oceans management addressing the many issues outlined above entails many agencies, organizations, and companies, producing tens of thousands of pages of reports and analyses, based on hundreds or thousands of scientific and other studies, to be discussed at a seemingly endless procession of meetings, conferences, consultations, and hearings, each dedicated to one small part of one particular issue. Taking part in all the meetings relevant to even a single issue requires more than one person dedicated to that task alone can handle. For most indigenous and other local organizations in the Arctic, this is rarely possible. Instead, people must choose which events to attend, which issues to study in depth, and what they can hope to accomplish. In many respects, this is the same position that nearly all participants in management processes must address. For indigenous communities, however, the problem is exacerbated by the breadth of issues of concern and the limited capacity available.

Let us take the example of Yupik and Iñupiaq Eskimo whalers in northern Alaska (see Huntington [1992] for further discussion). In 1977, the International Whaling Commission (IWC) voted to stop the centuries-old hunt for the bowhead whale, basing the decision on estimated harvest levels and the available minimum estimates for the whale population. The whalers argued that the population was higher that the IWC recognized and that it was growing. The U.S. government and the local government (North Slope Borough), working with the Alaska Eskimo Whaling Commission, conducted a number of studies, designed in part on observations made by the whalers. The studies showed that the population was indeed larger than estimated and in fact was growing. But this was only the first step.

Next, the whalers had to persuade the U.S. government to seek a larger quota, and then convince the IWC to approve that quota. This entailed participating in the annual IWC meeting, held at various locations around the world, as well as preparatory meetings with the U.S. delegation. The IWC, while accepting the improved population estimates, asked for more information on cultural need and killing methods, which in turn required additional studies and programs. The story does not end with the Alaska whalers, however. The IWC also governs whaling by other nations, and the Alaskans can find themselves caught in international politics (see brief overview in Noongwook et al. [2007]). Sometimes more study is required, and sometimes political and diplomatic work is necessary. In both cases, the whalers cannot afford to stand aside, but must take part in all phases to make sure their voice is heard.

And the IWC is only one aspect of bowhead whaling. As noted earlier, offshore oil and gas activity is a major concern for the whalers, both for access to and for the health of the whales. The Beaufort and Chukchi Seas have seen extensive offshore exploration and, in the case of the Beaufort, the beginnings of development and production (AMAP in press). The Minerals Management Service holds lease sales, each of which is preceded by an environmental impact statement, including public review periods and meetings. Oil companies also hold meetings, seeking agreements with the whaling communities about avoiding conflicts on the water. Other reviews and studies of impacts from noise, pollution, shipping, and so on are underway, each requiring some level of attention and scrutiny. It should also be remembered that much of the public process is devoted, not to the question of whether offshore activity should proceed at all, but to details of the conditions under which will occur, spreading local capacity ever thinner across the minutiae of regulations.

While extensive processes for public involvement are appropriate (and certainly better than little or no public involvement), the cumulative burden on the whalers and the associated scientific and legal teams is extremely high. Hiring more people could help, if the resources to do so were available. Combining environmental assessments or reviews to reduce the numbers of documents and meetings could also help. Another option, deciding not to participate in some meetings or events, may also be a necessity, but with the risk that the whalers are ignored because they are not present. This was part of the reason that the IWC ban was enacted in 1977, and the whalers are unlikely to want a repeat through inattention. Shipping, commercial fishing, contaminants, and climate change are also part of the picture for bowhead whales, now or in the next few decades. There is little reason to think that the issue will become simpler or the consequences lower.

Bowhead whales are only one example. Alaska hunters are also concerned with impacts to other marine mammals, to seabirds, and to

fish. Saami fishermen along the Barents Sea coast have a similar suite of issues to contend with and a similar range of management regimes, including international agreements. Hunters in West Greenland and the eastern Canadian Arctic likewise share stocks of many species, creating both international and domestic elements of management policy and practice in areas where commercial fisheries and offshore oil and gas activities are on the horizon. Capacity to engage effectively and meaningfully in management regimes depends in part on the structure of those regimes, as discussed next.

Organizational structure

A multitude of management issues need not lead to a proliferation of management regimes. Indeed, the notion of "ecosystem management" suggests that fewer management bodies working more closely together is a better idea than a fragmented system in which no agency or organization has the ability to consider all aspects of management together. There are, however, few examples of such coordination or consolidation. One of the better ones is in the Inuvialuit Settlement Region in Canada's Northwest Territories. Under the terms of the land claim settlement, the Government of Canada, the Government of the Northwest Territories, the Yukon Territorial Government, and the community and regional Inuvialuit organizations participate in five co-management groups. These groups govern fishing and hunting as well as environmental impact screening and review (Smith 2001).

Following the provisions of Canada's 1997 Oceans Act, which calls for integrated and precautionary management of oceans and coastal waters, the Inuvialuit, the governments, and the oil and gas industry developed the Beaufort Sea Integrated Management Planning Initiative (BSIMPI; see Fast et al. 2005). The initiative focused to start with on evaluating the idea of a marine protected area to conserve three areas of important beluga whale and fish habitats in the Mackenzie Delta. Though not without challenges, a three-year period of consultations with Inuvialuit, governments, and industry led to better mutual understanding and the identification of solutions that are acceptable to all stakeholders. As Fast et al. (2005: 113) describe:

> There has been a better definition of issues and problems. Communities, Inuvialuit management and co-management bodies, industry, and government agencies, including DFO [Department of Fisheries and Oceans, Canada], have a better understanding of the complexities of balancing conservation and development in the complex offshore environment of the Beaufort Sea. Access to information and understanding beyond a single realm such as science has been achieved. … Ultimately, the objective of integrated management is to influence human behaviour. This is the realm that has been advanced through the BSIMPI consultation process.

The BSIMPI is designed to address industrial development, but to do so in the full context of what such development may mean to the indigenous communities of the region. The accommodation of all aspects of local concerns is an essential component of this approach, ensuring the Inuvialuit that their views will be heard and taken into account. Some compromise will undoubtedly be necessary on all sides, but those decisions can be made in light of all relevant information that can be gathered, and through a structure in which power is shared. It should also be noted that the BSIMPI had considerable resources to work with, and extensive local experience in management processes thanks to the co-management groups established under the land claim settlement.

Elsewhere in the Arctic there are other examples of cooperative and co-management regimes (e.g., Huntington 1992, Caulfield 1997, 2004, Freeman et al. 1998, Hovelsrud and Winsnes 2006), but these usually address single species or issues rather than taking an integrated approach to oceans management. Still, the cooperative approach offers many advantages, including sharing of power and the ability to address various issues in relation to, rather than independent of, one another. Many such bodies have only advisory or otherwise limited authority, and as such cannot necessarily influence the full range of issues and threats they identify. Nonetheless, they have succeeded in many respects in providing a means for indigenous peoples to express their views and to be engaged in the management process.

Societal change

As noted by Noongwook et al. (2007) in the quote with which this paper opens, management regimes can conflict with traditional values. This remains true even for the most participatory regimes, if management actions run counter to traditional views of the relationship between people and the fish and animals that sustain them. In addition to helping conserve marine resources, management regimes can also promote cultural assimilation and even co-optation by enlisting indigenous participants in fulfilling the goals of the management agency with whom final authority rests (e.g., Nadasdy 2004).

Management regimes can also create social divisions within communities, as some individuals gain authority and stature by participation or employment within a management agency or body (e.g., Caulfield 1997). In a time when social and cultural change are rapid and profound, further drivers of change, even if inadvertent, are unlikely to have a long-term benefit for the communities involved. Instead, just as the full range of oceans management issues should be considered in making decisions about conservation measures, the full range of social impacts should be considered in determining how to create management organizations. Oceans management is a large topic, but only one of many interwoven aspects of life in today's arctic indigenous societies. It cannot be considered separately, but must be recognized as an integral part of a larger whole: the present and future of Arctic indigenous peoples.

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REPORT SERIES NO 129

Management of the Russian Arctic Seas

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Summary

The chapter describes the Russian Arctic seas as an object of management starting out with a description of their physical- and biogeographical features with special attention to LMEs and fisheries as the main resource usage. The chapter addresses also the current stage of other kinds of marine economic activities such as cargo shipping and oil and gas production and their prospects, as well as some social problems of the modern Russian Arctic.

The chapter then describes current federal legislation established, executive institutions responsible for the national marine policy development process and peculiarities of the policy formation and realization. The next steps suggested on the way to real implementation of integrated approaches, first of all at the federal level, are considered.

1. Introduction

Russia is by right considered and remains one of the leading maritime nations. A historical feature of Russia is its aspiration to the sea, to operate, develop and research its expanses and resources. The Russians started developing coasts and islands of the White and Barents Seas as far back as the XII century. In the middle of the XVI century (under Tsar Ivan the Terrible) the Muscovite Russia started active expansion to the north and east. Later in the XVI century and in the first half of the next one, future Russian towns were established in the Arctic.

With coasts bordering three oceans, the modern Russia with total land area of 17.1 million km² and the population of 142 mln people) has one of the most extended coastlines in the world (61 000 km without small islands) including the Arctic coast of 39 940 km (Fig. 1.1, Table 1.1).

The marine border of Russia running along the external boundary of the territorial sea has length of over 38 000 km. The area of the exclusive economic zone is over 6 mln km².

Situated in different climatic zones ranging from Arctic to subtropics, Russia's coastal zone is characterized by strong heterogeneity in natural, geographic and socio-economic parameters influencing the character of maritime activity. Thus, it is necessary to mention that approximately 17 million people populate the country's coastal zone (about 12% of the total population) of which 45% live in the coastal zone of the Black, Azov and Baltic seas (which accounts for only 2% of the entire coastal zone area), whereas only 15% live in the coastal zone of the Arctic regions (which accounts for 67% of the entire coastal zone area).

Fundamental changes in the socio-economic and political structure of Russia started in the 1990s have undoubtedly had essential influence on its maritime activity too. Complex situational analysis of economic activity by regional components of the coastal zone and seas of Russia have showed ineffective use of resources and depressive state of the environment in almost all the coastal provinces of Russia as well as the necessity to change the organization of the nature management and the character of interactions between the involved parties – resource users, population and authorities [1].

2. Geographical information and ecosystem characteristics

The following large marine ecosystems are defined in the Russian Arctic: Barents Sea, Kara Sea, Laptev Sea, East Siberian Sea, and Chukchee Sea. There is exact delimitation between the Russian West Arctic sector (Barents and Kara seas) and the Russian East Arctic sector (Laptev, East-Siberian and Chukchee seas) (Fig. 2.1). The official west boundary of the Barents Sea does not coincide with the sea boundary of the shelf. The continental slope is clearly pronounced in this area, depth increases 500 to 1 000 m each 10-20 km, therefore the west boundary of the Barents Sea LME must be laid along the edge of the shelf. It may be recommended to be delineated in the first approximation strictly south along the meridian 16° 30¢ from the southern extremity of Spitsbergen Island (Svalbard) down to the Norwegian coast.

The boundary between the Barents Sea and the Kara Sea along the Novaya Zemlya (New Land) Archipelago is quite obvious, but rather rough to the north of it. There are two hydrographic sections between Novaya Zemlya (New Land) and Franz Josef Land, areas of which (103 km² and 105 km², respectively) are substantially smaller than the area of the section running along the boundary between the Barents Sea and the Kara Sea (165 km²). However contrasts of depth and other natural factors at this part of the shelf are insignificant, therefore there is no need diverging from the official sea boundary in this case.

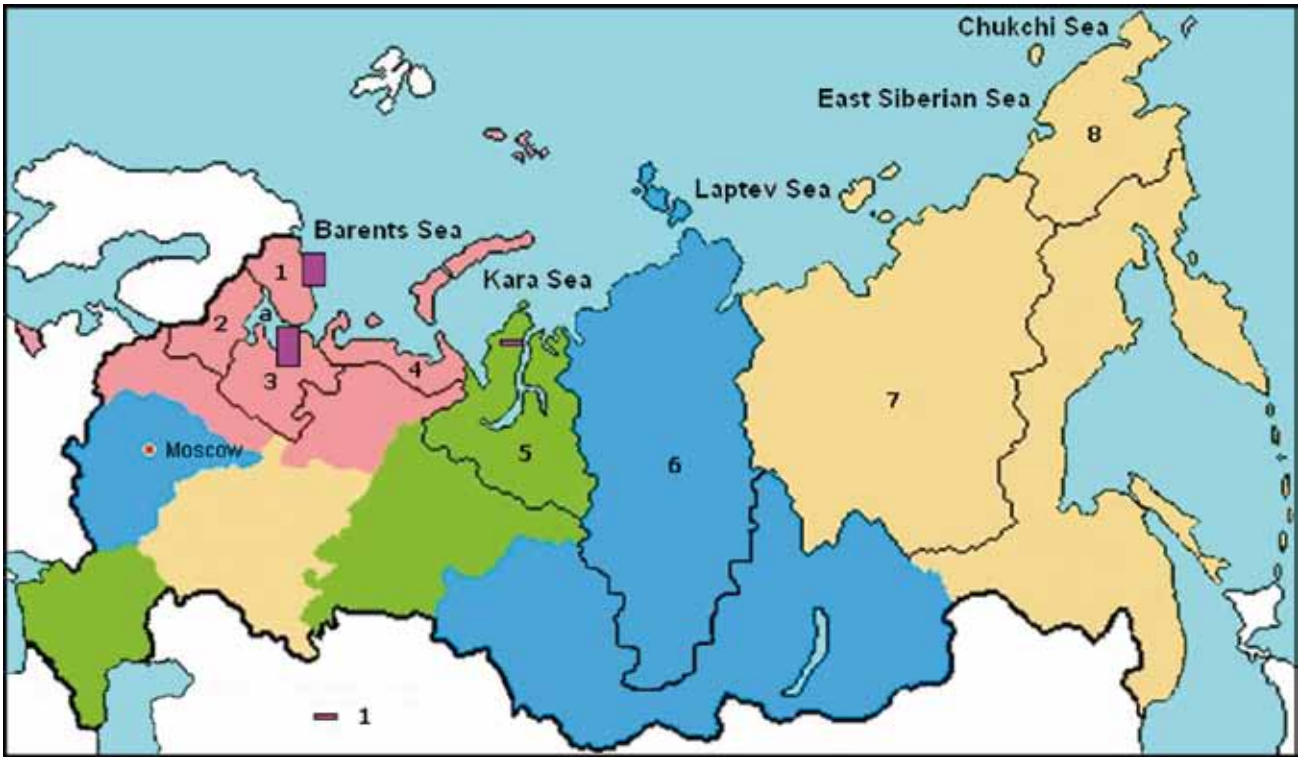

Figure 1.1: The Russian Federation, its federal districts (coloured) and Arctic coastal provinces (subjects of the Federation) (numbered, see Table 1.1)
a – White Sea
1 – equivalent of 100 000 people of a province's coastal urban population

Table 1.1: Federal districts bordering on Arctic ocean, Arctic coastal provinces (subjects of the Federation) and their Arctic coastline length

Federal districts (*okrugs*)		Arctic coastal provinces (subjects of the Russian Federation)	Coastline length, km *
North Western Federal District (District center - Saint Petersburg)	1	Murmansk Province (*Oblast*) (administrative center - Murmansk)	1730
	2	Republic of Karelia (Petrozavodsk)	600
	3	Arkhangelsk Province (*Oblast*) (Arkhangelsk)	8850, including Novaya Zemlya Islands (4320) and Franz Josef Land Islands (3410)
	4	Nenetsky Autonomous District (*Okrug*) (Naryan-Mar)	3180
Ural Federal District (Yekaterinburg)	5	Yamalo Nenetsky Autonomous District (*Okrug*) (Salekhard)	5570
Siberian Federal District (Novosibirsk)	6	Krasnoyarsk Province (*Kray*) (Krasnoyarsk)	9510, including Severnaya Zemlya Islands (2510)
Far Eastern Federal District (Khabarovsk)	7	Republic of Sakha (Yakutia) (Yakutsk)	7840, including Lyakhov Islands (560) and Novosibirsk Islands (1860)
	8	Chukotsky Autonomous District (*Okrug*) (Anadyr)	2660
		TOTAL	39940

* According to: Kalinina, L.I., S.A. Lukyanova, and G.D. Solovyeva. 1992. Mapping of Russian abrasion coasts. *Bulletin of the Moscow University, Ser. 5, Geography,* No. 3, pp. 46-50 (in Russian).

The shelf of the Russian East Arctic sector represents a single body with small depths (less than 50 m) and insignificantly rugged seabed. The sea boundary of the shelf coincides approximately with the official boundaries of the seas except for the Laptev Sea, where the abyssal hollow juts out deeply into the shelf. Taking all this into account, the boundary of the Laptev Sea LME could be delineated from Cape Chelyuskin to the north-east boundary point 79° N 139° E, i.e. southward of the hydrographical sea boundary.

River runoff is a chief natural factor for the shelf seas of the Russian Arctic. In the Barents Sea this is mostly characteristic of its south-eastern part, which is sometimes called the Pechora Sea and is the shallowest one receiving half of the total inflow of river water with the Pechora River runoff.

River runoff (Ob, Yenisei, Taz and other rivers) is a major factor affecting salinity, temperature, ice regime, and levels of man-caused contamination in the Kara Sea. The Kara Sea annually receives around 1 300 cubic km of river runoff which is more than 40% of the total runoff into the Arctic Ocean from Eurasia. The Laptev Sea is subject to a substantial impact of the river runoff with the Lena River as a major source of inflow (520 km^3 annually). The East Siberian Sea and the Chukchee Sea are less affected by this factor.

Sea ice is a major natural factor regulating seasonal cycles of photosynthesis, plankton development, and feeding and migrations of commercial fish stocks. Besides, it provides a habitat for some marine mammals. The aforementioned LMEs have quite different ice conditions: from total absence of ice to complete ice cover the whole year round.

The Southwest Barents Sea is free of ice all the year round which results in high biological productivity, development of fisheries and other economic activities. In the North Barents Sea drifting ice occurs any time of the year except for July and August when a probability to meet ice becomes less than 50 %.

A complete description of productivity of polar seas including its seasonal changes is not obtained up to now. Many areas either have never been visited by expeditions or there are only episodic data on them. Thus, until the mid 1990s there were no data available on the state of ecosystems in winter and spring for the seas running along the Northern Sea Route (East Barents Sea, Kara Sea, Laptev Sea, East Siberian Sea, and Chukchee Sea). Based on results of regular monitoring carried out by the Murmansk Marine Biological Institute (MMBI) (Russia, Murmansk) from Russian nuclear-powered icebreakers navigating the Arctic during the whole ice season, a series of new conclusions on the structure and function of Arctic ecosystems at different trophic levels (plankton communities to marine birds and mammals) has been obtained [3].

A sharp decrease in zooplankton and zoobenthos biomass is typical of seas of the Russian Arctic east of the Barents Sea. In a deep-water Arctic Ocean benthos biomass sharply decreases at a depth of 600-800 m. Characteristic values of benthos biomass differ five orders of magnitude, 0.05-0.1 g/m2 in the Arctic Ocean to 1 000 g/m2 and more at some parts of the Barents Sea shelf. On the whole the distribution of biomass closely depends on depth therefore the shelf boundaries can well be used as boundaries of benthic communities.

Fish fauna of polar seas is referred to as the circumpolar, Atlantic boreal and Pacific boreal according to the modern biogeographical zoning. The first one is spread all over the whole Arctic basin and its shelf seas, including the northern shelf of the Bering Sea, except for the South Barents Sea, which belongs to the Atlantic boreal area. The Pacific boreal includes the deep-water part of the Bering Sea. Almost all fishing areas are located within boreal areas.

Many fish species undertake long migrations which routes may depend on the inter-annual variability of water temperature. In warm years the Northeast Arctic cod spreads all over the whole Southeast Barents Sea while in cold years it migrates to central and south-western areas. Reduction of the cod habitat is accompanied by widening of the distribution area and increase in abundance of the polar cod, a representative of Arctic fish fauna.

Distribution density of sea birds and marine mammals is also closely connected with the level of LME bioproductivity. The most numerous rookeries are located in non-freezing coastal zones of Norway and Kola Peninsula. For some marine mammals (polar bear, ringed seal and others) sea ice provides a natural habitat and a room for migrations, therefore their distribution areas may become narrower or larger depending on long-term climatic changes.

Isolation of trophic connections, being another criterion for the LME delimitation, may be considered full only for benthic organisms and coastal phytocenoses. Even passively floating phytoplankton is advected with currents over large distance and cross LMEs boundaries. Representatives of higher trophic levels (fishes, birds, mammals) are often not limited by boundaries of particular ecosystems. Many fish species undertake passive and active migrations during their life cycle (spawn, larvae, juveniles, and mature fish). The general regularity is that an increased abundance of representatives of all the trophic levels is observed in ocean areas with high levels of primary production (upwellings, river estuaries).

Background contamination in the Barents Sea results from transboundary transport of contaminants entering the sea with the Norwegian current from the west and local contamination from land-based sources and intensive navigation. Contamination levels in open areas of the Barents Sea are significantly lower than those of western and southern

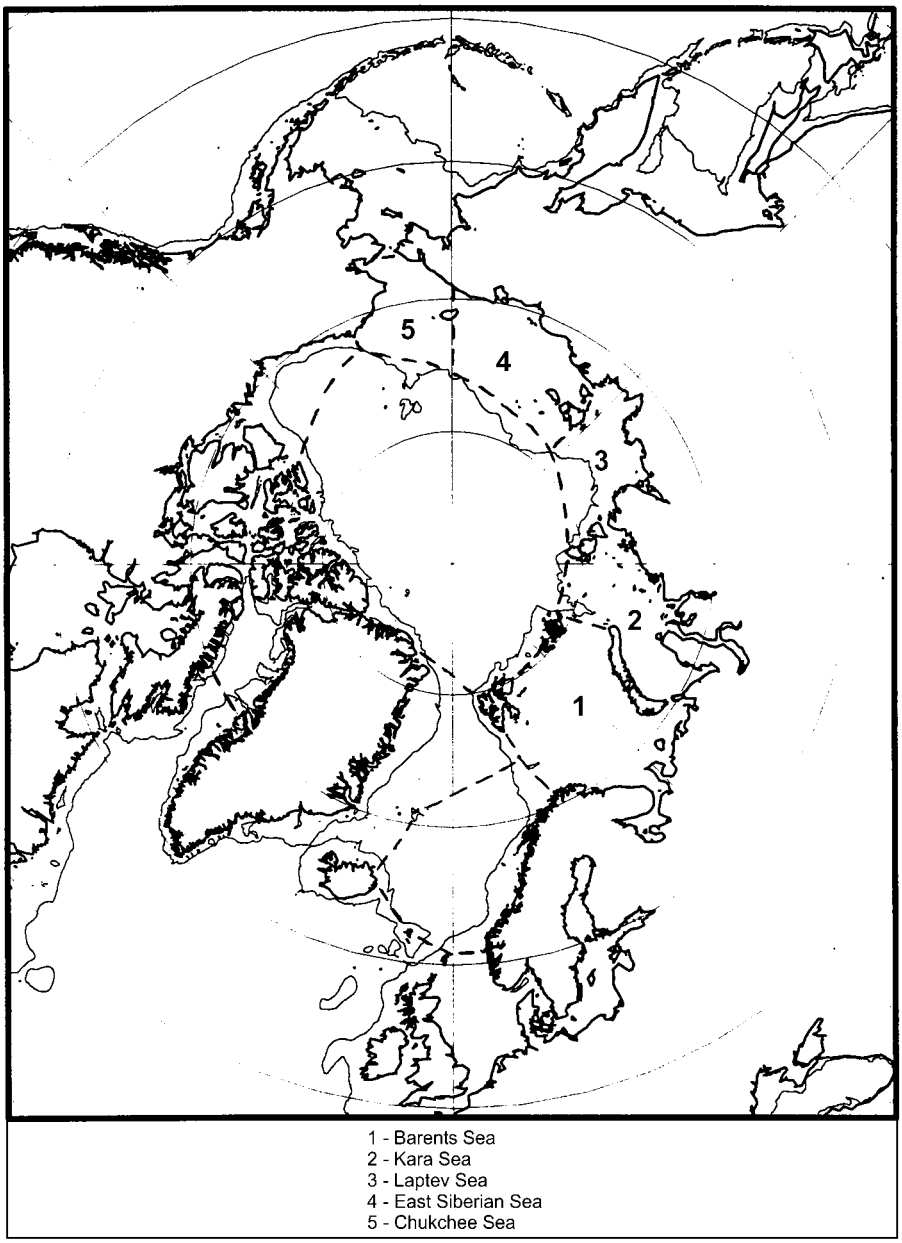

Figure 2.1: Boundaries of Large Marine Ecosystems of the Russian Arctic [2]

European seas. Exceptions are some coastal areas, especially Kola Inlet housing the largest port and industrial complex in the Arctic. High ecological vulnerability is also characteristic of the Southeast Barents Sea receiving contaminants from onshore oil and gas production sites located in the Pechora River basin. Offshore oil production which will start in the near future presents a potential ecological threat to this part of the Barents Sea.

River basins are major sources of contaminants for other Arctic seas of Russia. The most vulnerable water areas are the White Sea and estuarine areas of the Ob River and the Yenisei River in the Kara Sea.

A specific feature of the Russian Western Arctic sector is a threat of radioactive contamination as this region houses a large number of local sources of artificial radionuclides and receives contaminants from external sources. However in general nowhere in the Arctic chemical and radiation contamination is referred to as a major factor affecting ecosystems, quality of fish food products and health of sea bird and mammal populations which to a greater extent are subject to effects of bioaccumulation of toxic substances [4].

Arctic seas, compared to other regions of the World Ocean, are relatively clean and the state of pelagic (open-sea) ecosystems is as a whole stable (apart from overfishing of commercial species). However some shelf areas of arctic seas and coastal zones (Kola Inlet in particular) are substantially contaminated.

Among typical environmental problems in the Arctic are: a) specifying quantities of contaminants entering the Arctic and shares of contribution of their sources; b) studying assimilation capacities of single areas to the most dangerous contaminants, assessing their impacts on the biotic system; c) developing and introducing biological and chemical methods to assess effects of cumulative impacts of man-caused factors; d) developing measures for mitigating impacts of current levels of pollution on man and living nature taking into account slow character of self purification and restoration of arctic ecosystems; e) assessing impacts of climatic changes on ecosystems [5].

Special attention should be paid to the necessity to enlarge the area of protected land and water territories. Some scientists believe such areas should occupy 25 % of the whole Arctic area.

3. Socio-economic characteristics

Role of macroeconomic processes in Russia

Significant economic activity of the USSR on its coasts, in the adjacent seas and in the open ocean was conducted under conditions of a strictly centralized management system, based on a sectoral (ministerial) approach and exclusive state ownership of land, resources and means of production. The sectoral ministries were responsible, first of all, for the fulfillment of their own plans. Consequently integrated regional programs were paid little attention. That meant in practice that under conditions of the centralized directive management system there was no need for sound recommendations on integrated use of coastal resources and for objective mechanisms of coordination of interests and settlement of conflicts between the stakeholders [6].

Characteristic of the transitional stage, fundamental changes happened in Russia in the 1990s substantially influenced maritime activities as well. These changes include privatization and changed ownership patterns, significant revision of the governing role of national, regional and local authorities, noticeable weakening of attention to nature conservation measures under conditions of poor socio-economic situation. Characteristic of a transition period, costs of organization of a new system of economic relations– first of all relations between ownership and use of natural resources which interconnect national, regional and local interests and interests of private business – should also be mentioned. Then comes the insufficiency of the respective legislative basis and institutional structure for the integrated regional ocean management, absence of long-term experience in market regulation. Other things – typical for the transition period – that should be mentioned here are weak investment policy at different levels, insignificant practical demand for results of scientific research and lack of modern coastal zone cadastres necessary for effective management [7].

At the same time among positive things is a traditionally high level of expertise of specialists in natural sciences, including marine sciences, in Russia, and effective system of higher education, and availability of access to international experience in integrated approaches to ocean management.

On its way towards the modern political and economic system, Russia has gained relative success in solving tasks of two stages of drastic

socio-economic reforms. The first stage that occurred in the 1990s was directed at dismantling of the old socialist system by that time gone through economic, social, political and value crash.

Characterized by a chain of crises dramatically experienced by the society, this stage formed basic institutes of market economy and democracy and restored relative stability, both macroeconomic and political. By the end of the 1990s the following problems had been solved: 1) basic political institutions had been established, the most significant element of that being the adoption of the Constitution of the Russian Federation and regulation of federative relations; 2) macroeconomic stabilization had been reached by 2004 providing the country with a relatively steady currency and balanced budget; 3) mass privatization had been conducted which laid a basis for transition of the Russian economy to a market economy. Creation and development of private property institutions became one of the key factors creating a basis for further stable economic growth.

The second stage started in the beginning of the 2000s. This period has become the time of restoration and growth of the economy. The federal government has gained a possibility to solve strategic tasks. Intensifying efforts to ensure macroeconomic and political stability the President and the Government of Russia have directed major attention at formation of economic institutes typical for a modern market and democratic society and corresponding to the peculiarities of Russia. The Civil, Taxation, Budget, Labor, Land, Forrest, and Water Codes, new pension and bankruptcy legislation have been adopted. Much has been done towards debureaucratization (deregulation) and improvement of inter-budgetary relations (federal budget, regional and local budgets), improvement of monetary legislation, reforming of natural monopolies and other things [8].

At the same time, further progress in development of Russia's economy including national maritime activity obviously depends on, first of all, successful resolution of a range of problems, common for the development of the country and its economy as a whole. These problems include progressive structure shifts in the economy (diversification and overcoming of infrastructure restrictions), building effective market institutions and creating progressive business environment, improving effectiveness of government institutions, and developing human potential. This progress should be achieved by relying on strategic competitive benefits of Russia having substantial marine components such as energy, transit, innovation, and ecologic potential.

It should be mentioned that forming a new progressive competitive environment is especially important for such a traditionally conflict sphere as nature management, first of all multi-sectoral ocean management.

Speaking of key problems of the economy's maritime sector it should be mentioned that Russia still lacks economic, financial, legislative, and institutional basis for their solution. For the development of mineral and energy resources of the continental shelf, these problems include construction of new equipment, intensification of geologic and geophysical surveys on shelf, substantiation of enlargement of shelf boundaries. For the development of water biologic resources, these include reduction of a raw component in the Russian export of fish products and increase of the share of Russian producers, and significant reduction of the shady turnover of fish products. For the development of marine shipping these problems include growth of cargo transfer volumes in Russian ports and increase in the share of Russian shipping companies in the whole volume of national foreign-trade operations. This is also restoration of the ship building industry, improvement of economic provision of the Russian Navy, use of potential possibilities of the Northern Sea Route for the provision of stable functioning of the Russian Arctic Zone and transit sea shipping, intensification of scientific research, etc.

Since recently definite steps have been made to solve these problems. These are, among others, establishment of the Joint Ship Building Corporation by the Federal law in 2007, adoption of the Federal Target Program "Development of Civil Maritime Machinery and Equipment (2009-2016)", working out of the State Program for the Exploration and Development of the Continental Shelf, restoration of an self-dependent Federal Agency of Fisheries in 2007, adoption of the Federal Target Program "Development of Fishery Resource Potential and Its Effective Use", working out of a program for substantiation of the outer limits of the country's continental shelf, renovation of the Federal Target Program "Modernization of Russian Transport System" with its marine-oriented subprogram, etc.

The specificity of integrated marine management has not yet been introduced into the development and execution of comprehensive programs of socio-economic development of Russia's coastal provinces and coastal local communities (first of all the necessity of taking into account the spatial and territory aspect of the marine activity development).

Situation in the region

Nowadays the prevailing maritime activities in the Russian Arctic are fisheries in the Barents Sea and cargo shipping. Oil and gas production and extraction of chemical, mineral and building raw material have been substantially increasing over the last years (Fig. 3.1)
For Russia, sea shipping is of great importance connecting territories with each other and playing a vital role in external economic activities. The role of sea shipping remains essential in supporting the life of coastal communities of the Utmost North and the Far East of Russia. Sea transport as one of the main components of the maritime sector is

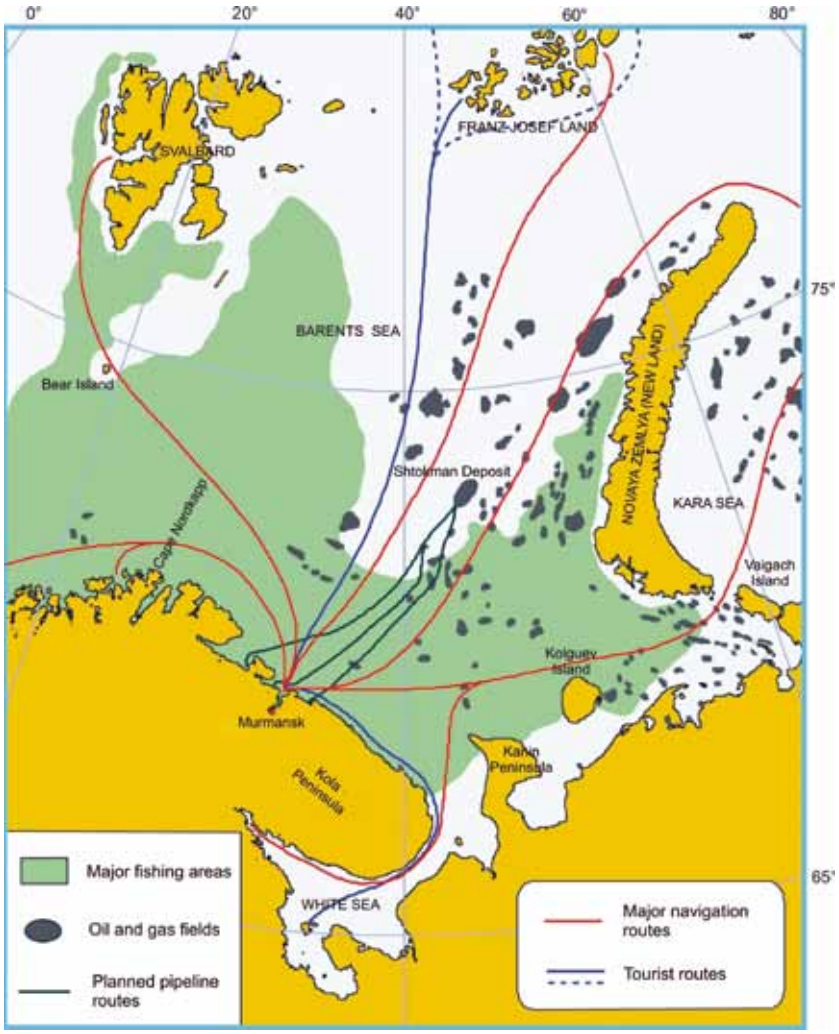

Figure 3.1: Scheme of economic activities in the Barents Sea [9]

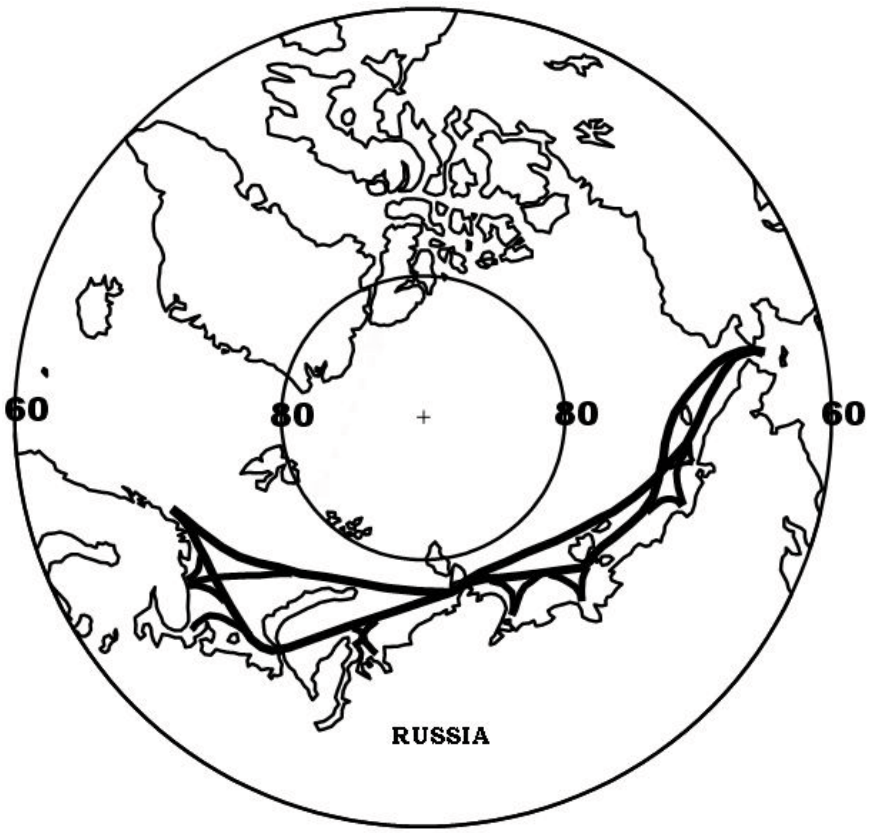

Figure 3.2: Major navigation routes in the Russian Arctic along the Northern Sea Route

closely and logically connected with other sectors of the economy, distribution of production and population in coastal areas, and exploitation and development of mineral, biological and recreational resources of the sea (Fig. 3.2).

Traditionally arctic seas have been used, first of all, for coastwise shipping or international shipping between neighboring countries. The Russian Northern Sea Route has always been playing a greater role both by volumes of cargo shipped and by its strategic significance. Geographically the Northern Sea Route runs from north-western boundaries of Russia (ports of Murmansk and Arkhangelsk) to the Bering Strait occupying about 3 000 nautical miles.

Northern Sea Route is a single latitudinal water artery connecting all the arctic and subarctic regions of Russia with their rich mineral, energy and biologic resources, and having a great influence on development of the Russian territories located south of the Arctic Ocean for many hundreds of kilometers (first of all along large rivers). Exploitation of the Northern Sea Route demands non-traditional approaches. This relates to severe nature conditions of the region, first of all ice cover along navigation routes and particular vulnerability of the arctic nature. Russia has spent great resources and efforts of many generations to explore and develop the Northern Sea Route having built the infrastructure, powerful ice-breaker and transport fleet, systems for hydrographic and hydrometeorologic support of shipping.
Volumes of cargo shipped along the Northern Sea Route reached 6.5 mln tons in 1987. Drastic economic reforms in Russia decreased this index by a factor of 4. Economic stabilization in Russia should inevitably result in restoration and further growth of the Northern Sea Route significance. The main factor of prospective increase of economic activity in this region is the development of onshore and offshore oil and gas production in the Barents Sea, South-East Barents Sea (Pechora Sea), and Kara Sea. Potential volumes of oil and gas shipping from these regions are estimated at 50 mln tons a year.
By now multiyear navigation practice has showed a possibility of all-the-year-round navigation of large-capacity vessels along the Northern Sea Route using both traditional and high-latitude routes.

The role of navigation in coastal waters (cabotage) is especially important for the northern and eastern coasts of Russia where it very often has no alternatives. Such territories involve the arctic zone from the Norwegian border to the Bering Strait including arctic islands and mouths of large Asian rivers, the Ob, the Yenisey, the Lena, and less extensive the Khatanga, the Anabar, the Olenek, the Yana, the Indigirka, and the Kolyma. Goods and materials are shipped to arctic ports of Russia according to a traditional scheme, both from the west and from the east. Petroleum products, technical cargo, and food products are mainly transported from west to east, from ports of the Western Arctic sector of Russia (Murmansk and Archangelsk) to Asian ports located in the Eastern Arctic sector of Russia. Far Eastern ports (Vladivostok, Nakhodka, Vanino and others) supply to the west into the Russian Arctic building material, technical and technological cargo, and food products. Transport of goods and materials from the Arctic is mainly oriented to the west. Coastal navigation plays an important role in the development of the Norilsk Industrial Complex, oil and gas complex of Western Siberia, and extractive enterprises of Yakutiya and Chukotka.

Economic crisis of the 1990s and transition of Russia from planned to market economy the most seriously affected the arctic regions which highly depended on centralized state governance and funding. The volume of annual shipping of goods and materials along the Northern Sea Route decreased from 6.5 mil tons in the 1980s to 1.5 mil tons in the end of the 1990s. In the Western Arctic Sector of Russia (Barents Sea and Kara Sea) shipping was reduced by a factor of 2.8 while in the Eastern Arctic Sector (from the Laptev Sea to the Chukchee Sea) it was reduced by a factor of 16. This happened because of collapse of many industrial enterprises in the Eastern Russian Arctic. At the same time the demand for annual marine transportation in the Western Russian Arctic remained owing to export-oriented industries (oil and gas, non-ferrous metallurgy, forestry). Turnover of goods in ports of the Eastern Arctic decreased in the same proportions and only the port of Dudinka has kept its importance as a main link between the Norilsk Industrial Complex and consumers of its output. The structure of transportation has also changed: the share of building material, machinery and equipment decreased while that of petroleum products, coal, and food products increased.

Economic activity along the Northern Sea Route has been intensified over the last years. The effectiveness of icebreaker pilotage increases with the growth of goods turnover. The growth of demand for shipping along the Northern Sea Route in the nearest 5-10 years is expected to be induced by the need for oil transport from deposits of Siberia and Northwest Russia and backward transport of pipes, building materials and other goods, and by the development of container traffic between Europe and Southeast Asia.

The latter concerns the use of the Northern Sea Route for transit between countries of North-Western Europe and countries of the Pacific Region (Japan, China, USA, Canada, etc.). As far back as the 18th century Russian scientist Mikhail Lomonosov proposed an idea of using icebreakers to make the Northern Sea Route a shortest way into the Pacific Ocean. So the extension of the Hamburg-Yokohama route (11 400 nautical miles via the Suez Canal) decreases by a factor of 1.7 via the Northern Sea Route.

Russian and foreign experts make optimistic estimates of the Northern Sea Route's competitive capacity for goods transit (compared to southern routes), its navigation reliability and safety. According to some estimates, the freight flow along the Northern Sea Route may reach 10 mil tons a year by 2010 and 50 mil tons a year by 2020 provided that appropriate investments into the development of the Northern Sea Route's infrastructure are made and that icebreakers and transport ves-

sels of new generation are constructed. Taking into account increased requirements to navigation under ice conditions and particular vulnerability of the Arctic nature, shipping along the Northern Sea Route should be executed under strict government control. This is consistent with the UN Convention on the Law of the Sea according to which countries bordering on seas ice-bound over 6 months a year have right to set their own rules of shipping within their jurisdiction areas.
The most serious manifestation of the economic crisis of the 1990s is the depopulation of the Russian Arctic. In the 1990s, the population of the northern territories of Russia substantially decreased (Table 3.1). Especially large relative losses fell on small settlements along the coast resulting from a decrease in military activity and concentration of

Table 3.1: Population of the largest towns and villages of the eastern sector of the Russian Arctic according to data of the population censuses of 1989 and 2002 (thousands of people)

	Amderma (Kara Sea)	Dikson (Kara Sea)	Tiksi (Laptev Sea)	Peve (East Siberian Sea)
1989	5.5	4.4	11.6	12.9
2002	0.65	1.2	5.9	5.2

fisheries in few large coastal sites (Murmansk, Belomorsk, Norwegian ports). This tendency is expected to be reversed due to a prospective upturn in the economy of Northwest Russia, especially in the oil and gas sector.

Eurasian coast of the Russian Arctic east of Kola Peninsula is weakly populated. The population of harbor towns and villages along the Northern Sea Route is 5 000 to 10 000 people, while smaller communities number only several hundreds of people each.

The aforementioned difference in demography and economy of coastal communities is well in accordance with the existing scheme of delimitation of LMEs. The most productive LMEs have denser population and dominate in the development of the marine sector of the economy.

On the Barents Sea coast, 90 % of all population is concentrated around Kola Inlet. According to the population census of 2002 corrected by a later assessment of the Murmansk population, the population of this territory nowadays is about 450 000 people including 332 000 people in the Murmansk agglomeration (the towns of Murmansk and Kola), 75 000 people in the town of Severomorsk and adjacent areas, and 43 000 people in towns located in the northwest of Kola Inlet (Polyarniy, Snezhnogorsk, Skalistiy). Rural population in the area is insignificant (about 1 % of the total). Almost all the people inhabiting this territory live within 5 kilometers from the sea. Almost all the infrastructure and enterprises are also located within this area.

Communities situated in other territories of the Arctic coast number less than 10 000 people each, except Naryan-Mar which is more likely an inland port than a sea harbor. It should be mentioned that maritime economic activities on the Kola Peninsula coast outside the Kola Inlet territory are mainly presented by naval stations and protection of frontiers. The port and industrial complex of Kola Inlet occupies a dominant, and even a monopolistic, place in the civilian maritime sector. It includes commercial and fish sea ports, land transport junction, fish processing enterprises in Murmansk, naval stations in Severomorsk and Polyarniy, and naval and civilian shipyards in Murmansk, Roslyakovo, Polyarniy, and Snezhnogorsk. The coastal zone is very unevenly developed: industrial enterprises and housing areas and mooring lines alternate with areas of the coast with natural undisturbed landscapes.

The current status and prospects of development of the port and industrial complex in many respects depend on the whole socio-economic situation in Murmansk Oblast (province), including the situation in mining industry, non-ferrous metallurgy, building, and agriculture, as well as living standard and employment.

The industry is presented mainly by raw sectors of economy (fishery, extraction and processing of minerals) and by processing industries (non-ferrous metallurgy, fish production, woodworking). Non-ferrous metallurgy occupies the largest share in the structure of industrial output (28 %). The share of electric power production is 22 %, 15 % fall on food production (including fish processing – 13 %), again 15 % is the share of chemical industry (production of apatite concentrate), ferrous metallurgy has 12 % and the share of engineering and machinery construction is 5 %. The contribution of other branches is insignificant. Annual indices of industrial output in some branches are the following: iron-ore concentrate – up to 10 mil tons, apatite concentrate – 3-4 mil tons, saw-timber – about 20 000 cubical meters. Annual fish catch by the beginning of the 1990s reached 1 200 000 tons, then in the mid 1990s it was reduced to 400 000-450 000 tons and in 2005 increased again up to 585 000 tons. However most fish caught in the Barents Sea (up to 75 %) is landed outside Murmansk Oblast. That's why the share of fish industry in the total production of output in the region decreased from 31 to 13 % in 2004. The capacities of fish processing enterprises in 2004-2005 were used only for 15-20 % of the total. The recession mostly affected the production of canned fish which now comprises only 10 % of the level of 1990. The fishing fleet is highly depreciated and obsolescent.

Since the beginning of the 2000s, a substantial increase in petroleum transport in Kola Inlet has been observed. Several offshore oil terminals were put into production. Land-based oil terminals are located at the oil storage depot of the Murmansk fish port, at the "Shipyard 35" enterprise, and at naval facilities. Offshore terminals in Kola Inlet transfer oil from shuttle tankers into storage vessels and then into large-capacity transport tankers. The largest of such terminals is the storage tanker "Belokamenka" with a deadweight of 360 000 tons located in the central bend of Kola Inlet near the village of the same name. The total volume of petroleum products processed at offshore and land-based terminals comprises now 20 mil tons and is expected to grow twofold by 2010-2015.

The only shipping company in the region capable of operating in the Arctic all the year round is the Murmansk Shipping Company (MSC). MSC has been traditionally specializing in arctic shipping and until August 2008 executed day-to-day management of the state icebreaker fleet. Since August 2008 the state icebreaker fleet has been transferred into the Atomflot Company, regulated by a different agency than MSC (Ministry of Energy instead of Ministry of Transport). Interactions between the Murmansk Shipping Company and the Atomflot Company will be rested upon a commercial basis.

MSC vessels transport 80 % of all goods and materials along the Northern Sea Route. A diverse structure of the fleet enables the MSC to ship the production of the "Norilsk Nikel" and the "Apatite" enterprises, transport coal from Svalbard, oil and petroleum products from the Varandey, the Kolguyev, Ob deposits, Yakutia, the White Sea, and Murmansk and from the Baltic Sea. The share of bulked cargo in total fleet operations (around 9 mil tons a year) increased from 20 to 50 % in 2000-2004. By 2005 the MSC controlled 12 vessels with a total deadweight of 290 000 tons running under the flags of convenience.

The MSC will play an important role in revival of shipping along the Northern Sea Route for the development of large gas deposits, transport of raw material abroad, and supporting arctic communities of Russia. The MSC possesses the new offshore terminal at Varandey. According to estimates, the volume of sea shipping in the Arctic may reach 12 mil tons by 2010 and 50 mil tons by 2020. In the light of these estimates Russia starts overhauling its cargo ice-class fleet and icebreakers. Recently a new nuclear-powered icebreaker called "50 Let Pobedy" (50 Years of Victory) has been commissioned into the icebreaker fleet. The icebreaker has replaced the decommissioned nuclear-powered icebreaker "Sibir" (Siberia) and, together with new

diesel electric icebreakers, is to support a stable navigation along the Northern Sea Route. The overhauling of the icebreaker fleet would be partially funded by private companies "Norilsk Nikel", "LUKOIL" and some other industrial groups in a form of state-private partnership. LUKOIL possesses its own tanker company which fleet comprised 10 ice-class tankers with a total deadweight of 180 000 tons in 2004. With the help of these tankers LUKOIL has started a year-round export of crude oil and gas condensate produced by the company in the Timano-Pechora region. In 2002 the Association of the Users of the Northern Sea Route was created. The Association united more than 20 member-companies.

It should be mentioned that the maritime sector in the Barents Sea is mainly oriented to exploitation of living resources. Other maritime activities either do not affect seriously the ecosystem (sea transport, military activities) or have just started developing and are expected to be intensified in the future (oil and gas production on shelf). Thus nowadays fishery is the main factor affecting the ecosystem, which though may soon be crowded by gas production from the Shtokman Gas Condensate Deposit being increasingly developed.

Thus, the Barents Sea plays a particular role which is determined by two major factors: first its special geopolitical and strategic role and second its rich natural resources. There is every reason to believe that in 2008-2015 this region will become one of the major sources of fuel reserves and an important factor of global energy safety. At the same time it's very important to prevent the loss of the Barents Sea living resources because of increased oil and gas production on shelf and to preserve the status of this sea as one of the most important World Ocean's basins as regards biological resources. Therefore the Barents Sea will inevitably be transformed into an integral area which implies special requirements to the management over this water body.

Nowadays the whole arctic shelf is regarded as a single oil and gas bearing super-basin with resources equal to 83-110 billion tons which exceeds resources of other oceans. Numerous oil fields have been discovered in the Kara Sea including huge Rusanovskoye and Leningradskoye gas condensate deposits, 4.5 trillion cubical meters each, exceeding the well-known Shtokman deposit in the Barents Sea which is planned to be put on production in 2013.

Biologic resources of the Kara Sea are used nowadays only by scarce local population and this will hardly change in the near future. Large-scale exploitation of living marine resources in the Kara Sea is impossible due to severe ice and climate conditions, scarce resources and their slow reproduction, and remoteness from markets. Fishing of commercial anadromous fish species here is more expedient in rivers. On the other hand, scarce population and lack of large industries in eastern Arctic regions of Russia serve as a protection against environmental degradation. That's why the management of the Kara Sea and other arctic seas should above all be rested upon nature conservation principles according to the federal acts: the Federal Act on the Protection of the Environment and the Federal Act on Environmental Examination.

Natural and ethnographic peculiarities of the Arctic region condition the development of environmental, fishing and extreme kinds of tourism here, related to its exotic nature. The development of tourist business is to a great extent connected to ways of further development of indigenous peoples of the North. A particular importance of interrelation between tourism and environmental protection in the Arctic has been largely understood since recently.

The concept of *Linking Tourism and Conservation in the Arctic* originated from the 1995 Second International Symposium on Polar Tourism in St. Petersburg, Russia. Since that time, a series of workshops have developed Principles and Codes of Conduct for Arctic Tourism and a mechanism for their practical implementation. Because tourism in Russia differs significantly from other parts of the Arctic, a separate effort will be required to introduce the principles and implement the mechanism there. The challenge will be to adapt lessons learned elsewhere for conditions in Russia — the largest and least disturbed parts of the circumpolar Arctic.

During the last years, Russian icebreakers have been making constant tourist voyages to the North Pole, the Franz Josef Land Archipelago, or from Provideniye (Providence) Bay (Bering Strait) along the Northern Sea Route with tourists from the USA, Japan, Canada and other countries on board. Major conditions for the development of this kind of tourism is a construction of a special fleet and coastal tourist infrastructure.

Speaking of participation of indigenous arctic peoples in management of the region's development one should mention that despite uniting organizations (including the Association of Indigenous Peoples of the North), indigenous peoples have very little influence on the decision-making process.

Fishery

The fish fauna of the Barents Sea includes about 150 fish species. One third of them are boreal species that rarely enter the Barents Sea from the west. Ninety to ninety-five species permanently live in the Barents Sea. Less than 30 species are of commercial value. Commercially important fisheries are for cod, haddock, saithe, capelin, polar cod, herring (2 species), red fish (2 species), wolffishes (3 species) and some other species. Most part of commercial fisheries falls under the jurisdiction of two and more countries therefore they are regulated by bilateral and multilateral agreements including the Joint Norwegian-Russian Fisheries Commission. These are fisheries for cod, haddock, Atlantic Scandinavian herring, capelin, red fish, black halibut, blue whiting, Atlantic mackerel, and partly saithe.

Commercial fishery serves as an index of the LME productivity and resources potential but simultaneously it imposes on a LME a potential risk of anthropogenic degradation due to over-fishing. Thus, annual catch in the Barents Sea has decreased 3 to 4 times during the second half of the 20th century. Dramatic changes in abundance of the most important commercial fish stocks, cod and capelin, have been registered.

The economically and politically dominant fishery in the Barents Sea is for Northeast Arctic cod. The Barents Sea fishery for cod depends on the state of its stock. Thus, if for the period of 1955-1979 the total annual catch averaged about 445 000 tons at fluctuations within the range of 202 000 to 841 000 tons, then when the cod stock was the most greatly depressed (1983-1984) the total annual catch decreased to 56 000-58 000 tons. Over the last seven years (2000-2006) the Russian cod quota varied within the range of 181 400 to 212 600 tons.

Among major problems that the Barents Sea fisheries for cod and haddock face nowadays poaching is one of the most important. According to Norwegian estimates, annual overfishing of cod over the period of 2002-2005 constituted 80 000 to 120 000 tons and 101 000 tons in 2005. According to Russian estimates this was less than 26 000 tons.

The current status of the cod stock (between 2005 and 2008), according to N.M. Knipovich Polar Research Institute of Fisheries and Oceanography (PINRO) data, is stable now and hardly will experience significant changes in the near future provided that Russia and Norway adhere to conservancy principles. At the same time inter-annual variations of the stock are inevitable due to natural fluctuations in numbers of generations entering the commercial stock. That was exactly the reason of that the Russian cod quota for 2007 was reduced to 179 500 tons.

A clear notion of the Barents Sea fisheries could be obtained with the help of maps showing registered vessels operations in the fishery for cod, which is the dominant commercial species in the Barents Sea. Undertaking long migrations (feeding and pre-spawning) the cod spreads during the year over vast areas of the sea forming gatherings of commercial value, which in most cases juxtapose with other commercial fish stocks.

Figure 3.3 demonstrates fisheries operations of fishing vessels in the Russian EEZ and in the disputable Russian-Norwegian area (Grey Zone) during 2006. Besides the cod fishery, vessels fishing for haddock and polar cod were also taken into account. Areas of the greatest fishing activity are marked by a darker color. As the figure shows in some areas fisheries operations lasted the whole year round.

The most important fishing areas in the Russian EEZ are the Rybachya Bank, the North-Eastern Slope of the Murmansk Bank, the Western Coastal Area, and slopes of the Gusinaya (Goose) Bank. In the Grey Zone these are the West-Eastern Slope of the Murmansk Bank, the Finnmarken Bank, and the Demidov Bank.

Transition of Russia to the market economy and partial demilitarization of Barents Sea coastal areas created conditions for development of coastal fishery on a new market basis. Nowadays the coastal fleet consists of about 160 vessels.

In 2005 and 2006 coastal quotas for bottom-dwelling species in the Barents Sea were at the level of 30 000 tons. Nowadays maximum utilization of coastal quotas for bottom-dwelling species is possible only when three types of fishing are used: trawl fishing, long-line fishing, and hook-and-line fishing. Taking into account peculiarities of distribution of bottom-dwelling stocks in Russian territorial waters, and the presence of the area west of the longitude 35° E banned for trawling, and poorly developed coastal infrastructure of Kola Peninsula, quotas allotted for coastal fisheries are most likely to be utilized in the following proportion: 70 % by trawlers, 20 % by long-line fishing vessels, and 10 % by vessels equipped with hook-and-line or jig gear.

When organizing coastal fisheries by the existing fleet under conditions of northern seas one should take into account certain restrictions. Fisheries in the coastal zone of the Barents Sea due to severe hydrometeorologic conditions, especially during the winter period, are limited to 7 months. One should also take into account the seasonality in the formation of commercial gatherings of different stocks within the coastal 12-mile zone, which is also makes these fisheries seasonally restricted.

Formerly costal fishery in Russia was referred to as the fishery within internal waters and the territorial sea of the Russian Federation. Division of fisheries into the costal fishery and sea fishery within the national exclusive economic zone along the line of the territorial sea (a 12-mile zone) created difficulties for fishing firms due to mobility of fish stocks. That is why the purpose of this fishery was specified – supplying fish for selling and processing in the territory of the Russian Federation. Such a fishery involves individual entrepreneurs and companies. Types of fishing vessels and fishing gear and methods of fishing are determined for each fishing area. Quotas for coastal fisheries on shelf and in the Russian EEZ, as well as in areas under jurisdiction of international agreements, are allotted by the Government of Russia. Quotas for fisheries in internal marine waters and the territorial sea are allocated between users by the Federal Agency of Fisheries of the Russian Federation on requests from regional governments. Quotas for the coastal fishery are allotted to a user only provided that fish caught is landed in the territory of Russia.

Coastal fishery contributes to the development of coastal and port infrastructure of the fisheries sector, social development of coastal communities, provides new jobs, increases revenues into budgets of different levels. Fishing and fish processing companies bear large social responsibility providing jobs for local population and supporting housing and communal infrastructure of local communities.

Fishery for marine biological resources is a traditional occupation for a number of indigenous peoples living in the Arctic. But only fisheries within the Barents Sea basin have national and international significance in the Arctic. There are still contradictions between Russian and Norwegian fisheries rules, especially within the Svalbard fisheries area, for example trawl mesh sizes, minimum size of the fish caught and others. Agreements on these normative differences can be successfully achieved within gradual Russian-Norwegian negotiations. Existing economic contradictions between the sea fisheries and coastal fisheries in Russia still remain unresolved.

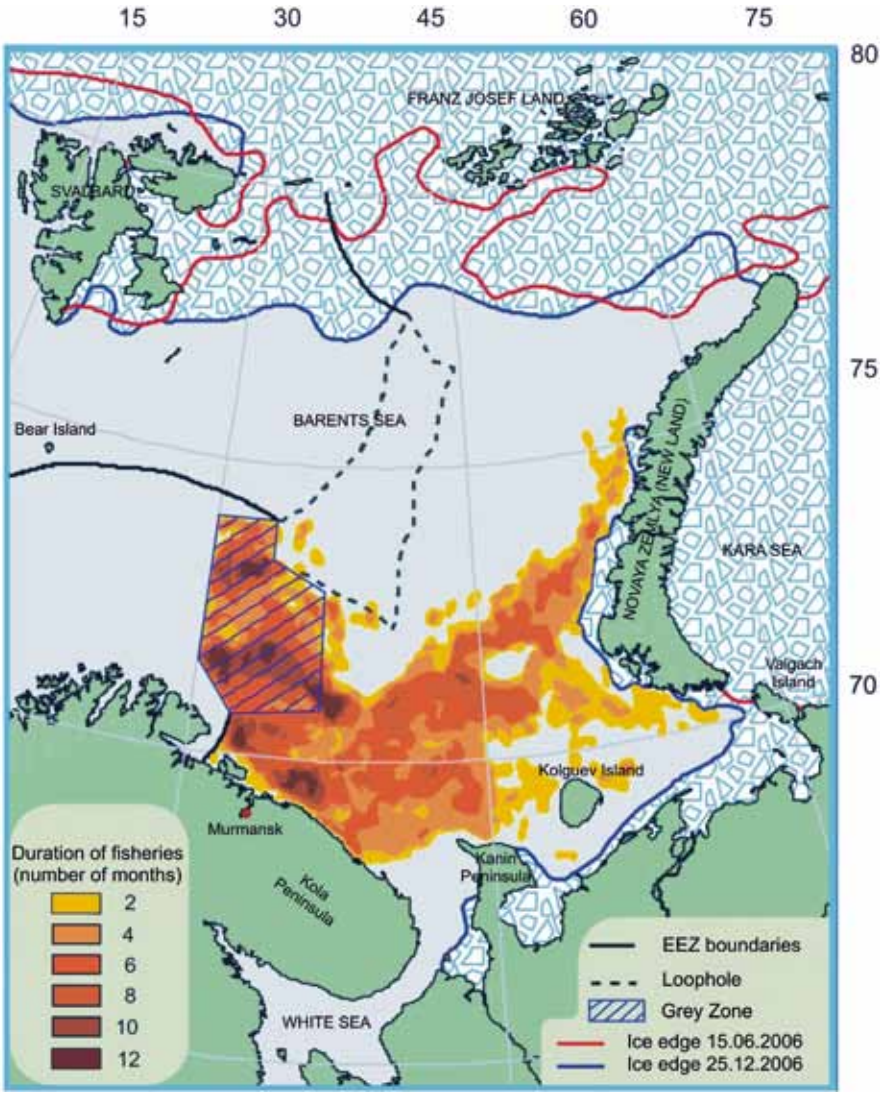

Figure 3.3: Fisheries in the Barents Sea in 2006 (according to remote sensing of fishing vessels) (source: The Natsrybresursy Company)

Management of biological resources in the Barents Sea is executed on the basis of the 1975 Inter-government Agreement on Cooperation on Fisheries between the former USSR and Norway. This agreement is executed through decisions of the Joint Norwegian-Russian Fisheries Commission. The main instrument of fisheries regulation is the allocation of annual TACs for each stock. This measure is based on estimates of commercial stocks conducted by scientists of the two countries within joint and national research programs. Besides, the Joint Norwegian-Russian Fisheries Commission uses such important instruments as introduction of a strictly limited catch for many fisheries by allocating national quotas, introduction of a minimum fish size for some fisheries, and a range of scientifically-induced restrictions for use of this or that fishing gear (territorial bans, mesh sizes, etc).

An important role in conservation of stocks and sustainable management of marine fish resources is still played by such international organizations as the International Council on Exploration of the Sea and some other. Despite that their decisions are of advice character, coastal states try to comply with them.

Nowadays there is need to introduce new methods of fisheries management, such as precautionary approach for TAC allocation, balance ecosystem-based fisheries, etc. Under conditions of decreased stocks, inconsistency of adherence to single-species cod fisheries becomes obvious. Over the last years the shrimp fishery has been increased in the

region first of all by Norway. Russia and Norway started commercial fishery for the red king crab acclimatized in the Barents Sea. At the same time Russian and Norwegian approaches to the red king crab fishery differ. Russia sets quotas for its red king crab fisheries while Norway does not. This depends on attitudes of both countries to this introduced species. Norway tries to overfish it following the provisions of the Convention on Conservation of Biodiversity. Russia considers the red king crab a valuable commercial resource which exploitation should be regulated without undermining the ability of the population to reproduce itself.

Development of fisheries in the region in the following years will be characterized by: a) fluctuations of stocks of the most common commercial species due to climate change; b) regulation of fisheries in high seas and introduction of international control of fisheries; c) increased development of aquaculture and fish farms in coastal zones and in EEZs.

Development of offshore oil and gas production will be a serious challenge to Barents Sea fisheries. In view of vulnerability of marine ecosystems, there is a need for a new nature conservation strategy based on assessment of contaminant impacts on the primary production, vital functions of marine living organisms, and commercial stocks and their reproduction capability. Special attention should be paid to development of the EIA procedure for oil and gas projects.

Future offshore oil and gas production activities may cause certain damage to marine fisheries. To compensate this damage there is a need to reproduce commercially valuable fish species and enlarge the network of marine protected zones. The volume of these measures should correlate with the scale of development of oil and gas production in the Russian economic zone.

4. Administrative division and legislation established

According to the Constitution adopted in December 1993, the Russian state (Russian Federation, or Russia) consists of subjects of federation recognized as equal in rights in mutual relations with federal government agencies, and independent in issues of their own competence. Nowadays there is a clear tendency towards integration of federal subjects when subjects having small population merge with larger ones. At present the Russian Federation consists of 83 subjects, 21 of which have direct access to the sea.

In 2000 the Decree of the President of the Russian Federation introduced the division of the country into seven federal districts in which presidential plenipotentiaries provide constitutional powers of the head of the state in the territory of the appropriate district. Each federal district includes a group of subjects of federation. Out of seven federal districts, five have access to sea, with three of them basically consisting of coastal subjects of federation, which play a leading role.

The new internal state structure of the Russian Federation is characterized by a high degree of independence of the subjects of federation. At the same time, some current coastal subjects of federation (autonomous districts on the north and northeast coasts of the country) do not appear to be ready to assume their status and executive duties of state functions because, before the Constitution of 1993 was adopted, they had been components of larger administrative-territorial units. Clause 2 of article 11 of the Constitution of the Russian Federation gives subjects of federation the right to form bodies of state power. Article 77 of the Constitution says that the system of bodies of state power of subjects of federation is established independently, including the provision that federal executive authorities and executive authorities of subjects of federation form a unified system of executive power.

These changes to the state system do not provide for unified implementation of the specific issues connected to management of the marine activity, which are referred to in the competences of the Russian Federation in its subjects of federation. In addition to the new federal structure, municipal governments were introduced throughout the Russian Federation. At the same time, article 12 of the Constitution of the Russian Federation says, “institutions of municipal government are not included into the system of state power”.

Article 8 of the Russian Constitution and federal legislation have established high levels of independence for municipal government institutions and provided them with a large number of rights and duties. Formation of municipal governments on this new basis has changed relations between the authorities of coastal subjects of federation and authorities of the coastal municipalities. These relations have not been fully defined. Regarding finances, the dependence of local governments on regional institutions, and through them on federal executive authorities, has not only been maintained but conditions of economic recession frequently exacerbated it. At the same time, there is no clear definition of the new order and rules of participation for coastal local government institutions in implementing maritime activity and national marine policy. As a result, in the Russian Federation there is a governing system based on three authority levels – federal, regional, and local. The relationship between these levels concerning marine activity problems in many respects remains uncertain.

Currently, according to Russian legislation, the legal status of sea expanses is established on a new approach basis. Clause 1 of article 67 of the Constitution of the Russian Federation states that the territory of the Russian Federation includes the territories of its subjects, internal waters, and the territorial sea and air space above them. This implies that internal maritime waters and the territorial sea are not part of territories of subjects of the Russian Federation. Clause 2 of article 67 says: “The Russian Federation has sovereign rights and carries out jurisdiction over the continental shelf and in the exclusive economic zone of the Russian Federation in the order determined by the federal law and international law regulations” (not by regional laws). Simultaneously, according to clause “m” of article 71 of the Constitution of the Russian Federation, the definition of the status of the territorial sea, EEZ and the continental shelf is also referred to the exclusive competence of the Russian Federation. These positions make it difficult to actively engage subjects of federation in implementing national marine policy and developing marine activity [8].

In the field of joint competence of the Russian Federation and its subjects there is no direct mention concerning marine matters either. It is necessary to note that clause “c” of article 72 of the Constitution of the Russian Federation specifies that “water resources” are a joint competence of the Russian Federation and its subjects. However, internal maritime waters and the territorial sea are declared in the Water Code of the Russian Federation to be federal property (article 8). At the same time, the operational regulation specifies in article 26 of the Water Code that management of the federal property on water bodies is to be carried out by the Government of the Russian Federation. Part of responsibilities for the management of federal property on water bodies, according to the Constitution of the Russian Federation and the Water Code, can be transferred by the Government of the Russian Federation to interested federal executive agencies and executive agencies of subjects of the federation. Under current legislation, subjects of the Russian Federation do not have regulating power in the sphere of marine activity, although they can (in some cases) participate in management of water bodies.

As already noted, definition of the status of the internal maritime waters, the territorial sea and the continental shelf according to the Constitution of the Russian Federation, is referred to the exclusive competence of the Russian Federation. The status of the specified sea expanses is determined in accordance with the international law and regulated by federal acts “On the Continental Shelf of the Russian Federation” (1995), “On the Internal Maritime Waters, Territorial Sea and Contiguous Zone of the Russian Federation” (1998), and “On the Exclusive Economic Zone of the Russian Federation” (1998). The establishment of such a detailed legal regime by means of federal laws and other legislative acts does not mean, however, exclude participation by coastal subjects of the Russian Federation in implementing of federal power on preservation, and use and management of marine resources and expanses. According to the Constitution, federal executive authorities have the right to establish such regimes for those sea expanses that provide an optimum level of competences of coastal subjects of the Russian Federation in the designated area. However, in the enacting legislation, these opportunities have not been realized [8].

Thus, changes to the internal administrative and territorial division at all levels are of an extremely deep and qualitative character. The

system of state power and management already has been created. It is provided with several legal regulatory acts, however, the process of reform is not complete. The changed state system, system of authority and management, as well as a multitude of conceptual documents, legislative and statutory acts, are not cohesive and require additional work. The reform of administrative-territorial division of the Russian Federation requires preparatory and implementation efforts.

Marine Doctrine

The Marine Doctrine of the Russian Federation for the period to 2020 [10], authorized by the President of the Russian Federation (27 July 2001), reveals the essence, content and method of implementing a national marine policy (Fig. 4.1) which is a major component of state policy of the Russian Federation. The Doctrine sets out a set of concepts necessary for resolving practical tasks in the World Ocean (Fig. 4.2). Russian national marine policy is carried out under two broad categories:

- Functional: examining types of marine activity (transport, fishing, naval, etc.) depending on Russia's economic opportunities and the role of Russia in international relations;
- Regional: taking into account Russia's position on the globe, as well as geographical and other features of its regions.

The Marine Doctrine of the Russian Federation provides criteria for evaluation of the national marine policy: an opportunity to implement the national marine policy's short-term and long-term tasks; a degree of realization of sovereign rights in the EEZ, over the continental shelf, and also high seas freedoms for merchant, fishing, research and other Russian specialized fleets; the ability of Russian maritime military component to protect territory from marine threats and state interests in the World Ocean.

Russia determined its national interests in the World Ocean and declared them in the Marine Doctrine. According to this document, the national interests of the Russian Federation in the World Ocean are:

- inviolability of Russia's sovereignty beyond its land territory to its internal maritime waters, the territorial sea, as well as to the air space over them, to the seabed and subsoil;
- safeguarding sovereign rights and jurisdiction of the Russian Federation in the EEZ and over the continental shelf, i.e., exploration, exploitation and conservation of natural resources (both living and non-living resources located on the seabed, in its subsoil and the waters superjacent to the seabed), as well as management of these resources; generation of energy from water, currents and winds; creation and use of artificial islands, construction and structures; marine scientific research; and protection and conservation of the marine environment;
- realization of the high seas freedoms in the interest of the Russian Federation including freedom of navigation, overflight, to laying submarine cables and pipelines, fishing and scientific research;
- protection of human life at the sea, prevention of marine environmental pollution, maintenance of the control over vital sea communications, creation of the conditions promoting benefits from marine economic activities to the population of the Russian Federation, especially its coastal regions, and also to the state as a whole.

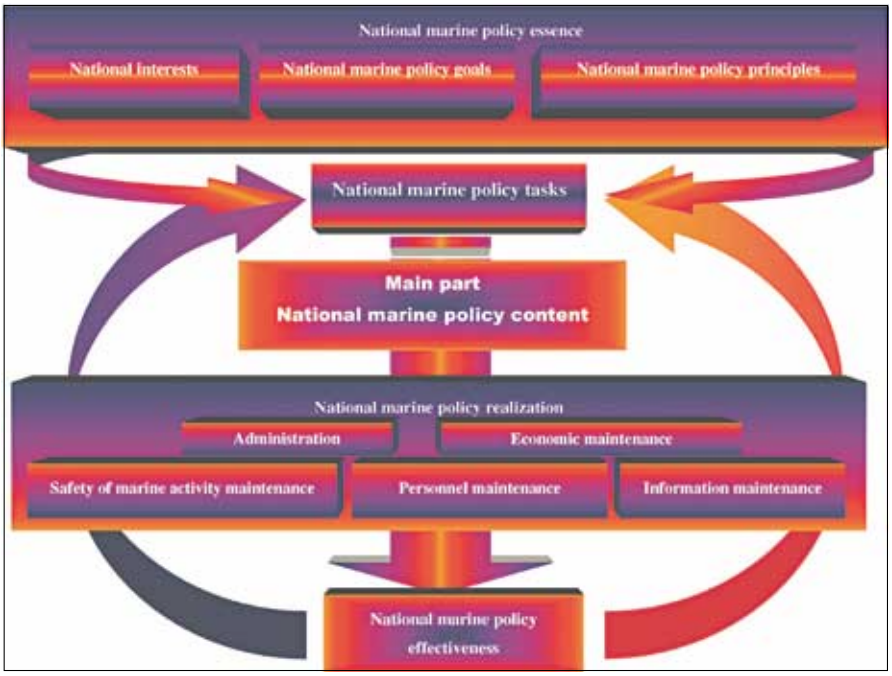

Figure 4.1: Block diagram of the Marine Doctrine of the Russian Federation [8]

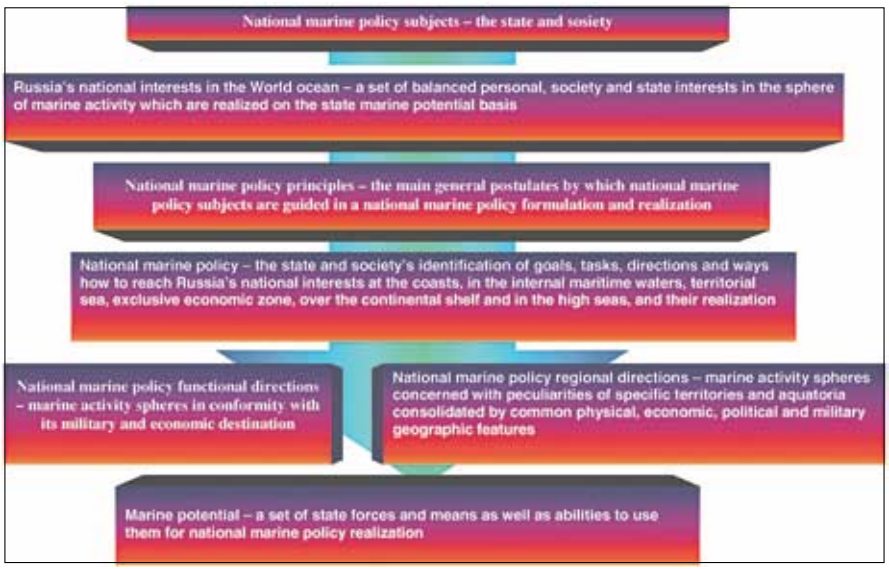

Figure 4.2: Development of marine activity conceptual definitions [8]

Thus, the purposes of the national marine policy of the Russian Federation are ensuring and protecting state sovereignty, sovereign rights, and freedoms of the high seas in the World Ocean.

The Marine Doctrine of the Russian Federation stipulates that subjects of national marine policy are the state and society. The state implements national marine policy through the bodies of state power of the Russian Federation and the subjects of the Russian Federation. Society participates in the formation and implementation of national marine policy through federal and regional representative bodies, institutions of local government and public associations working under the jurisdiction of the Constitution and the legislation of the Russian Federation.

The following are the basic activities of the national marine policy actors:

- comprehensive identification of priori ties of the national marine policy on near and long-term prospects;

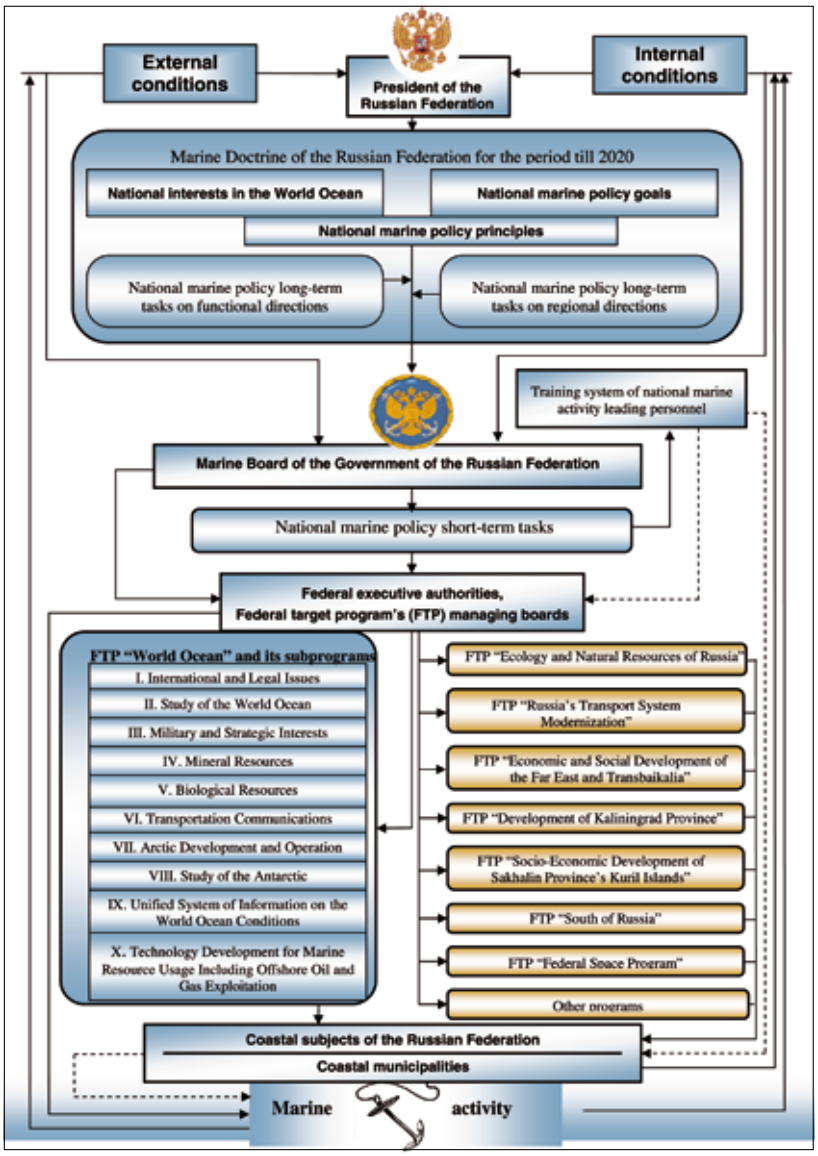

Figure 4.3: National marine policy realization scheme [8]

- continuous upgrading of the contents of national marine activity;
- management of the components of the state marine potential, branches of the economy and science related to maritime activity;
- creation of a favorable legal regime;
- economic, information, scientific, personnel another ensuring the national marine policy;
- evaluation of the efficiency of national marine policy and its subsequent updating.

The subjects of the national marine policy are guided by the principles of national marine policy formulated in the Marine Doctrine. These principles are common for both functional and regional category of national marine policy (Fig. 4.3).

The Marine Doctrine also implies coordination of efforts of the federal government and regional governments in defining priority objections and substance of the national maritime policy for short-term and long-range outlook, and in management of the constituents of the maritime potential of Russia, economy and science branches connected with maritime economic activities, and in planning of maritime economic activities and construction of the Russian fleet.

5. Institutions and Policy

The prerogative of defining priority objections and the substance of the national maritime policy belongs to the President of the Russian Federation. Besides, the President, according to the Constitution, undertakes measures to secure the sovereignty of the Russian Federation in the World Ocean, to protect and secure the interests of a person, society and the state in the field of maritime affairs. The President also provides guidance of the national oceans policy. The Security Council of the Russian Federation as a constitutional body attached to the President of the Russian Federation reveals threats, determines vitally important demands of the society and the state, and works out major directions of the safety strategy of Russia in the World Ocean.

Issues of national marine policy can be also considered at the sessions of the State Council of the Russian Federation, a deliberative body headed by the President of the Russian Federation that was created according to Presidential decree. It aims to sustain and use the potential of the regional supreme officials. Issues of marine activity are also supervised by the President's plenipotentiaries in federal districts of the Russian Federation, who can present their proposals in the field of marine policy.

The system of long-term decision-making along with the legislative and normative base together ensure that a sound state marine policy has been developed in the Russian Federation and that it continues to be improved. Its conceptual bases have been developed according to the 1982 UN Convention on the Law of the Sea (UNCLOS), which Russia ratified in 1997 as part of the Russian Federation's participation in activity of other international maritime institutions, treaties, and agreements and assumes appropriate national legislation development.

The Federal Assembly of the Russian Federation (the Parliament) within the frames of its constitutional authority does legislative business to ensure the execution of the national marine policy. For these purposes to be achieved, the Commission on the National Ocean Policy was established in 2004 within the Federation Council (the upper chamber of the Parliament). The main tasks of the Commission are the following: monitoring of legislation in the filed of the maritime affairs, elaboration of proposals for projects of federal acts for the Federation Council aimed at increasing the effectiveness of maritime economic activities, interaction with federal bodies of the executive power involved in maritime affairs.
Draft laws go to the State Duma where they are examined by appropriate committees and commissions, or are elaborated on by them. Afterwards draft laws have to be affirmed at plenary sessions. Draft

Table 5.1: Documents determining national marine policy conceptual basis [8]

Spheres of national interests	Military	Frontier	Economic
Doctrinal level	Constitution of the Russian Federation (dated 12.12.1993)		
	National Security Concept of the Russian Federation (dated 10.01.2000)		
	Foreign Policy Concept of the Russian Federation (dated 11.07.2000)		
	Military Doctrine of the Russian Federation (dated 21.04.2000)		The Russian Federation State Strategy of Economic Security (dated 29.04.1996); Draft Program of Medium-Term Social-Economic Development of the Russian Federation (2005-2008) (submitted to the Russian Federation Government 01.06.2005)
World ocean	Marine Doctrine of the Russian Federation for the Period till 2020 (dated 27.07.2001)		
	Naval activity		Sea shipping; Marine natural resources development
	The Russian Federation's Policy Principles in the Naval Activity Sphere for the Period till 2020 (dated 04.03.2000)	Concept of Protection of the Russian Federation State Border, of Internal Maritime Waters, Territorial Sea, Continental Shelf, Exclusive Economic Zone of the Russian Federation and Their Natural Resources for 2001-2005 (dated 01.09.2001)	Navigable Policy Concept of the Russian Federation (dated 22.07.2000); The Russian Federation Internal Water Transportation Development Concept (dated 03.06.2003); Fisheries Economy Development Concept of the Russian Federation for the Period till 2020 (dated 02.09.2003); Energy Strategy of Russia for the Period till 2020 (dated 28.08.2003)
	Federal Target Program (FTP) "World Ocean" Realization Concept (dated 17.01.1997)		
	FTP "World Ocean" (1998-2012) (dated 10.08.1998)		
Other kinds of activity connected to use of the World ocean resources and resources			
Air	Bases of the Russian Federation Policy in the Field of Aviation Activity for the Period till 2010 (dated 03.02.2001)		
Space	Bases of the Russian Federation Policy in the Field of Space Activity for the Period till 2010 (dated 06.02.2001)		

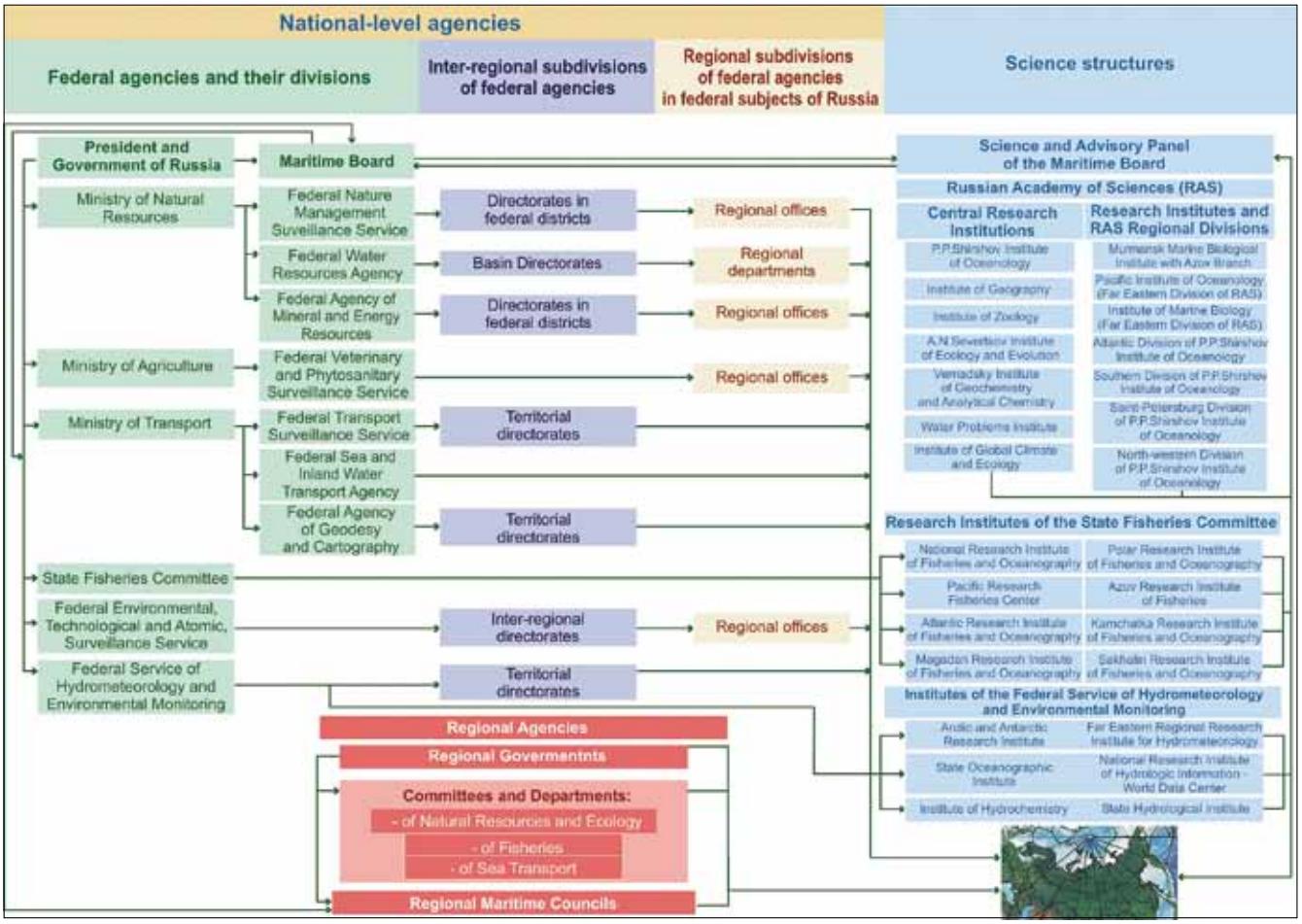

Figure 5.1: Scheme of management of civilian maritime activity in Russia [11]

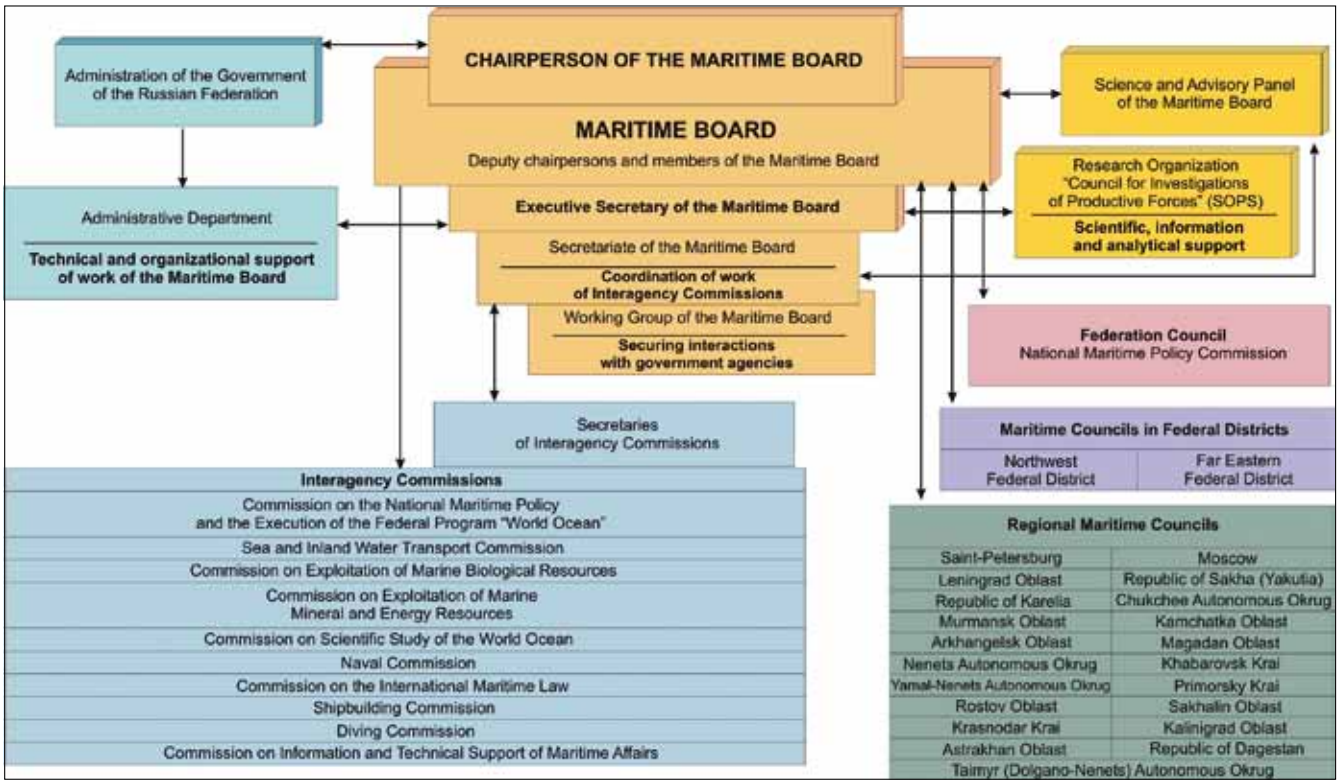

Figure 5.2: Scheme of Marine Board's activity and its interaction with federal legislative and provincial authorities [12]

laws accepted by the State Duma go on for approval to the Council of Federation. In cases of disagreement, conciliation commissions are created. When a draft law is approved in the upper chamber of parliament, it goes to the President of the Russian Federation for signature. The Marine Doctrine lays out the basis of the national marine policy.

At the same time, a system of basic documents outlining the contents of Russia's marine policy has been developed (Table 5.1), which is however being constantly improved.

Provisions stipulated by federal laws and other directive documents

are formalized by the normative legal acts developed and accepted by the Government of the Russian Federation, as well as the appropriate federal executive authorities.

Nowadays the oceans management in Russia involves around 10 federal ministries and agencies as well as regional governments of coastal regions (Figure 5.1). The exploitation of marine living resources is regulated by the Federal Agency of Fisheries. Navigation in the Arctic is regulated by the Ministry of Transport. The Ministry of Natural Resources and Ecology regulates prospecting and exploration and the Ministry of Energy - extraction of mineral resources on shelf and in coastal areas. Protection of marine environment and ecosystems is regulated by the Federal Nature Management Surveillance Service which is under the jurisdiction of the Ministry of Natural Resources and Ecology.

Marine Board

The Marine Board of the Government of the Russian Federation, headed by the Deputy Chairman of the Government of the Russian Federation (the Deputy Prime Minister), is a permanent coordinating body, which brings together the actions of federal executive agencies, regional executive agencies and the organizations engaged in marine activity of the Russian Federation, for the purpose of implementing Russia's marine policy. The Marine Board has become the main body responsible for formulation of short-term and current tasks (Fig. 5.2).

The Marine Board members are heads of federal executive agencies, regional executive agencies, scientific and other organizations that study, develop and use the World Ocean. The membership of the Marine Board is approved by the Government of the Russian Federation. Representatives of interested government bodies, federal executive agencies, regional executive authorities, state institutions, as well as scientists and experts on marine matters mentioned above take part in Marine Board sessions. With the Marine Board chairman's approval, representatives from NGOs, commercial entities and mass media can be invited to the Board's sessions. Marine Board activity was initially focused on the creation of conditions for decisions by the Russian Government, federal and regional executive authorities on tasks of protection and realization of sovereign rights and meeting obligations to the world community accepted by the Russian Federation in internal maritime waters, the territorial sea, the EEZ, over the continental shelf, the high seas, in Arctic and Antarctic regions, as well as on increased maritime activity efficiency and maintaining military-political stability, national security and neutralize maritime threats and strengthening the international authority of the Russian Federation.

The experience gained suggests that this coordination body is the major practical guide to marine activity in the Russian Federation. It carries out preparatory and scientific, political and economic recommendations for adjusting and implementing the marine policy of the state. The Marine Board has intensified its work over the last years. Its structure has been improved and new bodies have been established within the Board including interagency commissions, the Secretariat, the Science and Advisory Panel.

The aim of establishing interagency commissions was to intensify the work of the Marine Board and to form workable bodies within the ministries. That was hard work but now the process has been almost completed. At present the Marine Board includes several interagency commissions: Commission on the National Maritime Policy and the Execution of the Federal Program "World Ocean"; Sea and Inland Water Transport Commission; Commission on Exploitation of Marine Biological Resources; Commission on Exploitation of Marine Mineral and Energy Resources; Commission on Scientific Study of the World Ocean; Naval Commission; Commission on the International Maritime Law; Shipbuilding Commission; Diving Commission; Commission on Information and Technical Support of Maritime Affairs.

Over the last few years the Marine Board has managed to resolve one of the major problems – to establish connections with federal districts and federal governments of the Russian Federation. Such connections are exercised through special coordinating advisory bodies – regional maritime councils. In the Russian Arctic these are Government Maritime Council of Murmansk Oblast, Government Maritime Council of Arkhangelsk Oblast, President's Maritime Council of the Republic of Karelia, Government Maritime Council of Yamal-Nenets Autonomous Okrug, President's Maritime Council of the Republic of Sakha (Yakutia), and Government Maritime Council of Chukchee Autonomous Okrug.

Interactions with regional maritime councils, which include representatives of local governments (local coastal communities), allow taking into account demands and peculiarities of coastal regions. Initiatives of these regional councils would contribute to solution of burning socio-economic problems of coastal communities.

Advisory bodies on marine activity have been established in Moscow and in two federal districts. Interactions with these advisory bodies will allow executing Russia's ocean policy more efficiently.

Thus, established for the first time in Russia, the effective mechanism of coordination of actions of all the actors involved in maritime affairs integrates efforts of these actors in execution of provisions of the Marine Doctrine at all major directions of work of the Government of Russia. This mechanism is aimed at making prospective strategic decisions of Russia on exploration of resources and expanses of the World Ocean for national purposes.

World Ocean Program

The necessity of overcoming the negative consequences of maritime economic liberalization and uncontrolled privatization of the maritime economy basic production assets was evident in the mid-1990s. It was clear that Russia's participation in developing resources and expanses of the World Ocean was closely connected to improving management, including state regulation, together with purposeful scientific and technical development of marine activity in the country. For these purposes, Russia launched the federal target program (FTP) "World Ocean", approved by the Act of the Government of the Russian Federation of 10 August 1998, No 919. The concept of the program was approved by the Decree of the President of the Russian Federation in January 1997. Over forty federal and provincial executive agencies and a dozen of research organizations took part in the development of this program.

Adoption of the World Ocean Program at the nation-wide level was aimed at changing the existing narrowly-focused sectoral and local-provincial approaches to conducting marine activity that were realized through several dozens of state programs with branch or regional orientation. Since 1998, the World Ocean Program has become the basis of a nation-wide system of regulation and management of Russia's marine activity aimed at its integration and increased effectiveness (for more details, see [8]).

Unfortunately from the very beginning the World Ocean Program did not cover all the problems of maritime affairs listed in its conception which was approved by the President's decree. Moreover, the Program skipped complicated and the most critical problems of the regional development. The program does not reflect the problems of development of external economic and scientific links with foreign countries and personnel training. However, in 2007 on request from the Federal Agency of Science and Innovation, Murmansk Marine Biological Institute carried out a project called "Developing integrated methods of oceans and coastal zone management in arctic and southern seas of Russia", which testifies a slow increase of attention to this problem in the Government of Russia.

Scantiness of financial recources, week involvement of subjects of Federation in program implementation, underestimation of the importance of integrated approaches to the problems solution have resulted in stopping the realization of half of the subprograms (6 of 12) which Federal Target Program World Ocean consisted of, and the program has lost its leading and coordinating role in marine activity development, solving some important, but individual tasks. On the other hand, its Arctic Subprogram has received new, financial and content, impulse since 2008, aimed at the business activity and infrastructure development, as well as coordination in the Arctic.

Integrated approaches to marine management

Integrated approaches to marine management have been developing for the last 25 years. These are the Integrated Coastal and Oceans Management (ICOM) and the Ecosystem Based Ocean Management (EBOM) appeared later. The two approaches are closely connected with each other since the ICOM cannot be effective without identification of ecosystems as a whole including the human factor while the EBOM obviously implies an integrated approach to the ecosystems identified.

The EBOM approach continues developing and is widely recognized throughout the world as a concept used in global, national, and regional research, management (first of all in fisheries), and nature conservation programs and documents. However, compared to the ICOM approach, it yet has not been widely introduced into a real practice of the coastal management since it still lacks carefully worked out instruments for dealing with inter-sectoral problems and an institutional potential to be realized in practice. The last Global Conference on Oceans, Coasts and Islands (Hanoi, 2008) comprehensively considered both approaches and recommended to incorporate ICOM into EBOM and vice versa [13].

Adaptation and introduction of modern management practices (ICZM methodology) into the coastal and marine management in Russia started in the mid 1990s. At the federal level that was done through federal marine research programs and then since 2000 through the Federal Target Program World Ocean (with the Ministry of Economic Development of the Russian Federation as a state customer and coordinator). At the regional level that was mainly initiated by international projects and programs (e.g. the Black Sea and the Caspian Environmental programs).

Over the last years the following have been done [7, 14-16, and some others]:

- assessments of Russia's coastal resource potential and situation in its use;
- study of international experience in development and realization of national and local ICZM programs;
- a series of conceptual and methodological papers on the ICZM has been worked out and published;
- the ICZM curriculum has been drawn up and teaching students ICZM in the national higher school system has started;
- an article-by-article structure of several versions of federal draft law on ICZM has been worked out;
- first steps towards introducing ICZM principles and approaches into the process of elaboration of local programs for coastal development and use of coastal resources have been made by means of coordination of efforts of federal and international projects.

Working out requirements to the development of the ICZM system of the Murmansk Province and its initialization for Kandalaksha Bay (White Sea) at the local government level are the most successful examples made to introduce ICZM approaches on-the-ground in the Russian Arctic. The steps that have already been done for the latter include the elaboration of the Strategic Kandalaksha Bay ICZM Development Plan, substantiation of organization structure of an ICZM system for the local level, formulation of an action plan to develop a coastal zone management system at the local level [17].

Success and problems in the ICZM development in Russia raised understanding of the necessity to arrange a meeting that could gather together all the specialists involved with an aim of exchanging experience, consolidating efforts, discussing problems with leading foreign experts, and attracting attention, first of all of managers, to the importance of improving this sphere. In view of this, the first and yet the only specialized international conference on ICZM "Integrated Coastal Zone Management and its Integration with Marine Sciences" (130 participants from 20 countries) was held in 2000 in St. Petersburg.

In the course of detailed discussion of issues relating to the development and scientific support of the ICZM in countries with transition economies, the Conference confirmed the importance of efforts in this direction. It also helped identify problems hampering the ICZM development in these countries, work out recommendations for further actions including those at the international level, emphasize a special importance of administrative, economic and scientific circles of these countries being familiar with global practice of the development and execution of ICZM approaches and programs and the role of marine sciences in this.

During the last years ICZM problems in Russia are discussed at the special section of annual fora of strategic planning leaders held in Saint Petersburg by the International Centre for Social and Economic Research – Leontief Centre.

6. Towards ecosystem-based oceans management: disadvantages, challenges and future outlook

Summing up some general results of the ocean and coastal management in Russia it is important to mention the following: a) real introduction of ICZM approaches is a very hard task and will take many years, b) the essence of these approaches and instruments used by this methodology must be really understood, c) it is important that introduction of ICZM methods into management practices would be executed both downwards (from the federal level) and upwards (from the local level) with the unity of approaches used; d) the process of implementation must include all the ICZM instruments and procedures.

Despite that the ICZM realization in Russia was implied by the World Ocean Program Concept adopted by the Russian Federation President's Decree, these approaches still have not been adopted or remain unknown in administrative circles at all levels and other potentially concerned entities (e.g., business, local population, NGOs) which participation in the decision-making process is of critical importance. This is an objective proof of the fact that Russia, rapidly entered market economy, does not pay sufficient attention to assimilation of the modern managerial practice that has proved its efficiency in marine natural resource use. At the same time, the thesis on necessity for ICZM development and realization at a state level is especially topical in the country, since, on the one hand, the institutional and legal tools that have not existed before should be built anew, and on the other hand, there widely remain traditional expectations and habits of relying on the decisive role of the State.

Despite the existence of "points of growth" along the country's coasts (north, south, west, east) it is still hard for ICZM "to make its way" in real life in a market economy still being shaped. Subjective factor still plays a substantial role and application of the sustainable development approaches to the country's coasts still depends, first, on social responsibility and motivation of key executives on provincial and local levels, That is a direct consequence of a present level of economy and democracy development in Russia [7].

Present legislative and regulative basis in the maritime activity can also hardly contribute to development of modern ocean and coastal management technologies [18]:

1) Thus, in modern conceptual documents devoted to political and socio-economic development of democracies with market economy it is common, including in Russia, to identify three key acting subjects: state, society and business. Unfortunately, Russia's Marine Doctrine recognizes only state and society as subjects of the national marine policy excluding business with all consequences that it implies, which is of course does not meet the reality. Such an approach was presented also at the first discussion of the Draft Russia's Maritime Activity Development Strategy for the period until 2020 and further on.

2) For a range of objective and subjective reasons, the priority in the text of the Marine Doctrine was given to issues relating to the provision of national security of Russia (protection, preservation and ensuring of the sovereignty and sovereign rights of Russia in the World Ocean). In four paragraphs of the Doctrine describing Russia's national interests in the World Ocean, questions of maritime economic activity are mentioned only at the very end of the last fourth paragraph after the questions of control of communication functioning, prevention of marine environment contamination, and protection of man's life

at sea. The same way of formulation was chosen for major purposes of the national ocean policy as well.

The documents of such kind as the Marine Doctrine defining general ways of development of maritime activity, complex by nature, should clearly pronounce the priority of development of the economy and improvement of the quality of life. The Marine Doctrine should formulate a new, comprehensive and coordinated national marine policy, aimed at sound management of marine and coastal resources, development of maritime economy, stimulation of investments into maritime branches, protection of life and property, prevention of contamination, protection of marine environment, development of knowledge on environment, close cooperation of authorities and business for successful development of marine and coastal activities of Russia.

3) It is believed that the codification of norms of the Russian marine legislation could contribute to creation of internally consistent and integral maritime activity's legislative basis corresponding to modern state of country's economy as well as the best foreign experience, and to performance of measures to divide functions of state regulation and economic management of maritime activities. The following key provisions increasing effectiveness of Russia's maritime activities would be optimal to introduce into federal law:

- Application of integrated approach to planning and managing the maritime activity;

Nowadays Russia's maritime activity is regulated on the basis of a departmental (sectoral) approach and the use of different resources is regulated by different legislative acts. Such a management system entails numerous conflicts of interests between maritime economic activities, does not contain mechanisms to resolve them and is poorly environmentally-oriented.

- Mechanism for participation of subjects of Federation in clear and sound allocation of power between the federal government and provinces in the ocean management and use of marine and costal resources in the frames of defining the status of the territorial sea, national exclusive economic zone and continental shelf of Russia.

In other words, mechanisms (legislative, economic and institutional) to support the activity of regional and local authorities in developing coastal and marine resources are needed.

- Major principles of the national maritime policy such as ecosystem-based approach, adaptive management, participa tory process, application of the best existing scientific and technology knowledge, precautionary approach, preventive measures, conservation of biodiversity, etc.

These principles have been worked out and laid down into national legislation of leading maritime nations and the international maritime law. Some of these principles are included into the national legislation of Russia, for example into the Federal Act on the Protection of the Environment or into international conventions of which Russia is a signatory-state, for example the Convention on Biological Diversity. However these principles are not considered by maritime directive documents including the Marine Doctrine.

- Practice of development and realization of ICZM programs in the frames of complex programs of socio-economic development of Russia's coastal provinces and programs of coastal local communities development as an economic and legislative instrument of inter-sectoral coordination of different conflicting interests between coastal and marine resource users first of all in a territorial and spatial aspect.

There is a need for unified state management of coastal zones of Russia (including their both components: land and sea) based on global successful experience and recommendations of UN organizations and international fora.

- Effective and understandable mechanism of revealing and resolving contradictions, first of all between the federal government, provincial governments and local communities.
- Mechanism of regular system assessments (at different levels) of the effectiveness of marine management and monitoring of the effectiveness of the coastal area development program's execution.

In view of this, in 2005, on request from the Marine Board, the Ministry of Economic Development of the Russian Federation prepared a draft concept of a legislative act on the state management of maritime activities.

Generally speaking of improving management over Russia's marine activity at the present stage, it is believed that major tasks in this direction should be the following [19]:

- Specification and more precise definition of the Marine Doctrine provisions (preparation of its new corrected version based on eight years experience of its being in force) and its adoption by the President's decree;
- Elaboration of a draft federal legislative act on issues of state management of maritime activities and the inclusion of major definitions of the Marine Doctrine and provisions described above into it;
- A full inventory of maritime economic activities similar to that in leading maritime nations and on the similar methodological basis;
- Forming the package of national, subnational, provincial and local priorities for the development of maritime economic activities, based on provisions of the Marine Doctrine, system analysis of the inventory results, and major global trends in studying and utilizing the World Ocean's resources, which are formulated in documents of late international maritime fora. All stakeholders should be involved in this process;
- Elaboration of the Strategy of Russia's Maritime Activity Development on the basis of the abovementioned priorities (which should not be just a combined list of sectoral measures) and the Integrated Plan for implementing this strategy.

Based on a commonly recognized consecution "concept (doctrine) → strategy → program", it should be particularly mentioned that the elaboration and adoption of a new corrected version of the Marine Doctrine should precede the forming of the Strategy;

- Adaptation and mastering modern management technologies (ICOM, EBOM) in Russia's coastal zone management practices. At the same time developing and implementing both sectoral strategies and ICZM programs for definite coastal zones would become an effective instrument of harmonizing and realizing priorities identified;
- Forming a system of program measures of the Federal World Ocean Program in accordance with the Strategy of Russia's Maritime Activity Development;
- Increase the role of Russia in formulation and execution of international maritime policy.

Use of modern marine management models in coastal zones of Russia will provide for additional economic growth, competitive capacity, investment attractiveness, employment, and quality of life in the coastal provinces of the country, and will contribute to environmental protection and decrease damage from natural and man-caused disasters, and strengthen the safety of Russia. Besides, it may prevent further "creeping" privatization of Russia's coasts.

It is believed that, at the suggestion of the Ministry of Economic Development, modern integrated ecosystem-based ocean management approaches will be employed in the development of Russia's Government Arctic Policy Principles. The importance of these approaches is also increasingly recognized by provincial governments. Thus in May 2007 in Murmansk at the joint session of the State Council and the Marine Board hold by President Putin, the governor of Murmansk Province Evdokimov said that "as far as we can see from

our place, each issue is treated separately and independently of others: development of shelf deposits is one thing, the Northern Sea Route is another one, and transport communications are a third one. No coordination exists between them".

The work on forming ecosystem-oriented mentality in ocean and coastal policy and management is done through research projects and publications. Thus, in 2007 on request from the Federal Agency of Science and Innovation, Murmansk Marine Biological Institute carried out a project called "Developing integrated technologies for ocean and coastal zone management in arctic and southern seas of Russia", which testifies a slow increase of attention to this problem in the Government of Russia.

7. Conclusions

In Russia, as in the whole world, the last decades is characterized by an increase in attention to marine activity and improvement of its management. It can be noted that the basic parameters of national marine policy were formulated in the Russian Federation with the approval of the Marine Doctrine. The system of executive decision-making, which is necessary for implementation of a sound marine policy, has been developed through the creation of the Marine Board and continues to be improved. The Federal Target Program "World Ocean" is currently one of the mechanisms of implementing these decisions.

However, the aforementioned growth of activity has not yet transformed into success in realizing modern integral approaches including Ecosystem Based Ocean Management, neither in the national marine policy nor in coastal and marine activity management practices. These approaches have yet been applied neither in directive maritime documents not in developing marine management infrastructure.

It's obvious that Russia has just started its way towards the Ecosystem Based Ocean Management. It is the very stage when the idea has not yet been generally accepted by the society, first of all by administrative circles, and is just expected to be. The need for integrated approaches to marine activity management at all levels should be clearly stated by the federal legislation, taking into account that regional and local authorities do not fully recognize the importance of integrated approaches and are not fully able to apply them and that unstable socio-economic situation in some regions and local communities put aside the solution of ecological problems.

No doubt that employment of world-acknowledged integrated approaches in ocean and coastal management practices in Russia would help increase their effectiveness, stimulate comprehensive development of Russia's maritime economic sector, and contribute to improvement of the state of marine environment.

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REPORT SERIES NO 129

Finland

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1. Introduction

Finland has no truly Arctic waters, meaning marine waters that are geographically located in the Arctic area. However, Finland is surrounded by the Baltic Sea, which is a temperate, brackish-water sea basin sharing many characteristics and anthropogenic pressures with the Arctic Ocean. Among them are coldness and annual ice cover, low biological diversity and relatively simple food webs which lead to vulnerability to pollution and overexploitation. The Baltic Sea area is entirely covered by territorial waters and exclusive economic zones of the nine coastal states (Denmark, Estonia, Finland, Germany, Latvia, Lithuania, Poland, Russia and Sweden). In addition, the catchment extends to Belarus, Czech Republic, Norway, Slovakia and Ukraine. All Finland's marine territorial waters and exclusive economic zone are in the Baltic Sea.

Compared to Arctic Ocean, the Baltic Sea is small and heavily influenced by human activities. Baltic Sea has a large catchment area with 85 million inhabitants. The combination of a high population density, intensive agriculture, and other human activities, such as emissions from industry and transport both on the sea and throughout its catchment area are placing rapidly increasing pressure on marine ecosystems.

The environmental status in the Baltic Sea has drastically deteriorated over recent decades. Of the many environmental challenges, the most serious and difficult to tackle with conventional approaches is the continuing eutrophication (i.e. overload of plant nutrients into the sea) of the Baltic Sea. Inputs of hazardous substances also affect the biodiversity of the Baltic Sea and the potential for its sustainable use. Clear indicators of the declining environmental status of the Baltic Sea marine environment include problems with algal blooms, dead seabeds and overfishing, particularly of cod.

The Baltic Sea area has a long industrial history, which is also reflected in long history of environmental problems. The sea area and water volume are relatively small compared to the human-induced pressures. To alleviate the human-induced problems it was clear already 30 years ago that efficient co-operation between coastal states is needed. To protect the Baltic Sea environment trough intergovernmental co-operation the Baltic countries have adopted the Convention on the Protection of the Marine Environment of the Baltic Sea Area (Helsinki Convention). This is the first international convention, where all sources of pollution around a sea-area were made subject to a single convention. The Convention aims to prevent pollution from ships (including dumping), pollution from land-based sources and pollution resulting from the exploration and exploitation of the seabed and its subsoil. The Convention was signed in 1974 by seven coastal states and entered into force in 1980. In order to extend, strengthen and modernize the legal regime for the protection of the Baltic marine environment, the Convention was renewed in 1992, signed by all coastal states and entered into force in 2000. Helsinki Commission (HELCOM) is a governing body of Helsinki Convention.

In this chapter, Integrated Oceans Management in Finland is treated in the larger context of the entire Management of the Baltic Sea under the auspices of HELCOM. Also other relevant international processes applying Ecosystem Approach to management of human activities aiming at protection of the Baltic Sea environment are treated.

2. Characteristics of the Baltic Sea

The Baltic Sea is the second largest brackish water basins with a surface area of 415 000 km^2 and volume of 21 000 km^3. It is divided into several sub-regions and a transition zone to the North Sea, consisting of basins separated by sills. The major basins of the Baltic Sea are: 1) The Baltic Proper, 2) The Gulf of Bothnia, 3) The Gulf of Finland, 4) The Gulf of Riga and 5) The Danish Straits (Fig. 1). The mean depth of the Baltic Sea is only 55 m, and in the Gulf of Finland and the Bothnian Bay less than 40 m The surface salinity varies from 9 psu in the southern Baltic Proper to <1 psu in the innermost parts of the Gulf of Finland and the Bothnian Bay. On the SW coast of Finland, the surface

Figure 1. Land-cover map over the Baltic Sea and its catchment.
Source: UNEP Baltic Environmental Atlas.

Figure 2. Population density in the Baltic Sea catchment.
Source: UNEP Baltic Environmental Atlas.

salinity is usually between 5 and 6 psu and in the Quark area between 4 and 5 psu.

The catchment area covers 1.74 million km^2, with the largest areas in Sweden (25.3 %), Russia (19.0 %), Poland 17.8 %) and Finland (17.4 %). Forests cover approximately 54 % of the catchment area, agricultural land 26 %, wetlands 20 % and urban areas 4 % (Fig. 1). The ten largest rivers account for 59 % of the total drainage area of the Baltic. Extensive archipelagoes are typical for the northern and north-eastern parts of the Sea, the total number of islands being around 200 000. The population density varies from less than 1 person per km2 in the northern and north-eastern parts of the catchment area to more than 100 persons per km^2 in the southern and south-western parts (Fig. 2). Land use patterns follow the population density with a high proportion of arable land in the eastern, southern and western parts and predominantly wooded land in the northern part.

The Baltic Sea is heavily influenced by river discharge, and the sea has a positive water balance, meaning that river runoff and precipitation exceed evaporation. The dominance of river runoff leads to estuarine gradients in both salinity and ecosystem variables in the North—South dimension, with fresher waters in the northern and eastern parts.

The brackish nature of the sea is maintained by intermittent inflows of saline North Sea water through the Danish Straits. These episodic inflows, typically of size 100-250 km^3, renew the Baltic Sea deep water with highly saline and oxygen-rich North Sea water. The frequency and intensity of major inflows has decreased since mid-1970s, which has led to serious stagnation and hypoxia in Baltic Sea deep waters. Due to a strong choking effect of the shallow Danish Straits at the entrance of the Baltic Sea, tidal sea-level variation is generally only 1-10 cm. In the central Baltic Proper, the water column is permanently stratified, with the fresher surface water separated from the deeper, more saline water by a halocline. In the shallow southwestern area, the water column may be stratified or well mixed depending on the conditions. In summer, a thermal stratification of the water column occurs at approximately 25-30 m depth, separating the warm upper layer from the cold intermediate water above the halocline.

The Baltic Sea belongs to the seasonal sea-ice zone and freezes over annually. The ice season in the Baltic Sea normally extends from October-November to May-June, with an annual areal maximum usually in late February-early March. The inter-annual variation in the ice cover is large, ranging from 10% to 100% of the Baltic Sea. Ice covers an average of approximately 200 000 km², which equals almost half the entire Baltic Sea. During mild winters the maximum extent of the ice is well below 100 000 km².

The Baltic Sea extends over a large geographical area in the North-South dimension, which leads to regional differences in the annual primary production dynamics caused by variations in solar radiation. The characteristics of ice winter also vary considerably in the sub-basins of the Baltic Sea. Because of its very specific characteristics, the Baltic Sea has quite unique fauna and flora comprising of both marine and freshwater organisms. Many species are living near the limits of their physiological tolerance range in terms of salinity. In addition, comparably to the Arctic Ocean, life in the Baltic Sea requires adaptation to low temperatures. Due to the above mentioned reasons, biodiversity in the Baltic Sea is very low compared to temperate oceanic environments. Because of physiological constraints, cold temperatures and long residence time of the water, the Baltic Sea ecosystem is particularly sensitive to persistent hazardous substances.

3. Commercial activity in the Baltic Sea

The Baltic Sea has always been of great importance to the people living around it, providing continuous and predictable source of living, as well as routes for navigation. Today, shipping is the major offshore activity in the Baltic Sea. Other activities include construction (e.g. planned North Stream gas pipeline from Russia to Germany and several offshore wind-power parks) and sand and rock abstraction. In Finland, all offshore activities expect shipping are subject to environmental impact assessments and permits. Fisheries remain a valuable part of people's livelihood and the Baltic Sea is also a recreational resource of growing value.

3.1. Maritime transport

The Baltic Sea is one of the most intensely trafficked shipping areas in the world. According to HELCOM AIS (Automatic Identification System) data, 54 thousand vessels enter or leave the Baltic Sea annually via the Danish Straits and 40 thousand vessels enter or leave Gulf of Finland. At any given moment there are approximately 1800 AIS equipped vessels in the Baltic Sea. Both the number and size of the ships (especially oil tankers) have been growing during last years and also the amount of transported oil has increased significantly since the year 2000.

Many of the major oil terminals in the Baltic Sea are located in the eastern Baltic Sea, especially in eastern part of the Gulf of Finland. Oil transport through major oil ports in the Gulf of Finland was approximately 140 million metric tons, and the transport has been projected to increase to 250 metric tons by 2015. Liquid bulk chemical transport in the Baltic Sea was 9.1 million metric tons in 2004.

Finland's foreign trade is almost entirely dependent on maritime transport accounting for approximately 80 % of the trade. Amount of maritime transport in Finland was in 2005 in total approximately 90 million metric tons, fuels and forest industry products being the most important categories in maritime import and export, respectively. Also passenger traffic is dominated by ship transport, the share of ship traveling in annual travels being approximately 70 %. In 2005 17 million passengers were carried between Finland and other countries, mainly Estonia and Sweden.

One quarter of the maritime transport of goods is carried out in winter under ice-covered conditions. Finland is the only country in the world whose all international ports are annually ice-covered. Winter navigation in ice increases the risks of maritime transport and requires adequate ice strengthening for ships, icebreaker assistance services and continuous information on ice conditions.

The Baltic Sea has been designated as a special area under MARPOL 73/78 Annex I, II, and V with far-reaching prohibitions and restrictions on any discharge into the sea of oil or oily mixtures, noxious liquid substances and garbage. Also discharge of untreated sewage is prohibited within 12 nautical miles from the nearest land. Incineration of wastes and dumping are prohibited. In addition, The Baltic Sea has been designated as a SOx emission control area under Annex VI of MARPOL 73/78, and all ships navigating in the area are required to use fuel oil with a sulphur content not exceeding 1.5 % or use special measures to reduce sulphur emissions. In addition to the pollution prevention measures listed above, the Baltic Sea states have agreed on certain safety measures in the Baltic Sea area, like ship routing, ship reporting, traffic separation schemes, pilotage and safety measures for winter navigation. The Baltic Sea is also designed by IMO as a Particularly Sensitive Sea Area (PSSA).

3.2. Baltic Sea fisheries in Finland

The Baltic Sea fisheries are managed under the EU common fisheries policy (CFP). Annual total allowable catches are negotiated with the European Commission and allocated on national level. Formerly fishing quotas were internationally agreed in the Baltic Sea Fishing Commission, that ceased to exist beginning of 2007. The commission is now negotiating a new bilateral fishing agreement with Russia, that is only non-EU country of the Baltic Sea coastal states.

The commercial Baltic Sea fisheries in Finland is mainly carried on in the Gulf of Bothnia, Gulf of Finland and the Baltic Proper. The most important catch species are Baltic herring, wild salmon, whitefish, sprat and cod. Herring is mainly fished by trawling, salmon and some other species like cod and flatfish by nets and long lines. Freshwater species, mainly pike and perch are important catch for coastal fisheries.

There are approximately 1300 professional fishermen fishing in the Baltic Sea in Finland, of which full-time fishermen only 200. In total 3900 Fishing vessels are being used in offshore and coastal fishing. The vessels are typically small, only 54 vessels being longer than 21 meters.

4. Instititutions and policy for management of marine waters in Finland

Finland has relevant national legislation covering all sectors related to the management of the Baltic Sea. The national legislation is harmonized with the existing EU legislation, as well as with the Helsinki Convention and numerous ratified IMO and UN international conventions. The responsibilities on marine affairs are organized sector-wise, with Ministry of the Environment being responsible for environmental protection, Ministry of Trade and Industry for economic offshore activities (including EEZ), Ministry of Transport and Communications for shipping issues and Ministry for Agriculture and Forestry for fisheries. No permanent administrative body for coordination of marine affairs and integrated management exists, but coordination is done using normal administrative procedures and channels between the sectors and ministries. Temporary cross-sectoral working groups or bodies are being established upon need to implement national or EU legislation.

5. Introduction of Ecosystems-based oceans management in Baltic Sea (including Finland)

5.1. National Action Plan for protection of the Baltic Sea and inland waters

To enhance protection of the Baltic Sea and inland waters, Finland has developed a national Action Plan (Ministry of the environment 2005), which was adopted in 2005 and is currently in implementation phase. The Action Plan is based on government Decision-In-Principle on the protection of the Baltic Sea on 2002 (Ministry of the environment 2002). The timeframe for the implementation of the Plan is by 2015 but many measures being implemented are continuous in nature.

The Action plan has been jointly prepared by various administrative sectors and other actors. The plan is organized to encompass five main themes: 1) Combatting eutrophication, 2) Reducing risks caused by hazardous substances, 3) Reducing the harmful impacts of the use of the Baltic Sea, 4) preserving biodiversity and 5) Increasing environmental awareness. All sections are coordinated with HELCOM activities to ensure the national Action Plan's compatibility and applicability for joint efforts under the auspices of HELCOM and EU in protection of the Baltic Sea marine environment in the coming years.

5.1.1. Combatting eutrophication

This section includes complex and multifaceted measures to reduce nutrient loads entering the Baltic Sea and causing undesirable eutrophication effects, such as massive summertime blooms of harmful filamentous cyanobacteria, increased algal production leading to reduced water clarity and anoxic seafloor resulting from excess sedimenting organic matter. The measures are targeted to reducing nutrient loads from agriculture, municipal wastewater, rural settlements and industry. Also nutrient loads from shipping, atmospheric loads and loads from neighboring countries are targeted.

5.1.2. Hazardous substances

This section includes measures to reduce emissions of hazardous substances (e.g. POPs, heavy metals) nationally as well as to improve monitoring and international co-operation. Measures include both legislative controls and voluntary measures taken by industry. In addition to national legislation, EU Water framework directive targeted to the protection of inland and coastal waters is an important tool in planning and implementing emission reductions.

5.1.3. Reducing the harmful impacts of the use of the Baltic Sea

The section aims at reducing risks of shipping, coastal and recreational use and improving the preservation of coastal areas. Main focus in shipping is on measures to reduce risks of accidental and intentional oil and chemical spills by improving general navigational safety, reducing deliberate illegal releases of oil by better port reception and surveillance as well as improving the preparedness and response capacity to major accidental spills. Coastal and recreational pressures are met with better spatial planning (including location of shipping lanes), better control on sand and rock extraction from seabed and a new national strategy for ICZM.

5.1.4. Preserving biodiversity in marine and coastal habitats

This section aims at preserving the biological and geological diversity of marine habitats and preventing any decline in biodiversity. Measures taken will include a programme for inventory of marine ecosystems (VELMU) that aims to identify ecologically valuable marine areas, indicate the activities that could endanger their favorable status. In addition, co-operation in nature conservation and management of nature reserves with neighboring countries will be improved. To prevent spreading of non-indigenous species to Baltic Sea, Finland will actively lobby within the IMO for the signing of a binding agreement to restrict ballast water emissions and work within IMO and HELCOM to promote better technology in that particular area.

5.2. HELCOM Baltic Sea Action Plan

HELCOM has a central role in implementation of Ecosystem Approach in management of the Baltic Sea. The Ecosystem Approach was adopted by joint OSPAR/HELCOM ministerial meeting in 2003 and HELCOM subsequent actions will be based on it. HELCOM has developed a vision of healthy Baltic Sea, adjacent goals on four priority areas (mentioned below & Fig. 3) and system of Ecological Objectives to measure the progress towards these goals, which were approved in 2005. HELCOM 2007, Backer & Leppänen 2008).

Previous HELCOM efforts have led to noticeable improvements in many areas, for example concerning the inputs of nutrients HELCOM has already achieved a 40% reduction in nitrogen and phosphorus discharges (from sources in the catchment area) and likewise a 40% decrease as regards emissions of nitrogen to the air, as well as a 50% reduction in discharges of 46 hazardous substances. However, further progress cannot be achieved using only the old administrative measures and it is clear that a completely different approach will be required to restore good ecological status of the Baltic Sea. Moreover, the remaining challenges are more difficult than earlier obstacles. Reductions of nutrient inputs have so far mainly been achieved by targeting major point sources, such as sewage treatment plants and industry. In the future diffuse sources of nutrients including over-fertilised agricultural lands need to be targeted, including developing economies in the eastern Baltic Sea area.

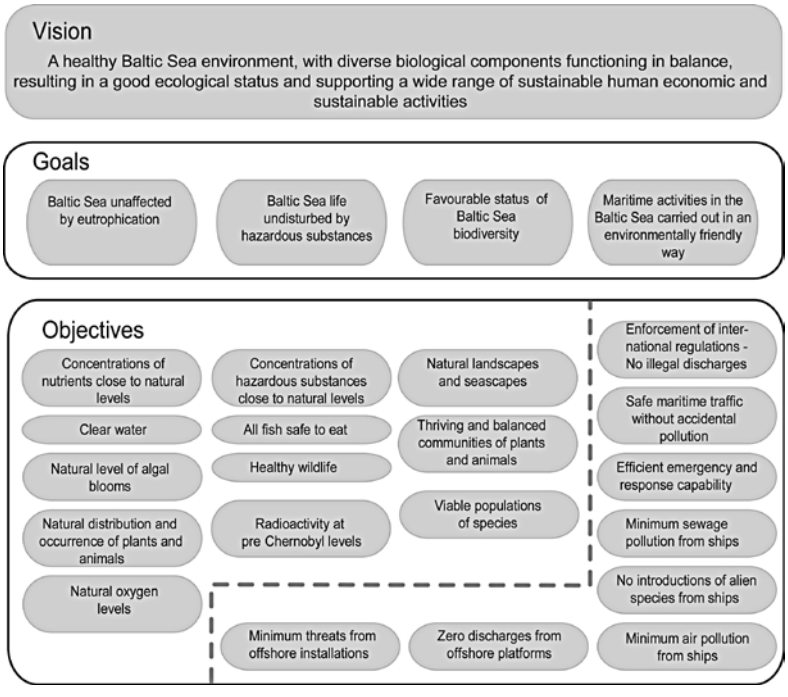

Figure 3. HELCOM Vision, Goals and system of ecological objectives. Source: HELCOM 2007

HELCOM has developed an ambitious strategy to restore the good ecological status of the Baltic Sea, called the Baltic Sea Action Plan (BSAP). The plan was approved by HELCOM countries in a ministerial meeting in Krakow, Poland on 15th November 2007. With BSAP HELCOM continues its central role in marine environmental protection in the Baltic Sea area. As one of the first schemes to implement the ecosystem approach to the management of human activities, BSAP will lead to profound, innovative changes in the ways the marine environment in the Baltic Sea region is managed. BSAP enables wide-scale and decisive actions to achieve healthy marine environment, with good ecological status and supporting a wide range of sustainable human activities. This vision sets a very ambitious target of achieving a good ecological status for the Baltic Sea by 2021. BSAP is essentially a joint regional policy, with common objectives, common actions, and common obligations. Successful implementation of the plan will largely depend on how all the coastal countries can co-operate to achieve the goal of a healthy Baltic marine environment.

As the EU Marine Strategy Framework Directive foresees such an action plan for each European marine eco-region, including the Baltic Sea, BSAP has been heralded as a pilot project for European seas in the context of the proposed directive. The EU has described HELCOM's plan as instrumental to the successful implementation of the new EU Marine Strategy in the region. Thus HELCOM will likely have a central role in the implementation of EU Marine Strategy Framework Directive in the Baltic Sea in the future. In developing the action plan, HELCOM has also taken into account the environmental provisions of the Maritime Doctrine of the Russian Federation. Close co-operation with Russia, which is the only HELCOM country outside the EU in the Baltic Sea region, is crucial for any further progress to be made in rescuing the troubled Baltic marine environment. HELCOM's innovative strategy will also be instrumental to the implementation of the renewed Northern Dimension policy, the Baltic Sea regional aspects of the EU-Russian Environmental Dialogue, and the Nordic Environmental Action Plan.

BSAP is clearly different from previous HELCOM programmes of action in that it is based on a clear set of Ecological Objectives defined to reflect a jointly agreed vision of a healthy Baltic Sea. Example objectives include clear water, an end to excessive algal blooms, and viable populations of species. Targets for 'good ecological status' are to be based on the best available scientific knowledge. The timeframe for reaching the targets will be a political decision. With the ecosystem approach, the protection of the marine environment is no longer seen as an event-driven pollution reduction approach to be taken sector-by-sector. Instead, the plan applies adaptive management of human actions employing cost-efficient solutions with the responsiveness of the marine environment as the starting point.

The plan has four main segments, according to the four main environmental priorities: combating eutrophication, curbing inputs of hazardous substances, ensuring maritime safety, and halting habitat destruction and the ongoing decline in biodiversity. A number of indicators will be selected for each objective, so that progress towards the desired 'good ecological status' can be measured. These ecological objectives and their associated indicators will be used to evaluate the effectiveness of existing environmental measures, and to identify where more measures are needed. The socio-economic component of BSAP evaluates the benefit of the measures proposed (including cost-effectiveness and cost-benefit analyses) compared to the socio-economic cost of inaction leading to further degradation of marine environment.

BSAP distinguishes between measures that can be implemented at regional or national level, and measures that can only be implemented at EU level (e.g. Common Fisheries Policy, Common Agricultural Policy, controls over the marketing and use of chemicals) or globally (e.g. the shipping controls defined by the International Maritime Organisation). Actions that need to be taken at European or global level must be addressed by HELCOM through the related international forums.
BSAP has been prepared with the active participation of all major stakeholder groups in the region, including governments, industry and NGOs, as well as individual citizens living on the shores of the Baltic Sea. The participation included two open stakeholder conferences in 2006, where elaboration of the plan was officially started and 2007, where the first draft set of actions to be included was unveiled. Stakeholder conferences will continue during implementation of the plan. Such participation scheme ensures that the plan is relevant and can be effectively implemented in practice.

5.3. Relevant EU Legislation and Policies in Finland

Valid EU legislation partly directed towards better protection and management of the marine environment is in place and transposed to national legislation or in preparatory phase. This EU legislation includes Nitrates Directive, Urban Wastewater Treatment Directive, Habitats Directive, Water Framework Directive, Integrated Pollution Prevention and Control Directive and proposed Marine Strategy Framework Directive.

In addition to the relevant EU legislation that has been transposed to national legislation, EU common policies regulate some marine-related affairs on Community level. The most important of them are already above mentioned Common Fisheries Policy and Common Agricultural Policy. The Commission is currently preparing also a Common Maritime Policy.

6. EU Marine Strategy and Marine Strategy Framework Directive

European Union has adopted an ambitious strategy to protect more effectively the marine environment of EU seas, with an aim to achieve good environmental status by 2021. The Marine Strategy will constitute the environmental pillar of the future EU maritime policy. The adjacent Marine Strategy Framework Directive (MSD, Directive 2008/56/EC) has entered into force in July 2008.

The Directive is using Ecosystem Approach to management and aims to holistic and well coordinated management and protection of EU seas. MSD will establish European Marine Regions on the basis of geographical and environmental criteria (the Baltic Sea, NE Atlantic, the Mediterranean Sea, Black Sea) and applies to marine waters under sovereignty and jurisdiction of the EU member states. Each member state is required to develop a detailed marine strategy for its waters in close co-operation with other member states and third states in the region (e.g. with Russia in the Baltic Sea).

The Marine Strategies will contain a detailed assessment of the state of the environment, a definition of "good environmental status" at regional level and the establishment of clear environmental targets and monitoring programmes. The directive will define generic descriptors for "Good Environmental Status". These descriptors are to be "disassembled" into indicators in Marine Regions. To support member states, European Environmental Agency (EEA) is preparing a pan-european set of indicators that can be used in the assessments. Each member state will draw up a programme of cost-effective measures. Impact assessments, including detailed cost-benefit analysis of the measures proposed, will be required prior to the introduction of any new measure. Where it would be impossible for a member state to achieve the level of ambition of the environmental targets set, special areas and situations will be identified in order to devise specific measures tailored to their particular contexts. The Marine Strategy is consistent with EU water framework directive from 2000 which requires that surface freshwater and ground water bodies achieve a good ecological status by 2015 and that the first review of the River Basin Management Plan should take place in 2021.

The original MSD proposal, prepared by the European Commission was released in October 2005. The proposal was scrutinized in the European Council and European Parliament in 2006. Political agreement in the European Council was attained in December 2006 under the Finnish Presidency, and after negotiations and amedments by the European Parliament. the directive was adopted on June 17th 2008 and entered into force in July 2008. Directive texts are available electronically at Eur-Lex service (http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32008L0056:EN:NOT).

7. Conclusions

Finland is surrounded by the Baltic Sea, which is a temperate, brackish-water sea basin sharing many characteristics and anthropogenic pressures with the Arctic Ocean. Compared to Arctic Ocean, the Baltic Sea is small and heavily influenced by human activities.
Shipping is the major offshore activity in the Baltic Sea and also most of Finland's foreign trade is dependent on it. Other activities include construction and sand and rock abstraction. In Finland, all offshore activities expect shipping are subject to environmental impact assessments and permits. Fisheries remain a valuable part of people's livelihood and the Baltic Sea is also a recreational resource of growing value.

The environmental status in the Baltic Sea has drastically deteriorated over recent decades. Of the many environmental challenges, the most serious and difficult to tackle with conventional approaches is the continuing eutrophication (i.e. overload of plant nutrients into the sea). Inputs of hazardous substances also affect the biodiversity of the Baltic Sea and the potential for its sustainable use. Clear indicators of the declining environmental status of the Baltic Sea marine environment include problems with algal blooms, dead sea-beds and overfishing. To protect the Baltic Sea environment trough intergovernmental co-operation the Baltic countries have adopted the Helsinki Convention. The Convention aims to prevent pollution from ships (including dumping), pollution from land-based sources and pollution resulting from the exploration and exploitation of the seabed and its subsoil. Helsinki Commission (HELCOM) is a governing body of Helsinki Convention. In this chapter, Integrated Oceans Management in Finland is treated in the larger context of the Management of the human actions in the entire Baltic Sea under the auspices of HELCOM. Also other relevant international processes applying Ecosystem Approach to management of human activities aiming at protection of the Baltic Sea environment are treated.

Finland has relevant national legislation covering all sectors related to the management of the Baltic Sea. The national legislation is harmonized with the existing EU legislation, as well as with the Helsinki Convention and numerous ratified IMO and UN international conventions. The responsibilities on marine affairs are organized sector-wise, with Ministry of the Environment being responsible for environmental protection, Ministry of Trade and Industry for economic offshore activities (including EEZ), Ministry of Transport and Communications for shipping issues and Ministry for Agriculture and Forestry for fisheries. No permanent administrative body for coordination of marine affairs and integrated management exists, but coordination is done using normal administrative procedures and channels between the sectors and ministries.

To enhance protection of the Baltic Sea and inland waters, Finland has developed a national Action Plan, which was adopted in 2005 and is currently in implementation phase. The plan is organized to encompass five main themes: 1) Combatting eutrophication, 2) Reducing risks caused by hazardous substances, 3) Reducing the harmful impacts of the use of the Baltic Sea, 4) preserving biodiversity and 5) Increasing environmental awareness. All sections are coordinated with HELCOM activities to ensure the national Action Plan's compatibility and applicability for joint efforts under the auspices of HELCOM and EU in protection of the Baltic Sea marine environment in the coming years. HELCOM has developed an ambitious strategy to restore the good ecological status of the Baltic Sea, called the Baltic Sea Action Plan (BSAP). The plan was approved by HELCOM countries in a ministerial meeting in Krakow, Poland on 15th November 2007. With BSAP HELCOM continues its central role in marine environmental protection in the Baltic Sea area. As one of the first schemes to implement the ecosystem approach to the management of human activities, BSAP will lead to profound, innovative changes in the ways the marine environment in the Baltic Sea region is managed. BSAP enables wide-scale and decisive actions to achieve healthy marine environment, with good ecological status and supporting a wide range of sustainable human activities. This vision sets a very ambitious target of achieving a good ecological status for the Baltic Sea by 2021. BSAP is essentially a joint regional policy, with common objectives, common actions, and common obligations. Successful implementation of the plan will largely depend on how all the coastal countries can co-operate to achieve the goal of a healthy Baltic marine environment.

The European Union has adopted an ambitious strategy to protect more effectively the marine environment of EU seas, with an aim to achieve good environmental status by 2021. The Marine Strategy will constitute the environmental pillar of the future EU maritime policy. The adjacent Marine Strategy Framework Directive (MSD) has been adopted and entered into force in July 2008. The Directive is using Ecosystem Approach to management and aims to holistic and well coordinated management and protection of EU seas.

MSD will establish European Marine Regions on the basis of geographical and environmental criteria (the Baltic Sea, NE Atlantic, the Mediterranean Sea, Black Sea) and applies to marine waters under sovereignty and jurisdiction of the EU member states. Each member state is required to develop a detailed marine strategy for its waters in close co-operation with other member states and third states in the region (e.g. with Russia in the Baltic Sea). Implementation of national action plan and BSAP are coherent with the requirements of MSD and aimed at to be a part of MSD implementation in the future.

In conclusion, Finland, by harmonized national, HELCOM and EU ecosystem approach-based processes now has appropriate framework for ecosystem-based management of human actions relevant to the marine environment. Implementation of HELCOM Baltic Sea Action Plan and MSD is just in initial phase and evaluation of these new instruments remains a future task.

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REPORT SERIES NO 129

Norway and Integrated Oceans Management – the Case of the Barents Sea

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1. Introduction

In 2002, the Norwegian Storting (parliament) adopted a White paper laying out the future oceans policy of the country (St.meld. nr. 12, 2001-2002). The White paper signaled the introduction of integrated oceans management, based on an ecosystems approach. The development of integrated oceans management plans is central to the implementation of this policy, and the first such management plan for a Norwegian sea area, the Integrated Management of the Marine Environment of the Barents Sea and the Sea Areas off the Lofoten Islands (BSIMP) was adopted in 2006.

The waters under Norwegian jurisdiction range from 55° N latitude in the North Sea to 85° N latitude north of the Svalbard archipelago in the Arctic Ocean a distance of more than 3300 kilometers. [1] More than two — thirds of the waters under Norwegian jurisdiction are north of the Arctic Circle. The Norwegian Sea borders the Barents Sea off northern North Norway and Russia to the east (Fig. 1– map). About 10% of Norway´s population of 4,7 million people live in the three northern counties: Nordland, Troms and Finnmark. The Svalbard archipelago is part of the Kingdom of Norway. Due to the influence of the Atlantic current, the climate in the Norwegian Arctic is more benign than at corresponding latitudes in North America (Loeng, 1991).

This chapter addresses the development, introduction and implementation of the Integrated Management of the Marine Environment of the Barents Sea and the Sea Areas off the Lofoten Islands (BSIMP) in the context of the overall Norwegian oceans policy. The management plan area includes the coastal ecosystems off North Norway and parts of the Norwegian Sea, in addition to the Norwegian part of the Barents Sea. The Barents Sea falls partly under Norwegian, partly under Russian jurisdiction. An area in the central Barents Sea is beyond 200 nautical miles and therefore high seas.

2. Background

The Barents Sea – Lofoten area is a clean, rich marine area of major economic significance for Norway. It is a nursery area for fish stocks that provide the basis for significant fisheries and food for important seabird colonies. A number of marine mammal populations live in the region. The area has a rich benthic fauna including coral reefs and sponge communities (Føyn, et al, 2002).

The Barents Sea–Lofoten area is crossed by important transport routes, and is believed to contain commercially viable petroleum resources. In recent years there has been considerable growth in tourism. The fisheries in the area are internationally significant and play an important role in the economy of North Norway. The sea and the fisheries are vital for coastal communities, and this is reflected in the ways of life and identity of the population.

The ecosystem

The components of the ecosystems in the Barents Sea–Lofoten area are closely linked. For a more detailed description see Føyn, et al. 2002. Seabirds transfer nutrients from marine to terrestrial ecosystems. Fish live on the plankton production, and transfer nutrients between marine ecosystems as they migrate from the open sea to coastal waters. The area covered by the management plan consists of several naturally delimited ecosystems that interact and influence each other: the Barents Sea itself, the rest of the area covered by the management plan (Fig. 1), which can be divided into three ecosystems: the area south of Tromsøflaket, the area around Svalbard, and parts of the deep-sea areas of the Norwegian Sea.

There are large natural fluctuations in environmental conditions throughout this area, for example in the inflow of Atlantic water. Economic activities create anthropogenic pressures on the marine ecosystems, as do external pressures such as long-range transboundary pollution. Other important potential stress factors include oil pollution and the spread of alien species.

1 In addition, the Jan Mayen Island to the north of Iceland and east of Greenland is under Norwegian sovereignty. Norway is the only country with territorial interests in both the Arctic and the Antarctic.

The Barents Sea is relatively shallow, with an average depth of 230 m. It is bordered in the west by the Norwegian Sea, which is more than 2500 m deep, and in the east by the coast of Novaya Zemlya, and stretches from the Norwegian and Russian coasts at its southern edge to about 80°N. It covers an area of about 1.4 million km^2. Several major fish stocks in the North-east Atlantic spend part of their life cycle in the Barents Sea.

The inflow of warm Atlantic water supports high biological productivity and keeps large parts of the Barents Sea ice-free year-round. Because the water is shallow, vertical mixing normally goes down to the bottom in winter, bringing nutrients up to the productive surface waters where they sustain biological production in spring. Variations in environmental conditions result in large seasonal and inter-annual fluctuations in the production of phyto- and zooplankton and therefore in the food for fish, seabirds and marine mammals. Therefore, recruitment to these populations varies from year to year. The food chains in the Barents Sea are often relatively short, with few but robust species that are well adapted to the environment. There are large populations of individual species, and they may have wide distribution ranges. Even though individual species are robust, the environmental pressures may have significant impact when food chains are short. Some fish species, such as herring and cod, spend parts of the year or part of their life cycle in the Barents Sea and the rest along the Norwegian mainland coast and in the Norwegian Sea. For polar cod and capelin, the Barents Sea is a spawning ground, nursery area and feeding area. When the inflow of Atlantic water is high, the temperature in the Barents Sea rises. This allows fish such as herring and cod and other marine organizms whose distribution to a certain degree is limited by low temperatures to expand their ranges. Cooling of the Barents Sea, on the other hand, is favorable for capelin.

The marginal ice zone can be considered as a separate ecosystem that retreats gradually northwards in spring and summer. This creates particularly favorable conditions for phyto- and zooplankton production. Capelin feed on these organisms, and transport energy from biological production in the marginal ice zone to coastal waters further south where they spawn. Thus, seabirds and other species associated with coastal areas also benefit from production in the northern parts of the Barents Sea.

The high production of plankton and fish in the Barents Sea supports some of the largest seabird colonies in the world, totally about 25 million birds. Most of these migrate out of the region in winter. A number of marine mammals forage in the Barents Sea and calve in temperate waters further south (minke whale, humpback whale, fin whale), while some spend their whole lives in the Arctic (beluga whale, narwhal). The large populations of harp seal and minke whales consume considerable quantities of cod, herring and capelin. Russian scientists have estimated that the total biomass of benthic animals in the Barents Sea is about 150 million tons, with an annual production of 25–30 million tons. About 3000 marine species have been recorded. Relatively little is known about the distribution of benthic animals. Sponges and corals dominate the seabed in certain areas.

Commercial activities

The main commercial activity of the management plan area is fisheries. The Barents Sea is one of the world's most important fishing areas. Fishing of North-east Arctic cod, North-east Arctic haddock, capelin, herring, tusk, ling, wolf-fish, deep-sea redfish, North-east Atlantic Greenland halibut and shrimp and king crab trawling is/had been carried out in the area. Most fisheries in the Barents Sea are sustainable (IMR 2008:11). North-east Arctic cod (510 000 tons in 2007 is the most important fishery. Overfishing has been substantial, but has been declining since 2006. Overfishing of biological resources has negative consequences for the ecosystems of which those resources are integral parts. In addition, benthic communities may be disturbed by trawls. Also, by-catches of seabirds and marine mammals can be a problem in certain areas and at certain times of year.

Minke whales (the quota for 2008 was 900 animals in the North-eastern stock area, of which 535 were caught,) is the only species of whale hunted for commercial purposes in the management plan area. Some seals (common, grey, bearded and ringed) where some indi-

viduals are taken by local hunters and residents in the settlements of Svalbard and northern Norway. The commercial hunting grounds for harp and hooded seals lie outside the management plan area.

Petroleum-related activities are growing in the management plan area. Seismic surveys and exploration drilling for oil and gas began in 1980. Up to 2008, about 80 exploration and appraisal wells have been drilled. Discoveries are mainly gas, but also some oil. The gas and condensate field "Snøhvit" northwest of Hammerfest came on stream in 2007. The Ministry of Petroleum and Energy expect to receive a plan for the development of the oil field Goliat in 2009. The Barents Sea North of 74° 30' is not open for petroleum prospecting.

Also *transportation* is a major activity in the management plan area. Traffic involving fishing vessels, cargo vessels and passenger ships can have adverse impacts on the environment through operational discharges to water and air, releases of pollutants from anti-fouling systems, noise, the introduction of alien species via ballast water or attached to hulls and local discharges from zinc anodes in ballast tanks. In addition, an increase in maritime transport will increase the risk of accidental spills of oil and chemicals. From 2002 to 2020, it is estimated that the total distance sailed will rise by 27.7 per cent for cargo ships, 22.7 per cent for passenger ships and 9.4 per cent for fishing vessels.

Tourism has its most important effects on land. Marine systems can however also be affected, for example by disturbance of seabird nesting areas and moulting and birthing sites for seals. Cultural remains associated with old hunting sites exist in these areas. According to the office of the Governor of Svalbard, the total number of tourist landing sites outside the settlements and Isfjorden has increased from 56 in 1996 to 168 in 2007.

The scale and frequency of pressure factors and the vulnerability of the environment will determine the extent of the impacts.

3. Institutions and policy

Regulatory frameworks have been developed for most marine policy areas with the establishment of ministries, agencies, and legislation in the period after World War II. The domestic oceans regime is based on the 1976 Economic Zone Act, which extends jurisdiction over living marine resources to 200 nautical miles and reserves the utilization of those resources for Norwegian vessels. The continental shelf resources and their exploitation are regulated by the 1996 Petroleum Act. Still other acts elaborate the regulatory framework for petroleum resources, fisheries, and the environment. The acts provide for enabling legislation to facilitate the adaptation of regulations to changing circumstances.

The EEZ off the Norwegian mainland was established on 1 January in 1977 (Fig. 1). In 1978 a 200 nautical mile fisheries protection zone was established around Svalbard. The extension of jurisdiction brought jurisdictional issues with neighboring countries. In the Barents Sea, talks to establish a boundary there have been held between Norway and Russia since the mid-1970s.[2] A second jurisdictional issue concerns the fishery protection zone around Svalbard.

Most of the Norwegian fisheries occur on stocks that are shared with other countries. International cooperation is therefore critical to their management. A number of bi- and multilateral agreements have therefore been negotiated with neighboring countries to provide for the management of shared fish stocks, the most important of which are those with Russia and the EU. Norway is also party to the North East Atlantic Fisheries Commission (NEAFC), which manages the fisheries at the high seas in the region. The Joint Norwegian-Russian Fisheries Commission meets annually to agree on total allowable catches (TACs) of shared stocks and on the allocation of quotas for the major fisheries in the Barents Sea. About ten per cent of the total quota is traded to third countries. The cooperation also includes fisheries research and enforcement of fisheries regulations. The Commission in 2002 adopted a management strategy with multi-annual quotas based on a precautionary approach.
The fisheries policy include limits to access to fisheries, restrictions on catches (quotas), and technical regulations on fishing gear to be used and fishing seasons and areas. Important aspects are discard bans and flexible closures of areas with juvenile fish. There are virtually no open access fisheries in Norway. The enforcement of fisheries regulations occurs both at sea and when the fish is landed. The Coast Guard (a service in the Navy) is responsible for inspecting fishing vessels at sea. The sales organizations buying the fish and the Directorate of Fisheries control landings.

IUU fishing is a challenge to enforcement of fisheries regulations in Norway, as elsewhere.[3] Ships flying flags of convenience and transshipment of cargo on the high seas make enforcement difficult. Increased international cooperation on enforcement has been important in coming to grips with this.

The management of marine mammals is vested in the International Whaling Commission (IWC), the North Atlantic Marine Mammals Commission (NAMMCO), and the Joint Norwegian-Russian Fisheries Commission. Controversies over whether whales should be subject to harvest have paralyzed the IWC, which has not set quotas for commercial fisheries for more than two decades. Since 1993 Norway has set unilateral quotas for the take of minke whales on the basis of the work in the IWC Scientific Committee.

As with fisheries, maritime transport is to a large extent regulated by international rules that provides a framework for how Norway can regulate transport activities in its waters. The Coastal Administration has the operational responsibility for the governmental emergency response system for acute pollution. It is also tasked with ensuring that the damage-reducing measures implemented by other bodies are adequate.

The chief objective of the Norwegian petroleum policy is to maximize the returns from the industry for the good of the society. National control over the industry, the development of a domestic petroleum industry, and participation by the state are key elements of the policy. The development of a comprehensive institutional framework has been critical to the achievement of the objectives. The 1996 Petroleum Act provides for a licensing system that is the core of the regulatory regime. The act empowers the government to regulate all aspects of the industry.

Petroleum activities are subject to a strict regulatory regime: Exploratory drilling has to be approved by the Petroleum Directorate and the State Pollution Control Authority. New fields to be developed and the laying of pipelines require the consent of parliament or government, depending on the scale of the project. Also, operators have to undertake environmental and socio-economic assessments and subject them to public hearings before government approval is granted. The petroleum industry is a major contributor of emissions to air. For CO_2, 28 per cent of the national emissions stem from the petroleum industry's production of energy at the petroleum installations. In 1991 Norway introduced a CO_2 tax, aimed at reducing emissions. The 1981 Pollution Control Act imposes a number of restrictions on emissions and discharges.

The petroleum industry is taxed in the same way as other businesses, i.e. a 28 per cent tax on net income. A special tax of 50 per cent, justified by the super-profitability from resource rent, is levied on top of that. The income from the petroleum activities is of great significance to the public finances. To maintain the level of revenue generated by the industry and the activity in associated industries, new fields have to be found and brought into operation at regular intervals. The southern part of the Norwegian continental shelf is now relatively well explored, and activity is therefore moving northwards in search of new fields. Developments in technology are making operations in Arctic

2 The entire Barents Sea is a continental shelf area and will eventually be divided between Russia and Norway. As to the waters, there is an enclave of the high seas known as the "Barents Sea Loophole."

3 In recent years, IUU fishing in the Barents Seas is estimated to have been 100,000 tons or more annually. Since 2006 these figures have been declining and are now a fraction of that.

waters feasible. The price of oil and gas is also an important factor in this regard.

Environmental concerns are generally considered an important issue in the Norwegian polity. Ministries are required to check their policies against specific environmental standards. The constitution of Norway explicitly states the right to a good environment[4] The Ministry of the Environment has several designated agencies,[5] and several important Acts regulate use and protection of the marine environment. The primary international environmental agreements are the OSPAR cooperation on the marine environment in the north-east Atlantic and the Kyoto Protocol, as well as IMO-agreements and the London Dumping Convention. Organic compounds, oil, and chemicals used in petroleum production are the most significant discharges to the sea in Norwegian waters. Domestic regulation of such emissions is largely mandated by OSPAR, and includes the objective of zero harmful discharges to the sea.

4. The process of introducing ecosystem-based oceans management

During the debate on the white paper on the marine environment (Report No. 12 (2001–2002) Protecting the Riches of the Sea, the Storting endorsed the need for integrated management of Norwegian maritime areas based on the ecosystem approach. This is in line with international developments in regional cooperation in the north-east Atlantic within the framework of OSPAR, the Arctic Council, and the North Sea Conferences.

The decision-making process and stakeholder involvement

All major policy sectors in the marine realms have strong international dimensions. The most significant pollution problems in Norway are brought from abroad by ocean currents and winds. Major fish stocks are shared with other countries. And due to the small domestic market, fisheries products as well petroleum production have to be exported. The international aspects of marine policy in Norway can therefore hardly be overstated.

Norway is a parliamentary democracy. The government remains in power as long as it has the confidence of the majority in parliament, the "Storting". Its political system includes a strong tradition for participation of organized interests in the formulation and execution of public policies (Olsen 1983), a comparatively high degree of centralization of decision-making power, and a relatively consensual political process (Heidar 2001) where the differences between political parties may be difficult to discern as viewed from abroad. The implication is that policy-making in the marine sectors tends to involve interests that are likely to be affected by decisions, which is also a legal requirement. The ministries are the hubs of decision-making, with little or no powers devolved to regions.[6]

The Saami Parliament has entered into a consultation agreement with the Norwegian government. This mandates a consultation procedure on all matters pertaining to Saami culture, and requires that its Parliament should have real influence on decisions affecting its remit. The Saami Parliament is however not satisfied with the actual use of the procedure, and has noted that there were no consultations on the Barents Sea Management Plan.[7] It was however part of the regular hearing process in advance of the adoption of the plan. Following the adoption of the plan the Saami Parliament has been invited to the meetings of the Reference Group that considers the implementation of the management plan.

Marine issues are important in the domestic political debate, due to their economic significance and political salience. In addition to economic interests, non-state actors such as environmental non-governmental organizations (NGOs), regional political bodies, and indigenous groups are increasingly engaged in issues relating to marine policies. This is a development that tends to bring increased levels of controversy. In fisheries, stakeholders are involved in decision-making through a Regulatory Meeting arranged regularly by the Fisheries Directorate.

4 Paragraph 100b of the 1814 Constitution. Norges Riges Grundlov , Eidsvoild 17de Mai 1814. Ministry of Justice, Oslo.

5 These agencies include pollution control, nature management and polar affairs.

An important part of the decision-making context is that as the management plan was developed, new legislation was developed pertaining to ocean resources and biodiversity conservation, respectively. The new Oceans Resources Act was adopted by the Storting in May 2008. The act consolidates all relevant provisions for the management of living marine resources into a single act, thereby facilitating its implementation. Its overall objective is to ensure an economically and ecologically sustainable management of wild marine living resources (including genetic resources) by sustainable use and long-term conservation of the resources. The act states that the natural resources are the property of the state as long as they are in the wild. The act also lists principles and concerns to be taken into consideration in the management of resources, among them the precautionary approach, an ecosystem-based approach, implementation of international law, transparency in decision-making, and regard for the Saami culture. The act makes explicit the legal basis for marine protected areas. It also provides that in implementing an ecosystem-based approach, precise resource management objectives can be established. The act therefore provides a more modern and appropriate basis for the management plan than previous legislation.

A new act on biodiversity conservation is also in the works, intended to be submitted to parliament in 2009. The principle of sustainable use is central to the law, and it is to be implemented through the establishment of conservation objectives for nature types and species, and through the enactment of certain environmental principles: the precautionary principle, the polluter pays principle, and the principle of responsible technologies and practices.

Knowledge

In fisheries, the basis for resource management is the scientific advice provided by the International Council for the Exploration of the Sea (ICES). Based on inputs from research institutions in the member countries, ICES assess the status of fish stocks and marine ecosystems and provides scientific advice on conservation measures to member states and regional fisheries management organizations. The primary marine research institution in Norway is the Institute of Marine Research.

In the context of the development of the Management Plan for the Barents Sea the task of knowledge development was complex and demanding. Large and challenging knowledge gaps were identified that have to be filled to enable the design and long-term implementation of scientifically sound and adequate monitoring of essential elements of the Barents Sea ecosystem. The knowledge gaps were categorized as monitoring, research and mapping needs. During the process there have been a unanimous call for the development and implementation of better procedures for how new knowledge gaps can be identified, prioritized and filled as well as finding good procedures for handling scientific uncertainty.

Interagency cooperation and the development of the plan

A multi-sector approach lies at the core of the ecosystem approach, as multiple concerns and economic sectors have to be coordinated and reconciled. Work on the management plan started in 2002 after the adoption of the white paper on the marine environment, and was organized through an inter-ministerial Steering Committee chaired by the Ministry of the Environment. Other members of the Steering Committee were the Ministry of Labor and Social Inclusion (from June 2005), the Ministry of Fisheries and Coastal Affairs, the Ministry of Trade and Industry (from November 2005), the Ministry of Petroleum and Energy and the Ministry of Foreign Affairs. The analytical work started in 2002, and was carried out by government directorates and institutions under the four Ministries as well as some external institutions. The Institute of Marine Research and the Norwegian Polar Institute were leading several of the assessments and analyses. Fig. 2 gives an overview of the development process, which essentially evolved through three phases.

The initial scoping phase entailed the production of status reports for various economic sectors in the region, valuable areas, the

6 Coastal zone planning is an exception. The municipal authorities have substantial powers to plan and execute local policies regarding use of the coastal zone.

7 The Saami Parlimament´s supplementary report regarding the ILO Convention no. 169, Resolution 026/08.

socio-economic situation, and the environment and natural resources. The second phase consisted of assessments of potential impacts of petroleum activities, shipping, and fisheries, as well as the impact of external stressors as for example climate change. This phase also entailed consultation with relevant stakeholders. The final phase in the development of the plan included aggregate analyses, assessing the total impact on the environment, identifying valuable and vulnerable areas, defining knowledge gaps, and the setting of management goals. Also, in this phase a stakeholder conference with broad participation was held.

A key challenge during the development of the plan was to integrate work across institutional sector barriers at both ministry and agency levels. Success depended in large measure on allowing non-specialists to have a say in how a specific sector was to be managed, or how to assess the impact of that sector in relation to the ecosystem. This was a difficult process, requiring care and time, but in the end it succeeded.

Adoption of the plan

The Management Plan for the Barents Sea was presented to the Storting as a government white paper in March 2006 (Report No. 8 (2005-2006) to the Storting), and was adopted in June the same year. While the process leading up to the adoption of the plan was surrounded by some controversy over the extent of limitations to be placed on petroleum-related activities in the plan area, the actual work of developing the plan, which implied cross-sector collaboration, was relatively uncontroversial.

Geographical area

The Management plan area covers the Norwegian Economic Zone and the fisheries protection zone around Svalbard (Fig. 1), limited to the east by the border with Russia. The plan area extends southwest to include the Lofoten area, and west past the continental shelf break in the Norwegian Sea. The areas closer than 1 nautical mile to shore are to be managed according to the EU Water Management directive. Inside the area the plan aims to lay the overall foundations for the integrated management of all human activities, in order to ensure the continued health and safety of the entire marine ecosystem and the human communities dependent on its functions.

5. Implementation of the integrated management plan for the Barents Sea

The government white paper

The notion of an ecosystem approach implies that different types of uses of the ocean environment have to be reconciled, in order to realize the objective of sustainable use of the oceans. While this understanding of the ecosystem-based approach to oceans management may appear uncontroversial, decisions will in fact have to be made that favor certain interests at the expense of others. The approach taken in Norway through the integrated management plan is rather technical: ordering of priorities, selection of criteria and collection of data to assess against them. On the basis of that the optimal choice can be derived.

Sector based actions

Fisheries have a substantial impact on the ecosystem in the Barents Sea. The fishery authorities' responsibility is to continue to develop an ecosystem-based approach for that particular sector. Initiatives and measures here include bringing down illegal, unreported and unregulated fishing (IUU fishing), rebuilding certain fish stocks that have been depleted, increasing the general knowledge of distribution and ecology of relevant species, reduction of by-catches and damaging of benthic communities by fishing gears, and the development of selective fishing gear such as sorting grids. In the petroleum sector, comprehensive legislation and control and enforcement procedure ensure that the impact of petroleum activities on the environment and any inconvenience to other industries are dealt with. The decision to open an area for petroleum activity is made by the Storting. Specifically for the management plan area and the North, is the requirement that drilling operations in the north are required to have zero discharges.[8] The plan also places significant restrictions on when and where petroleum-related activities can take place (Fig. 5). The 2006 white paper on the management plan summarized the general negative effects the oil and gas industry can have on the environment through operational discharges of chemicals and oil to the sea, mechanical disturbance of the seabed, the effects of seismic surveys on fish and marine mammals, and emissions of NOx, VOCs and CO^2 to air. However, the conclusion was that given the strict standards that apply to petroleum activities in the Barents Sea, discharges to the sea and mechanical disturbances of the seabed are not expected to have significant environmental impacts. That leaves possible negative effects of larger accidental oil spills as the only potential significant environmental impact.

The relationship between fisheries and petroleum activities is a major environmental issue. The general experience from the North Sea is that fisheries and the petroleum industry can coexist. The increase in petroleum-related activities in the north has, however, brought a new awareness of the interactions of petroleum activities and fisheries. Among the contentious issues are the effects of seismic surveys on fisheries. A number of measures have been devised to limit potential damage from potential oil spills.

Policy tools for integrated oceans management

The plan itself establishes a number of policy tools: area-based management, species management, ecosystem indicators, and risk evaluation. In addition, the concept of valuable and vulnerable areas is a centerpiece of the plan.

Area-based management

Area-based management is a major policy tool in the context of the management plan. For areas identified as particularly valuable and vulnerable (Box below), special caution will be required and special considerations will apply to the assessments of standards for and restrictions on activities. In these areas activities should be conducted in such way that all ecological functions and biodiversity are maintained. In addition, a network of marine protected areas, including the southern part of the management area, will be established in Norwegian waters, at the latest by 2012 in order to maintain biodiversity and keep certain areas undisturbed.[9] The Nature Conservation Act provides the legal basis for permanent and general protection of areas against activities that have an impact on the environment and natural resources.

In the management plan area, several sub-areas are identified as particularly valuable and vulnerable (Fig. 4). Vulnerability is assessed with respect to specific environmental pressures such as oil pollution, fluctuation in food supply and physical damage. When assessing vulnerability, type of impact and duration has been considered. Differentiating between natural and human-induced pressures on the environment is however difficult. Furthermore, an area is usually not equally vulnerable all year round, and all species in an area will not be equally vulnerably in relation to a specific environmental pressure. Vulnerability can be measured at individual, population, community and ecosystem level.

The most important criteria for selecting the valuable and vulnerable areas were:

- whether it supports high production and high concentration of species
- whether it includes a large proportion of endangered or vulnerable habitats
- whether it is a key area for species for which Norway has a special responsibility or for endangered or vulnerable species
- whether it supports internationally or nationally important populations of certain species all year round or at specific times of the year

Negative pressures in these areas will in some cases affect a great deal of a population or a great deal of the ecosystem and might persist for many years.

8 Except for those resulting from the drilling of the top-hole section for surface casing.

9 A plan for marine protected areas has been drawn up, but the final selection of areas will be decided by the Ministry of the Environment, in cooperation with the Ministries of Fisheries and Coastal Affairs, Trade and Industry, and Petroleum and Energy.

An example of area-based management in effect is the framework for petroleum activities based on an evaluation of the particularly valuable and vulnerable areas and an assessment of the risk of acute oil pollution (Fig. 5). In some areas no petroleum activity will be permitted at all, while in others no new activity will be permitted or it can occur but not between 1 March and 31 August. Based on new knowledge gained through research, monitoring and ongoing activities this framework will be re-evaluated when the management plan is updated in 2010.

Another example of areas-based management is the mandatory routing and traffic separation scheme for maritime transport 30 nautical miles from the coast. This arrangement is precautionary, to reduce the risk of acute oil pollution from ships. This is still close enough to be within the coverage area of a special system for traffic surveillance and control (the Coastal Administration's AIS system), but at the same time far enough out to allow a certain response time in case of an oil spill.

A third example involving area-based management is temporary or permanent closure of areas to for example certain types of fishing gear motivated by the type of benthic community, underwater cultural heritage, or unwanted changes in commercial fish stock sizes and the size and age structure of these stocks. Marine protected areas have been established under the fisheries legislation to protect coral reefs from damage caused by bottom trawling in the Barents Sea – Lofoten Area.

Species management

Another important policy measure is species management. Norway has signed a number of international agreements and conventions on species protection and management, e.g. the Convention on Biological Diversity (CBD), the Convention on Trade in Endangered Species of Wild Animals (CITES), the Convention on the Conservation of Migratory Species of Wild Animals (CMS), the Agreement on North Atlantic Marine Mammal Commission (NAMMCO), the Agreement on the Conservation of Polar Bears and their Habitats, etc. To implement these, the Government has established a set of objectives for species management in the Barents Sea – Lofoten area. They are listed in the white paper on the management plan (Report No. 8 (2005-2006) to the Storting):

> Naturally occurring species will exist in viable populations and genetic diversity will be maintained.
>
> Harvested species will be managed within safe biological limits so that their spawning stocks have good reproductive capacity. Species that are essential to the structure, functioning, productivity and dynamics of ecosystems will be managed in such a way that they are able to maintain their role as key species in the ecosystem concerned.
>
> Populations of endangered and vulnerable species and species for which Norway has a special responsibility will be maintained or restored to viable levels. Unintentional negative pressures on such species as a result of activity in the Barents Sea – Lofoten area will be reduced as much as possible by 2010.The introduction of alien species through human activity will be avoided.

The most important criteria for selecting the valuable and vulnerable areas were:
whether it supports high production and high concentration of species

whether it includes a large proportion of endangered or vulnerable habitats

whether it is a key area for species for which Norway has a special responsibility or for endangered or vulnerable species

whether it supports internationally or nationally important populations of certain species all year round or at specific times of the year

Negative pressures in these areas will in some cases affect a great deal of a population or a great deal of the ecosystem and might persist for many years.

Elements of the monitoring system as they are defined in the white paper on the management plan include the following concepts:

Ecological quality
The ecological quality of an ecosystem is an expression of the state of the system, taking into account the physical, biological and chemical conditions, including the effects of anthropogenic pressures.

Indicators
An indicator is a variable that in present context provides specific information about a particular part of the ecosystem. Indicators will be used to assess how far the management goals have been reached and whether trends in the ecosystem are favorable.

Reference values
Reference values correspond to the ecological quality expected in a similar but more or less undisturbed ecosystem, adjusted for natural variation and development trends. Precautionary reference values are used for harvestable stocks.

Action thresholds
The action threshold is the point at which a change in an indicator in relation to the reference value is so grate that new measures must be considered.

Ecosystem indicators

A third policy tool is ecosystem indicators. It is desirable to be able to evaluate the state of the ecosystem, i.e. ecological quality, at any given time. In order to do so a set of indicators have been identified. It is important to choose indicators that give information about the state of a particular part of the ecosystem at a given point in time. Relevance to ecosystem management, relevance in relation to Norway's international obligations, feasibility in practice, and their role in the ecosystem are criteria used here. The indicators can be grouped into those which reveal something about the physical state of the water bodies in the Barents Sea and the production of phytoplankton and zooplankton, and indicators for components of the ecosystem that live on this production.

A satisfactory evaluation of environmental status is only possible when different indicators are combined with background information, like distributions maps for various species, information about ecology etc. One challenge is to distinguish between the effects of human activity and natural fluctuation in the ecosystem.

Based on the chosen indicators, a monitoring system is set up. The management plan emphasize that the system must be dynamic and flexible enough to be changed and updated in the light of new knowledge. Furthermore, additional ongoing monitoring in the Barents Sea will also be used in the yearly evaluation of the state of the ecosystem carried out by the Advisory Group on monitoring of the Barents Sea.

Risk evaluation

There will always be a risk connected to petroleum activities and maritime transport in the Barents Sea. Risk evaluation is therefore important in the assessment of policy measures. Maritime transport contributes considerable more to the overall risk of acute oil pollution than the oil and gas industry in the management plan area. However, in spite of an expected increase in the volume of maritime transport by 2020, the implementation of measures such as the already mentioned minimum sailing distance from the cost, traffic separation schemes and vessel traffic service centers will reduce the risk of oil spills associated with maritime transport by half from 2003 to 2020.

Based on risk identification and understanding of possible accidents scenarios and their consequences appropriate emergency response systems can be put in place. Based on an evaluation of whether there is adequate basis for decision-making or not, possible actions to reduce uncertainty etc., risk-based decisions are taken. Models and risk analysis are being used as tools to estimate risk. They focus on different aspects of risk, e.g. the probability of accidental discharges,

the probability of oil contamination, the risk of damage and potential damage-related costs. It is however, important to be aware of the pros, cons and limitations of these tools. Risk will also change over time due to change in traffic volume, implantation of measures, lessons learned from accidents, new technology etc

6. Conclusions

The Management Plan for the Barents Sea provides a foundation for co-existence of industries as well as measures for addressing the main challenges relating to pollution and the maintenance of biodiversity. Ecosystem-based management calls for cooperation across sectors, both with respect to monitoring, mapping and research.

The responsibility for increasing knowledge about the different pressures on the environment, as well as the implementation and enforcement of regulations and laws relating to the management plan, resides with the sector-based ministries and agencies. Norway is a relatively small country with an efficient and homogenous central administration, and coordination can be achieved between ministries and agencies from different sectors. The overall responsibility for the implementation of the plan however resides with the Ministry of the Environment.

Also, the implementation of the management plan is based on existing legislation. Recently, new legislation for the management of oceans resources have been adopted, and new legislation on the conservation of biodiversity are in the process of being developed. These acts emphasize the ecosystem approach to the management of marine ecosystems and the natural resources there.

A close international cooperation, particularly with Russia, is a premise for satisfactory management of the Barents Sea. In fisheries management, Norway and Russia has had a bilateral cooperation in a Joint Fisheries Commission since 1975.[10] In environmental management, Norway and Russia has had a Joint Commission on Environmental Protection since 1988. In 2005 a Marine Environment group was established under this commision, with the aim of enhancing cooperation on ecosystem-based management of the Barents Sea. A team of Norwegian and Russian scientists is currently preparing a joint assessment of the state of the environment and biological resources for the whole of the Barents Sea, as a basis for further cooperation on ecosystem-based management.

Permanent working groups

The actual work of implementing the management plan relies heavily on a tight integration between science and relevant management agencies. In response to the adoption of the management plan three permanent working groups have been established:

- An advisory group on monitoring to assist in coordination of the system proposed by the Government for monitoring the state of the environment
- A forum on environmental risk management focusing on acute pol lution in the area, which will provide valuable input to environmental risk assessments
- A forum responsible for the coordination and overall implementation of the scientific aspects of ecosystem-based management

The different groups have a broad membership, with representatives from the relevant public institutions with responsibility for and expertise in the various sectors, but will also draw on expertise from other sources as necessary. The groups report to a Steering group headed by the Ministry of Environment and in which relevant Ministries participate. In order to make sure that that the various business, industry, environmental organizations and Sami groups have their say on the implementation of the plan, a reference group has been established. The meetings of the reference group are open and all relevant stakeholders have an opportunity of be informed of the work and let their voice be heard in this regard.

Updating the plan

While the plan was adopted in 2006, it is now under revision to take into account new knowledge and changing situations. None of the regulations are set in stone, but up for revision as new and better knowledge becomes available. The first revision of the plan will take place in 2010, while a new management plan also for the Norwegian Sea will be adopted in 2009. Following the first update of the plan in 2010, there will be an updated version of the whole Barents Sea management plan in 2020 with a time frame up to 2040.

10 Scientific cooperation in the Barents Sea goes at least back to the 1950s.

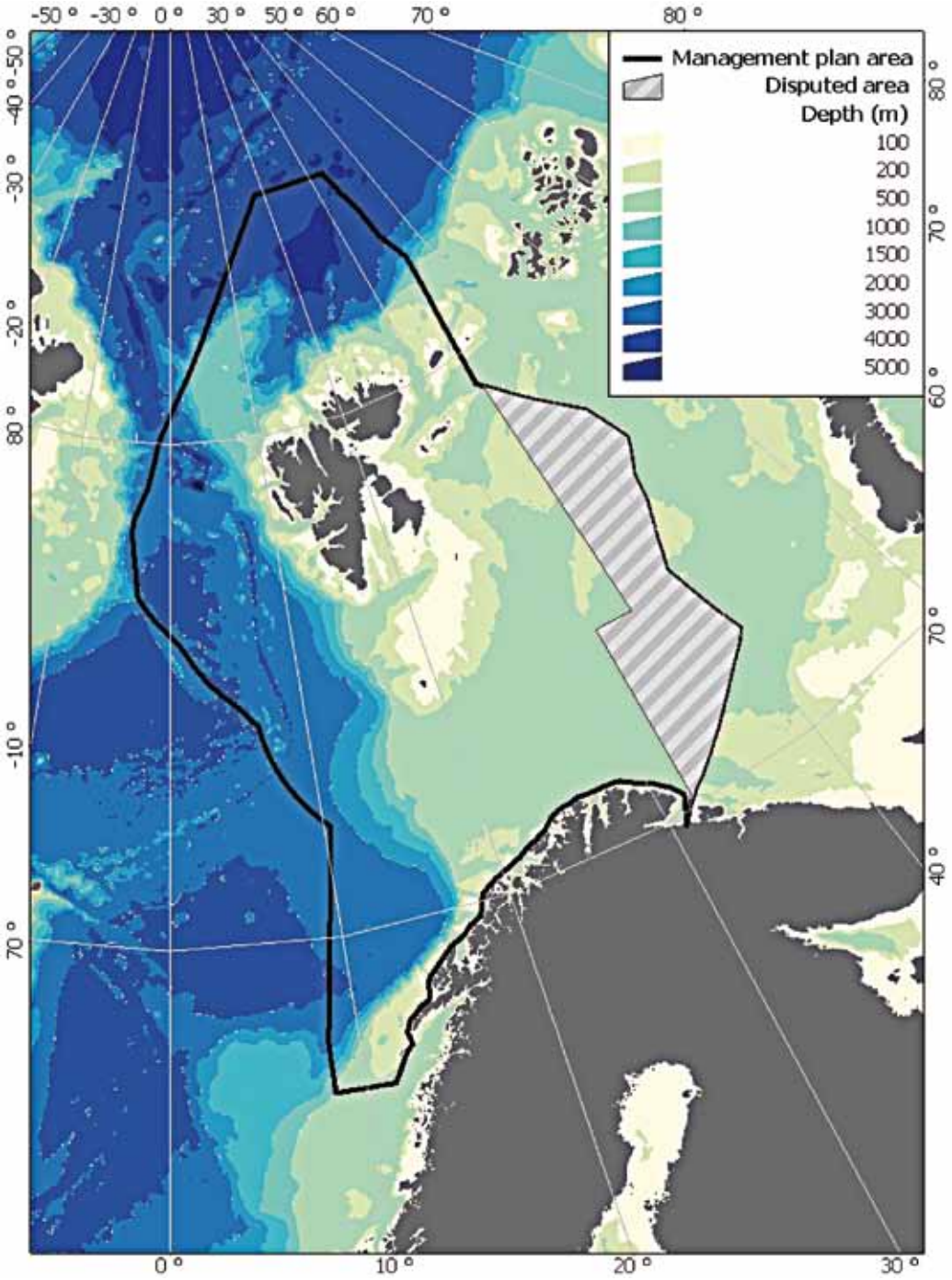

Figure 1. The Barents Sea. Plan area for the management plan (black line), Area of overlapping claims (grey hatched).

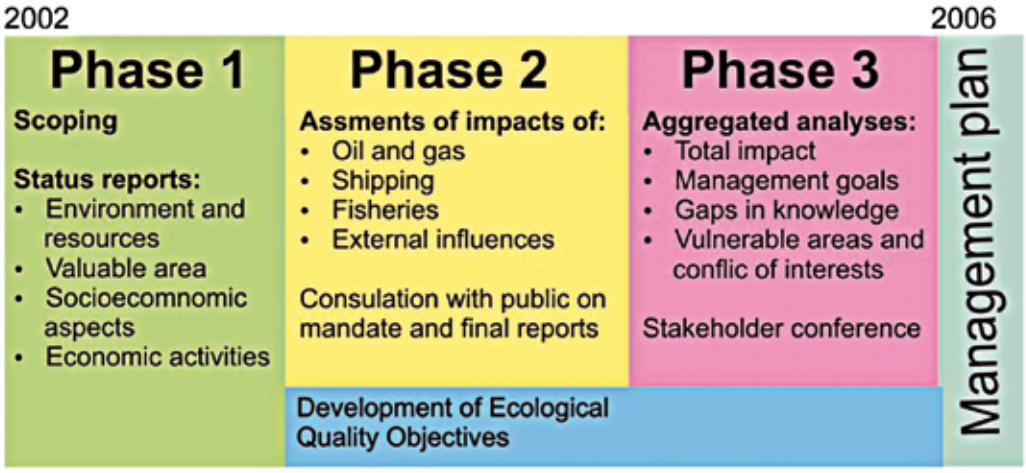

Figure 2. Development of the management plan from 2002 to 2006. The work was led jointly by four ministries, while the analyses and assessments were carried out by government directorates and institutes.

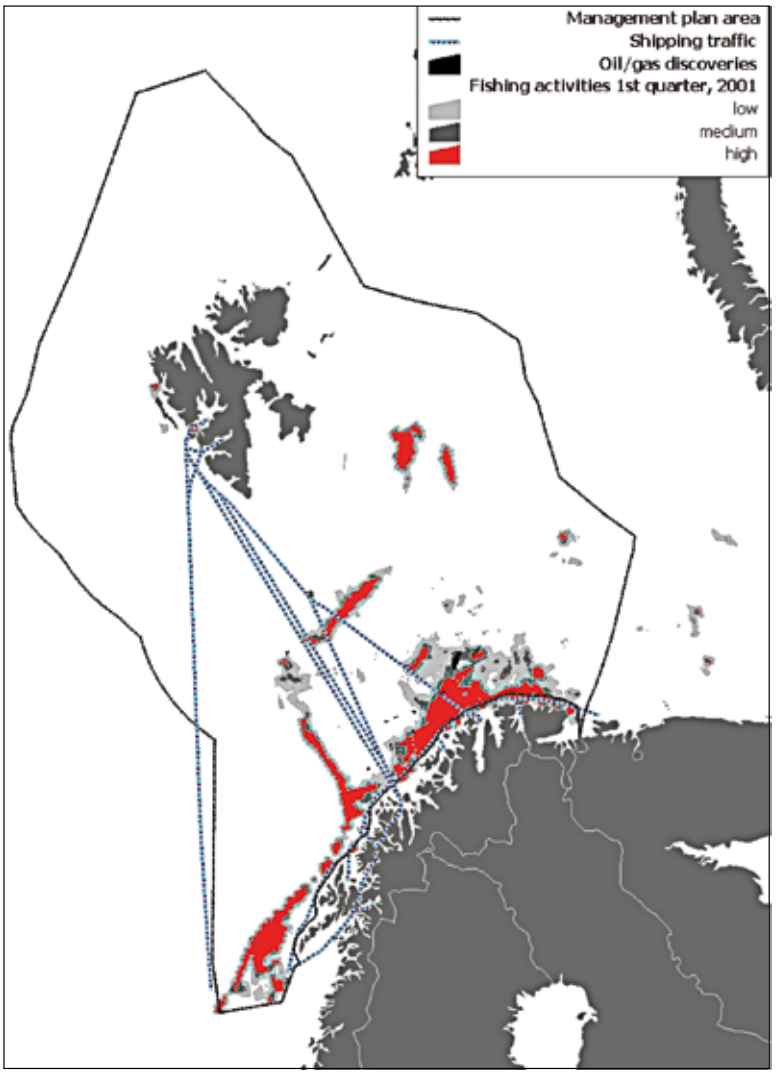

Figure 3. Human activities in the Barents Sea – Lofoten region.

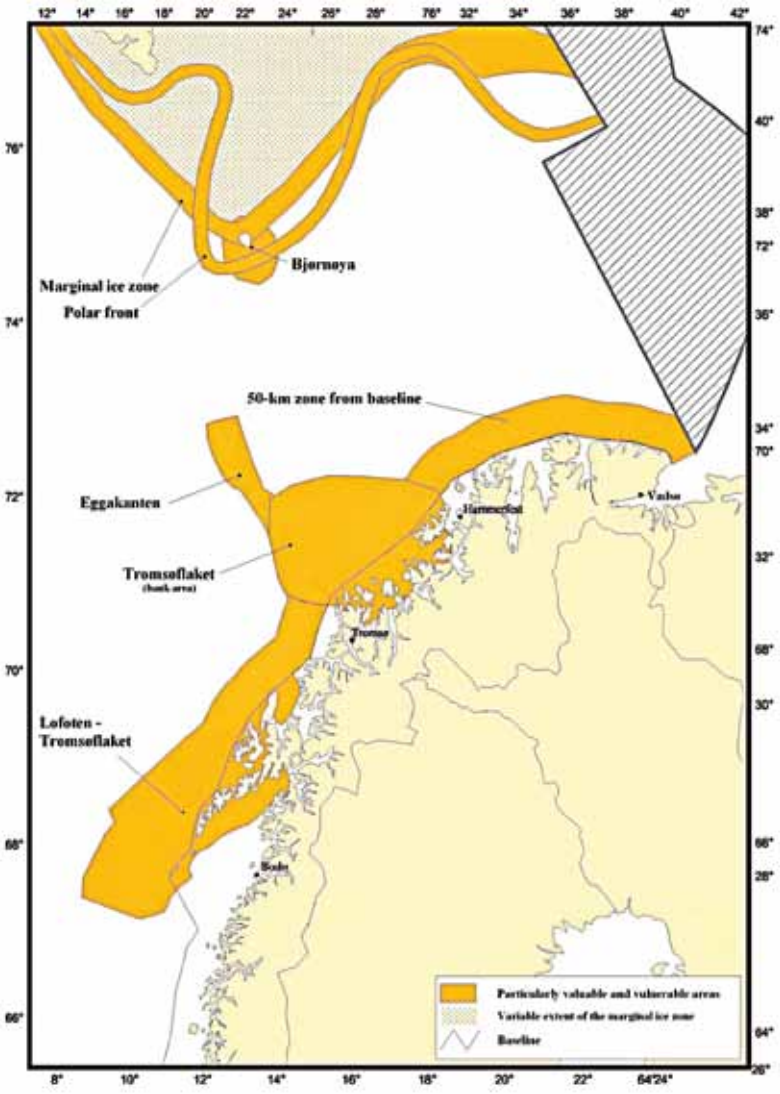

Figure 4. Particularly valuable and vulnerable areas in the Barents Sea – Lofoten Area.

Figure 5. Framework for petroleum activities in the Barents Sea –Lofoten area for the period 2006 – 2010.

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REPORT SERIES NO 129

Iceland

1. Introduction

The waters around Iceland, fed by the warm Gulf Stream, offer exceptional conditions for fish stocks to thrive, making Iceland's exclusive fishing zone of 758,000 km^2 some of the richest fishing grounds in the world. The currents and topography around Iceland provide oceanographic conditions that give relatively closed system on the continental shelf around the island. The geographical position of Iceland on the ocean ridges means that the country is in the vicinity of mixing areas of the warm and cold currents. The warm North Atlantic current originating in the Gulf of Mexico meets with the polar East Greenland current, flowing south along the East Greenland coast. Close to the coast there is a coastal current which flows clockwise around Iceland and is formed by mixing of warm oceanic water with fresh water from land. Due to these rather well defined conditions the area around Iceland has been defined as one of the large marine ecosystems (LME).

Icelandic policy on ocean issues is based on maintaining the future health, biodiversity and sustainability of the oceans surrounding Iceland, in order that it may continue to be a resource that sustains and promotes the nation´s welfare. This means sustainable utilization, conservation and management of the resource based on scientific research and applied expertise guided by respect for the marineecosystem as a whole. The health of the ocean and sustainable utilization of its living resources provides one of the main basis for Iceland´s economic welfare.

Understanding the marine ecosystem is the foundation of sensible and sustainable harvesting of the resources. The fishing industry is one of the main pillars of the Icelandic economy. Responsible fisheries at the Icelandic fishing grounds are the prerequisite for the Icelandic fishing industry continuing being a solid part of the Icelandic economy and a principal pillar in Iceland's exports.

Icelanders have structured a fisheries management system to ensure responsible fisheries, focusing on the sustainable utilisation of the fish stocks and good treatment of the marine ecosystem. The fisheries management in Iceland is primarily based on extensive research on the fish stocks and the marine ecosystem, decisions made on the conduct of fisheries and allowable catches on the basis of scientific advice, and effective monitoring and enforcement of the fisheries and the total catch.

2. The Icelandic government policy

In light of the importance of marine resources for Iceland, the government has adopted a clear and responsible long-term policy.

The principal objectives of Icelandic policy on the ocean are to maintain the ocean´s health, biodiversity and productive capacity, in order that its living resources can continue to be utilised sustainably. This means sustainable utilisation, conservation and management of the resource based on research, technology and expertise, directed by respect for the marine ecosystem as a whole.

The policy is based on three pillars. Firstly, on the UN Convention on the Law of the Sea, which provides a legal framework for ocean issues and, a basis for the management, conservation and utilization of the ocean area both within and beyond the Icelandic jurisdiction. Secondly, on the principle of sustainable development, the basis of which was established at the 1992 UN Conference on Environment an Development in Rio de Janeiro. Thirdly, on the principle that responsibility for the conservation and utilization of marine ecosystem is best placed in the hands of those States directly affected by decisions taken and have the greatest interests at stake.

3. The public sector

Ministry of Fisheries

The Ministry of Fisheries is responsible for the conservation and utilization of the living marine resouces, which encompasses the duty to respect and take into account environmental concerns. It addresses these concerns through its policies and legislation as well as through its commitment to the UNCLOS. The Ministry for Environment i.a. sees to concerns pertaining to the prevention of pollution of the ocean, matters pertaining to toxic and hazardous substances and conservation of biodiversity.

The Ministry is responsible for management of fisheries in Iceland, and the implementation of legislation, and issues regulations to this effect. The Ministry´s duties are general administration, long-term planning and relations with other fisheries institutions at the international level. Three bodies assist the Ministry of Fisheries in management and general administration tasks: Directorate of Fisheries, The Marine Research Institute and The Coast Guard.

Directorate of Fisheries

The Directorate of Fisheries is an Icelandic Government institution under the ultimate responsibility of the Minister of Fisheries. The Directorate is responsible for implementing government policy on fisheries management and handling of seafood products.

The Directorate enforces laws and regulations regarding fisheries management, monitoring of fishing activities and imposition of penalties for illegal catches. The Directorate allocates catch quotas and issues fishing permits to vessels. Furthermore, the Directorate is the competent authority responsible for the operation of border inspection posts.

Collection, processing and publication of fisheries data is also the responsibility of the Directorate of Fisheries in collaboration with Statistics Iceland.

The Marine Research Institute

The Marine Research Institute (MRI) is a government institute under the auspices of the Ministry of Fisheries. MRI conducts various marine research and provides the Ministry with scientific advice based on its research on marine resources and the environment. The institute has around 170 employees, 2 research vessels, 5 branches around Iceland and a mariculture laboratory.

The three main areas of activities of the MRI are the following: To conduct research on the marine environment around Iceland and its living resources, to provide advice to the government on catch levels and conservation measures and to inform the government, the fishery sector and the public about the sea and its living resources.

MRI's avtivities are organized into three main sections: Environment Section, Resources Section and Advisory Section.

Marine Environment Section

A large part of the section´s work deals with environmental conditions (nutrients, temperature, salinity) in the sea, marine geology, and the ecology of algae, zooplankton, fish larvae, fish juveniles, and benthos. The available data on fishing effort of the Icelandic fleet is very accurate and have made it possible to map in detail the distribution of otter trawl effort around Iceland. Priority have been given to map the distribution of benthic assemblages and habitats which are considered to be sensitive to trawling disturbances. Such information are important in order to predict which species and habitats are being at risk of being damaged by fishing activites and for protection of important marine habitats. The closure of five vulnerable coral area are one of the results from this work. Amongst the larger projects undertaken within the Environmental Section are investigations on surface currents using satellite monitored drifters, assessment of primary productivity, overwintering and spring spawning of zooplankton, studies on spawning of the most important exploited fish stocks and seabed mapping.

Marine Resources Section

Investigations are undertaken on the exploited stocks of fish, crustaceans, mollusks and marine mammals. The major part of the work involves estimating stock sizes and the total allowable catch (TAC) for each stock. Examples of some large projects within the Marine Resources Section are annual ground fish surveys covering the shelf area around Iceland and surveys for assessing inshore and deep-water shrimp, lobster, and scallop stocks. The pelagic stocks of capelin and herring are also monitored annually in extensive research surveys using acoustic methods. Further, in recent years an extensive program concentrating on multi-species interactions of exploited stocks in Icelandic waters has also been carried out.

The Fisheries Advisory Section
The Fisheries Advisory Section scrutinizes stock assessments and prepares the formal advice on TAC´s and sustainable fishing strategies for the government.

The Coast Guard

The Iceland Coast Guard, which falls under the auspices of the Ministry of Justice, is responsible for patrol and monitoring in Iceland´s EEZ as well as on the high sea outside Iceland's EEZ where Iceland has direct fishing interests such as in the NEAFC area. Additionally the Coast Guard inspects fishing gear noting whether it fulfills the requirement of regulations.

4. The fishing industry

The fishing industry is the mainstay of the national economy, however it does not receive any subsidies. The Icelandic fishing industry is quite competitive and has expanded its operation to other countries. It has a stake in the sustainable use of the marine resources.

The total Icelandic catches amount to 1.3 – 2 million tons annually. Figure 1 shows Icelandic fish catch for all major species in 1905-2006. The importance of the fishing industry peaked during the 20th century. The main reason for the increase in volume of the Icelandic fisheries, starting around 1970s, is the start of capelin fisheries and in recent years increased herring and blue whiting fisheries.

The fishing fleet consists of several vessel types. Officially they are divided into trawlers, decked vessels and undecked small vessels. Not all fishing vessels registered in Iceland are active but may lay idle, e.g. in 2005 only 1 449 vessels out of 1 752 registered were active. With the implementation of the ITQ (individual transferable quota) system, overcapacity in the fisheries was not an issue in itself anymore as it is up to the operator of the vessel to conduct the fisheries in its most efficient way.

The fisheries sector in Iceland provides over 50% of earnings of exported goods, making the annual market value of seafood around 2 billion US dollars. Fisheries have and will continue to play a great role for the economic survival of the nation even though it's share is reductive as other industries are growing fast. The most important market for Icelandic export of marine products is the European Economic Area amounting 70-80% of the total value with UK as the biggest single market reaching over a quarter of the total export value of marine products in some years.

5. The fisheries management system in Iceland

The Fisheries Management Act from 1990 is the cornerstone of the current system of fisheries management in Icelandic waters. The Act aims at promoting the conservation and efficient utilisation of fish stocks, thereby ensuring stable employment and settlement throughout the country. The Act is intended to provide the principles for fisheries management and to create a foundation for efficient, rational and sustainable utilisation of fish stocks, in order to provide maximum resource yield for the country as a whole. These targets thus fit in well with the concept and objectives of sustainable development.
The catch limitation system is the basis of the Icelandic fisheries management system. The system is intended to limit the total catch and to prevent more fishing from the fish stocks than the authorities allow at any given time. The catch limitation system is based on the catch share

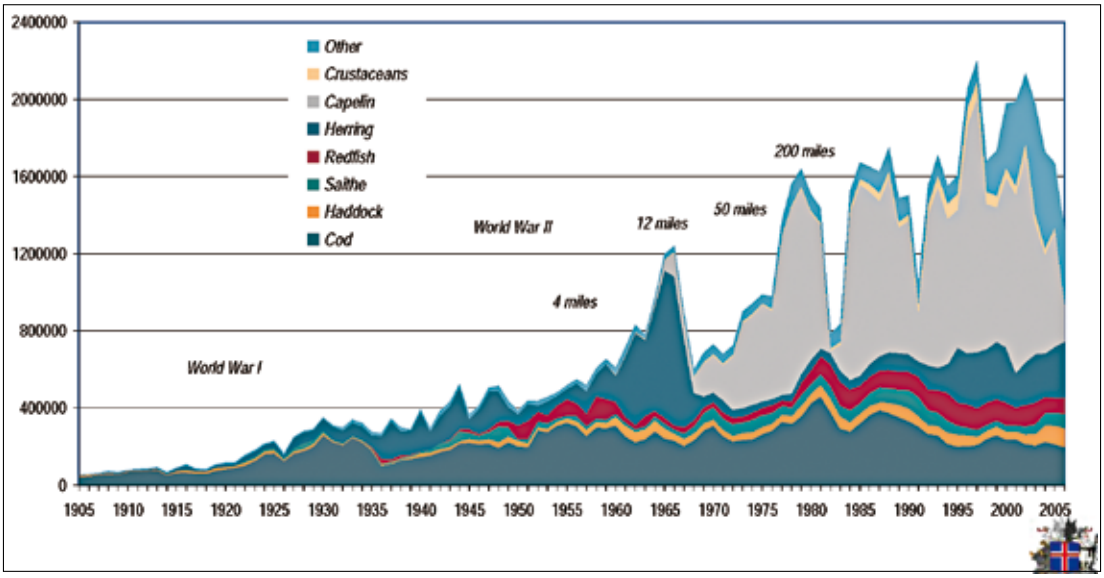


Figure 1. Icelandic Catch 1905 - 2006
Source: Statistic Iceland.
Notes: 1905-1944 catch from Icelandic grounds (ICES area Va) / 1945-2006 Icelandic catch from all grounds.

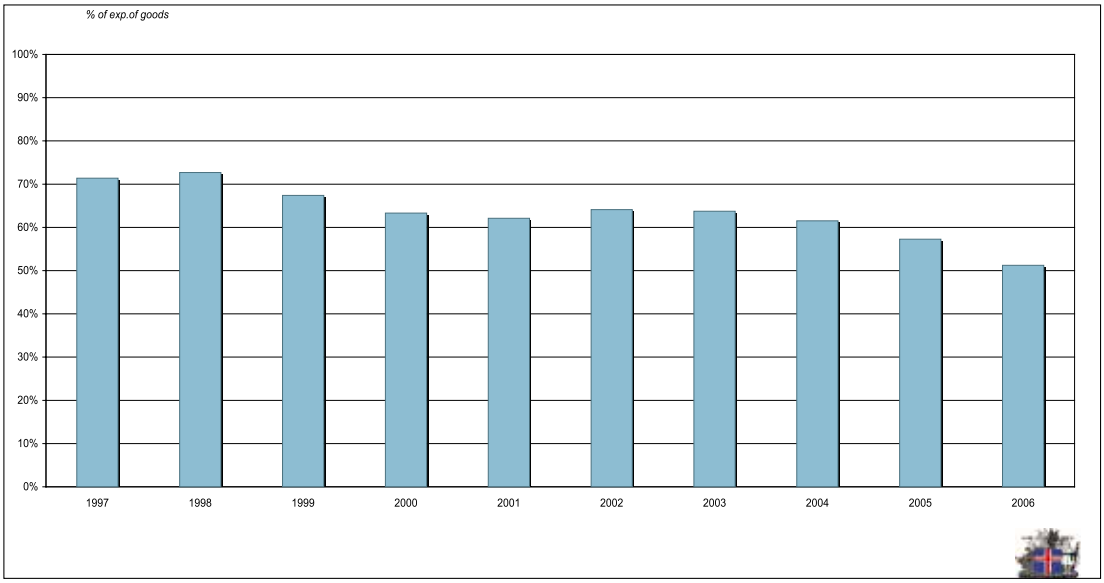


Figure 4. Percentage of value of exported goods
Source: Statistics Iceland.

allocated to individual vessels. Each vessel is allocated a certain share of the total allowable catch (TAC) of the relevant species. The catch limit of each vessel during the fishing year is thus determined on basis of the TAC of the relevant species and the vessel's share in the total catch. The catch share may be divided and transferred to other vessels, with certain limitations.

It was in 2004 the fisheries management system became a uniform quota system. The small vessels that were still in a system of fishing days were then issued a catch quota in accordance with their fishing permit. This final merging of the days at sea system and the quota systems resulted in a comprehensive system that ensures that fishing is in accordance with the decision of the Minister of Fisheries and supports sustainable utilisation of the natural resource.

The management has three pillars, firstly the general individual transferable quota system (ITQ), secondly the small vessels ITQ, where there are restrictions on use of gear and selling of quota is limited to that part. Thirdly there are regional policy instruments, where a limited quantity of quotas are allocated to vessels in communities that are dependent on fisheries and have been adversely affected by national fluctuations or other shocks. Fishing vessels are allocated a fixed quota share of the species subject to TAC. The combined quota share for all vessels amounts to 100% of each species. All commercial fishing activities are subject to these quotas

In addition to the ITQ system which, together with the TAC allocation, is the cornerstone of Iceland's fisheries management, there are a number of other measures that are integral to the overall management system.

Deciding the total allowable catch (TAC) based on scientific grounds

The Minister of Fisheries is obliged by law to take recognition of the advice from the Marine Research Institute before determining the annual TAC. The Minister of Fisheries determines the annual TAC of every species subject to quota regulation. A scientific assessment of the state of the fish stocks and the condition of the ecosystem constitutes the main basis of determining the TAC each year. Conformity between the scientific fisheries advice and the authorities' decisions on the TAC is a principal factor for ensuring responsible fisheries management. The authorities' decisions on the maximum catch are based on social and economic factors, yet always focused on ensuring the long-term renewal of the fish stocks. For instance the Minister decided to cut down the TAC in cod in 2007 ca. 30% according to the advice of the MRI. The Icelandic authorities have implemented a utilization strategy with the long-term objective of ensuring sustainable fisheries.

The catch rule

There are different ways to implement a precautionary approach in fisheries. In 1995 Iceland adopted a catch rule for cod, and catch rules for capelin and herring had been adopted previously. The catch rule was a result of extensive work by marine biologists and economists who provided advice on maintaining stability in the fishing sector, the most favourable stock size and efficient rebuilding of the cod stock, among other things, taking into account the relationship between cod, capelin and shrimp stocks.

Figures 2 and 3 show the development in the management in cod and the capelin fisheries as well as catches from these fisheries during the period 1988-2006/7. Since 1995 the TAC in cod fisheries follows a catch control rule which allows for a certain percentage of the fishable stock to be fished. The rule has been amended couple of times and the percentage lowered to ensure the sustainability of the stock.

As there is a strong connection between the cod and the capelin stock the management advice for capelin takes into consideration the need of the cod stock for capelin as fodder.

Effective catch control and enforcement

Effective control is an inseparable part of the responsible fisheries management and ensures that the catches in Iceland are well in conformity with the TAC every fishing year. The Directorate of Fisheries is responsible for the implementation of laws and regulations regarding fisheries management in Iceland and for monitoring and enforcement regarding the fisheries operation and the fish processing. All commercial fisheries are subject to authorization by the Directorate of Fisheries.

The fisheries inspectors of the Directorate of Fisheries monitor the correct weighing and registration of the catch. Information on each vessels allowable catch and quota use is regularly updated and made public and accessible to all on the Directorate's web-site, as mandated by law, thus ensuring transparency. Any catch brought ashore is to be weighed by accredited harbour officials. Upon completion of weighing, the relevant harbour authorities register the catch in the central database of the Directorate of Fisheries, which ensures a steady overview of the status of the allowable catch of every vessel and how much has been taken from the fisheries quota. After the information about the catch has been entered into the database it is accessible to everyone on the Internet. This arrangement provides a great deal of transparency and ensures better control and inspection of the fishing and catch position of Icelandic boats and vessels.

The fishing gear is subject to effective monitoring, as well as the composition of the catch and its handling onboard the fishing vessels. The

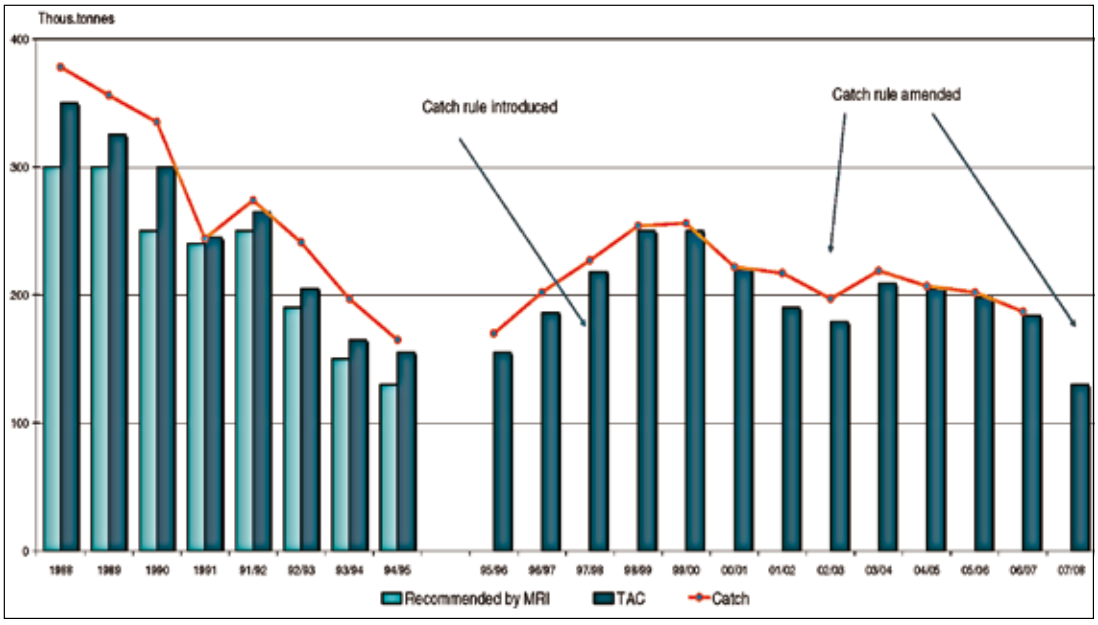


Figure 2. Management and fisheries for cod 1988-2007/08. Source: Directorate of Fisheries, MRI.

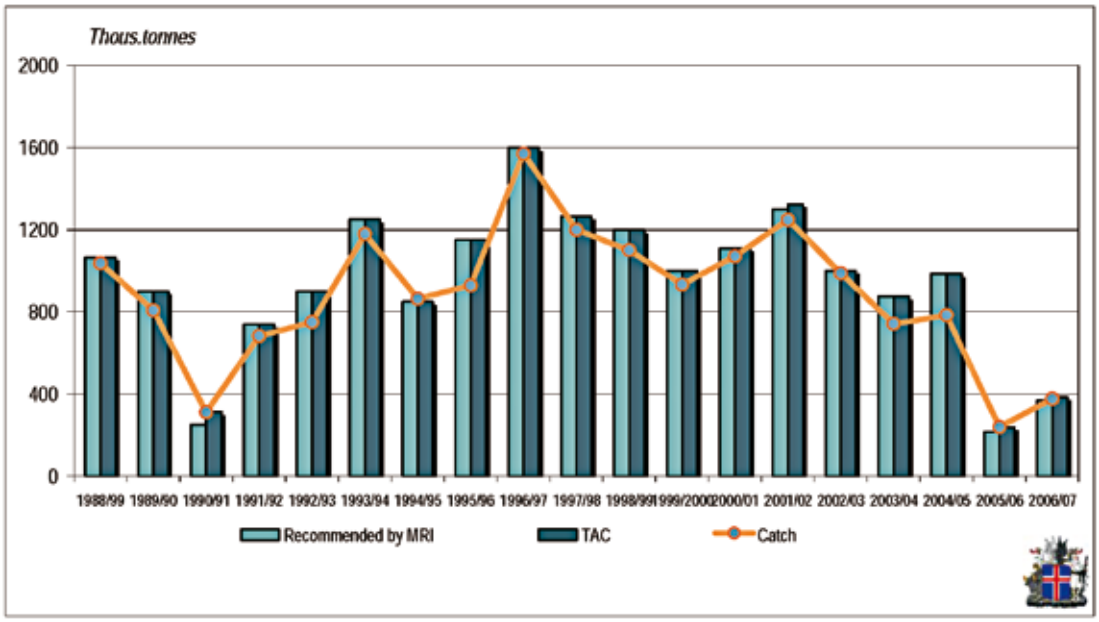


Figure 3. Management and fisheries for sapelin 1988-2007/07
Source: MRI

inspectors have access to the catch logs, which state the location of the fishing activity, the day of the catch, the type of fishing gear used and the catch quantity. If such control reveals the presence of much small fish or juveniles at the fishing grounds, the Marine Research Institute temporarily closes the relevant fishing grounds without delay.

Reliability of catch information ensured

The effectiveness of monitoring of the fisheries and catch control is reflected, among other things, in the observed good conformity between the TAC and the real catch every year. Anyone purchasing and/or selling catches is obligated to present reports to the Directorate of Fisheries, containing information on the purchase, sale and other disposition of fish catches. If discrepancy materializes in the database of the Directorate of Fisheries between the information stated in the reports and the information received from the harbour weighing, measures are taken when this is deemed appropriate. This ensures independent checking of the accuracy of information about the catches that are brought ashore. Experience shows that there is good conformity between the catch information of the Directorate of Fisheries and the information about the total fish export as registered elsewhere. This conformity illustrates the reliability of the catch information.

Severe penalty for breaches of the fisheries management legislation

Breaches of the law and regulations on fisheries management are subject to fines or revoking of the fishing permit, irrespective of whether such conduct is by intent or negligence. Major or repeated intentional offenses are subject to up to six years imprisonment. If the catch of a vessel exceeds the allowable catch of the said vessel of individual species, the relevant fishing company must obtain an additional catch quota for the relevant species. If this is not done within a certain timeframe, the fishing permit may be revoked as well as a charge having to be paid for the illegal catch.

Special measures for protecting small fish and the ecosystem

In addition to the ITQ system which, together with the TAC (total allowable catch) allocation, is the cornerstone of Iceland's fisheries management, the management system is supported by other management measures such as closure of areas to protect juveniles, stringent restrictions on fishing gear, and use of protected areas to conserve important vulnerable habitats. The closures may apply to specific fishing gear, fishing-vessel size or all fishing for certain periods of time. Annually, such temporary closures of areas are in force to protect spawning grounds of cod and other demersal species. These closures aims at conserving certain biological resources, spawning grounds, juveniles or unwanted bycatches.

The regulations concerning the type of fishing gear permitted, include the minimum mesh size, fishing with trawls is prohibited in large areas near the coast which serve as spawning and nursery areas. Grids in fishing gear are obligatory in certain fisheries to prevent catches of juvenile fish.

Extensive provisions are made for temporary closures of fishing areas to protect spawning fish from all fishing. In addition, the Marine Research Institute (MRI) has the authority to close fishing areas temporarily without prior notice if the proportion of small fish in the catch exceeds certain limits. If small fish or by-catch repeatedly exceeds guideline limits, the relevant area is closed for a longer period of time. Additionally, in some areas the use of bottom contact fishing gear is totally prohibited to protect vulnerable habitats, e.q. corals. In a 2005 report on the protection of vulnerable marine areas, three areas south of Iceland in total 73 square kilometers were considered in need of a special protection and a need for further electronic mapping of the seabed identified. The fisheries sector was given the opportunity to comment or amend these proposals before the Minister decided upon them. In the process the protected areas were extended to cover some 80 sq.km, including five coral reefs. A new regulation adressing especially vulnerable benthic habitats provides for prohibition of fishing activities with bottom contacting gears.

The closures of the coral reefs were done with acceptance of the fishing industry. The gathering of information and definitions of areas to be closed or protected were work of cooperation between the main stakeholders, i.e. the fishing industry, authorities and the scientific authority.

Clear rules on discards and the disposition of by-catch

Collecting and bringing ashore any catches in the fishing gear of fishing vessels is obligatory according to law. Discarding catch overboard is prohibited and such conduct is subject to penalty according to law. If a vessel catches any species in excess of its fishing permit, the relevant fishing company has the option of obtaining additional quota within a certain period of time after landing the catch.

A part of the criticism of the quota system has been that it creates incentives for fishermen to throw away valuable catch when they don't own the necessary quotas. As a response to this criticism the Icelandic Parliament decided that every operator could land up to 5% in excess of his annual catch quota (0.5% for pelagic species). This excess catch must be registered and weighed separately, sold at an auction market and the proceeds go to a research fund that supports marine research.

Another feature of the legislation that helps against discards is that the fishermen can land up to a certain limit small or undersize fish with only 50% of the weight being charged against the annual catch quota.

The limit is generally 10% for each species in each landing. The smaller fish is normally sold for a lower price so the fishermen don't have the same incentive to throw it away.

The Directorate of Fisheries and the Marine Research Institute conduct research and estimate discarded catches. The results indicate insignificant discards by the Icelandic fishing fleet.

6. Ecosystem-based fisheries management in Iceland

Sustainable utilisation of resources is the key to a rational and responsible conservation and management of living marine resources. The marine ecosystem are being examined by using a holistic approach, in order for Icelandic policy to include all aspects of marine life.

In Iceland the Marine Research Institute carries out research on the ocean's commercial stocks and provides the authorities with fisheries advice. The Marine Research Institute is an independent institution that falls under the auspices of the Ministry of Fisheries and is the main research body in Iceland conducting marine and fisheries research. Stock assessments are based on systematic research of the size and productivity of the fish stocks and the marine ecosystem. Additionally, the institute investigates fishing gear and its impact on the ecosystem, including bottom trawl, line, net and mid-water trawl fisheries and the fishing gear's selectivity. Research on the impact of fishing gear is among other things aimed at minimizing to the extent possible such impact on the ocean's ecosystem.

Active collaboration with international scientific organisations ensures that the focus is on internationally acknowledged research methods that provide the best available information on the condition of the fish stocks around Iceland at any time. Stock assessments and scientific fisheries advice are the main foundations of the decisions made by the authorities on the TACs each year. Prior to the Marine Research Institute's advice on the total catch being published, the institute's assessment of the size and condition of the main fish stocks is presented to and evaluated by relevant committees of the International Council for the Exploration of the Sea (ICES). Additionally, there is collaboration with other multi-national organizations, including NEAFC (Northeast Atlantic Fisheries Commission) and NAFO (Northwest Atlantic Fisheries Organization), when addressing stocks occurring beyond the Icelandic Exclusive Economic Zone.

Management of the utilisation of living marine resources in in Icelandic waters has to a significant extent reflected the elements comprising the ecosystem approach. Emphasis has been placed on research and harvesting advice having regard to the interaction and interconnections between different stocks and species in marine ecosystem. Many research activities in recent years have been directed towards a more holistic view such as bottom trawl surveys and other resource surveys that were initially targeted at certain important fish stocks but are now also valuable source of information on any related or non-tareted, often, non-commercial species. The governement of Iceland has published an official policy document on ocean matters with ecosystem approach to fisheries as part of the portfolio.

In Reykjavík an international conference on responsible fisheries in the marine ecosystem was held in the year 2001. The conference was held in preparation for the Johannesburg Summit on Sustainable Development. The Conference was held by FAO at the invitation of the Icelandic government and with support of the Norwegian government. The Conference was a major player in introducing the content and concept of an ecosystem approach into fisheries management. This approach implies that utilisation of marine resources should be managed from a wider perspective than that of simply considering commercial fish stocks. The Conference resulted in the Reykjavík Declaration on Responsible Fisheries in the Marine Ecosystem. The declaration was introduced and discussed at the Johannesburg Summit.

At the scientific symposium held in conjunction with the Reykjavík meeting it was concluded that many of the measures that are being implemented under single-species management shemes are in the spirit of ecosystem approach. As experience and circumstances allowed, improvement should be made on the existing methods in a stepwise process. Since then a the process has been good, but to determine objectives, criteria and appropriate/relevant indicators is complicated, and in general the matter is still at a design or development stage. While this development has taken place, many countries have continued to elaborate on single-species approach with standard ingredients such as those that have been developed and improved in Iceland and elsewhere in recent years. These comprise TAC´s to limit total fish removals, fishing gear, spatial/temporal restrictions, restrictions on vessel sizes, selective mesh size and gear, season length and timing, multispecies interactions and area closures, short or long-term. All these elements are essential and in the spirit of ecosystem approach to fisheries.

By weighing one resource against another authorities and stakeholders in Iceland have, with help of harvest control rule, managed the economically valuable cod stock, that feeds on capelin and shrimp. Every year sufficient quantity of capelin is left as fodder for the cod and sufficient quantity is left of capelin to spawn. Due to the close dependence of capelin as food for cod, short-term predicitions for cod are significantly linked to predictions of the development of capelin stock in the following year. And since cod is valuable in economic terms, the long-term strategy was to build up the cod stock at the cost of lower shrimp yields. Likewise, in terms of biomass, whales constitute a major component of marine life in Icelandic waters and may significantly influence the yield of the interacting fish stocks, different views arise as to how to value and manage the whale stocks. Weighing of components provides in this case like the other a basis for longer term management strategies.

A well founded framework of ecosystem approach to fisheries is an appropriate tool to weigh these resources and take a well balanced management action with predicted consequences.

A pragmatic approach is under development at the MRI, to be applied in the current single stock fish assessments. For each species and a stock that is assessed, the aim is to map relevant information both for research and management purposes:

1. The quality and nature of the assessment techniques used.
   The quality of the data. Stocks may be assessed with the help of age-based techniques and managed on the basis of a well defined long-term management strategy, they may be assessed with age-based techniques or length-based techniques and catch data, and managed on *ad hoc* basis. In data poor situations, one would normally require special caution and notation of this would be relevant in this context.
2. The effects of the given fishery on the target stock.

   i) Further, the effects of the fishery in question with respect to dis cards of target and non-target species by gear and area will be mapped. Indirect mortalities of target and non-target species would be examined. An assumed level of impact would be noted, availability of estimates and monitoring series, and whether there is a specific need for actions to be taken.

   ii) The potential effects of the fishery in question on the physical environment by area, e.g. fish and benthic habitats (spawning grounds, nursery grounds and coldwater corals).

   iii) The potential effects of the fishery in question on different ecosystem components or species/stock complexes. This includes examination of benthic and zooplankton communities, sea birds, marine mammals and fish communities. Examination of whether the exploitation of the target species affects the livelihood of other biological resources, e.g. due to lesser predation or competition. e,g. fish and benthic habitats (spawning grounds, nursery grounds and coldwater corals).

Several other factors have to be taken account of in this appraoch which can be applied for each species caught in a single-species management scheme.

3. Relevant, multispecies considerations will be noted. Availability of food-web data and modelling.

4. A special attention will be given to potential effects of enviromental changes on the target stock in question, since the concern is not only on the human activities on the ecosystem.

5. A routinely considerations for some special management, where they may seem needed. Operational factors have to be noted and taken account of, e.g. change in markets or technological shift in the fisheries. Change in the distribution of stocks.

All these additional ecosystem considerations would cast light on aspects that are relevant for ecosystem approach to fisheries. This would be reflected in the assessment work itself, and in future plans of investigations. In addition to conventional advice to authorities on recommended TAC´s, a qualitative statement on important or relevant issues in ecosystem context would follow, that would put the advice into a wider ecosystem approach to fisheries context than conventional advice.

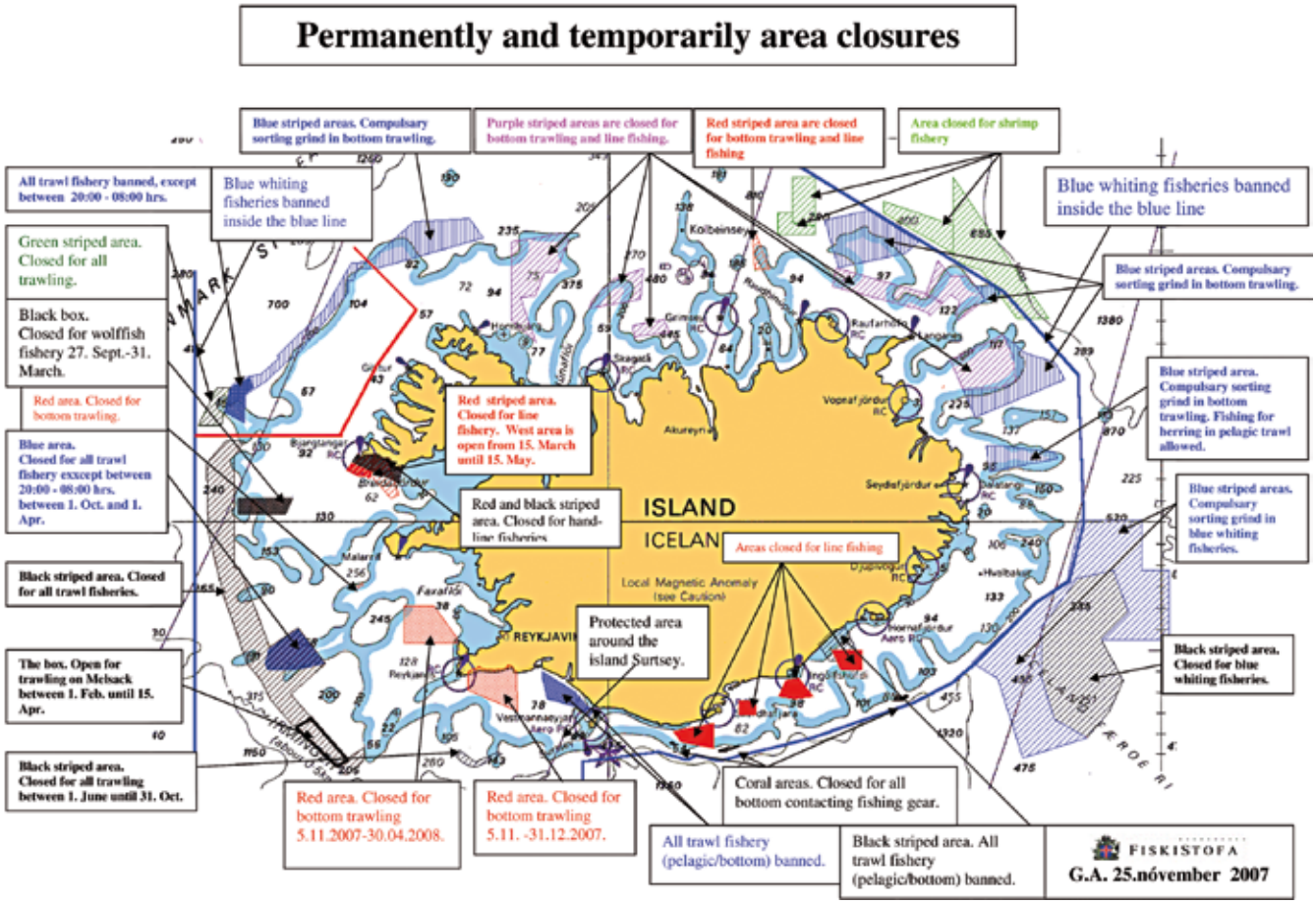
By taking account of the circumstances in the waters around Iceland the Marine Research Institute is step by step adding important components to the already functioning single-species scheme and by doing that improving and building up an ecosystem approach to fisheries. The framework for fisheries management is gradually being adapted to fit the objectives of the ecosystem approach that is being built in step by step in the assessment scheme that is aready being used. This framework is built on a national priorities that can be diverse in objectives from other national or regional frameworks, taking account of different circumstances.

An important objective and implementation strategy of an ecosystem approach is that it must be developed in consultation between governments, scientists and stakeholders. The cooperation between scientists and the industry has long history in iceland as part of the fishing fleet has been involved in scientific work every year for decades. The examples above on multispecies management system, the relationship between cod, capelin and shrimp and the influence of whales are cases worth referring to when discussing EAF. In this cases scientist and fishing industry have been heavily involved. The closure of five vulnerable marine habitats (coldwater corals) was developed in good cooperation with stakeholders. In the scientific work of location, fishermen supplied valuable information on locations of coldwater corals which led to the above mentioned closure of five areas. The closure was done with acceptance of the industry.

Ecosystem approach to fisheries is based on existing management practices, knowledge and structure, it uses the principles and instruments of conventional fisheries management and develops them to further incorporate ecosystem consideration. Increased scientific knowledge is the fundamental tool for continual development of the ecosystem approach to fisheries. Ecosystem approach is therefore an adaptive process. At the MRI the development of a practical applications of the ecosystem approach to fisheries is in work. By maintaining the current emphases and objectives, increased knowledge are being used to improve resource management methods step by step. A broadened single-species considerations may provide a pragmatic approach to move stepwise forward in this respect.

7. International agreements and regional co-operation

The main share of Icelandic catches are fished inside the Icelandic EEZ from stocks that are solely managed by Icelandic authorities, e.g. almost all cod processed and exported from Iceland is fished according to the Icelandic management system. Several stocks are joint stocks managed by Iceland in co-operation with other nations, as they occure both inside and outside Icelandic EEZ. Fishing from joint stocks are managed either by bilateral agreements beetween states or multilateral agreements often performed in the regional fisheries managment organizations.



The United Nations Fish Stocks Agreement (UNFSA) is the basis for international fisheries management and for conservation of straddling and highly migratory fish stocks. Iceland regards the UNFSA as of a paramount importance, as it strengtherns considerably the framework for conservation and management of straddling fish stocks and highly migratory fish stocks by regional fisheries management organizations (RFMOs). The RFMOs are highly relevant for co-operation between coastal states and high seas fishing states as well are other regional arrangements for the conservation and management of fishing from such stocks. It is intended to ensure their long-term conservation and sustainable utilisation.

It is the view of Icelandic authorities that competent regional organizations are the preferable forum to solve a management issues when several states utilize a common resource.

Iceland is a party to various of regional arrangents on fisheries management in the North Atlantic, including Northeast Atlantic Fisheries Commission (NEAFC) and Northwest Atlantic Fisheries Organization (NAFO). In both these RFMOs a holistic view is taken to the utilization of the marine resources in the high sea.

Iceland has emphazised the role of the Food and Agricultural of the United nations (FAO) in the field of fisheries. Iceland has been actively taken part in the development of guidelines for deep-sea fisheries in the high seas and made financial contribution to this important work of FAO. Furthermore, Iceland has put effort in the work of COFI of effective measures against vessels enganged in IUU fishing on the high seas.

8. Steady improvements

Fisheries management in Iceland has a long history and the fisheries management system has been under development for decades with a focus on the fisheries being both economical and sustainable with respect to the natural resources' utilization and renewal. In recent years, measures have been taken in strengthening an ecosystem approach to the fisheries management in Iceland. Increasing emphasis is placed on research and development of methods in this field, and on fisheries advice that takes into account various interrelated factors in the ecosystem, such as the interaction of the species, environmental change and multi-species impacts. The focus is furthermore on strengthening research on the effects of fishing gear on the ecosystem, particularly on the seabed and the living bottom communities.

Icelanders have the ambition to be in the forefront of responsible treatment of the natural resources of the ocean. Hence, steady improvements are made of the fisheries management in Iceland and its scientific basis and measures are taken to strengthen the dissemination of information on the Icelandic fisheries.

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REPORT SERIES NO 129

Greenland

Summary

In Greenland elements of ecosystem-based ocean management have been introduced, but an integrated ecosystem-based ocean management is still to be developed. Practices in management of fisheries and hunting, sea traffic, mineral resources, and nature conservation are predominantly management by single species or single activities with elements of stakeholder involvement.

The important success element in moving towards integrated ecosystem-based ocean management is the achievement of sustainable use of natural resources.

Currently, the main obstacle is the lack of a national strategy for the use of ecosystem-based management, including a strategy for nature conservation and species management in Greenland. There is a need to develop desired aims for nature conservation and species management in line with international conventions and national policies. Furthermore, strategies on monitoring and stakeholder involvement, and guidelines on ecosystem-based management in relevant sectors are to be developed.

8.1 Greenland and the marine ecosystems

Greenland covers an area of 2.166.086 km^2 and more than 80 per cent of the island is covered by the Greenland Ice Sheet. The northernmost point is Cape Morris Jesup, only 740 km from the North Pole, while Cape Farewell in the south shares latitude with Oslo, Norway.

Atlantic and Arctic waters surround the island of Greenland. To the south Greenland meets the North Atlantic Ocean and to the east the Greenland Sea and the 240 km wide Denmark Strait between Greenland and Iceland. The west coast of Greenland meets the Davis Strait and Baffin Bay, and north of Qaanaaq Smith Sound and Nares Strait, waters that separates Greenland from Ellesmere Island, Canada. In Nares Strait a mere 26 kilometres separate Greenland from Canada. North of Greenland lays Lincoln Sea and Wandels Sea, both within the Arctic Ocean.

The Greenland coastal line covers 44.087 km. The coast is dominated by deep fiords and archipelagos, and conditions for marine activities can be challenging as icebergs, sea ice and storms are common.

Climate and the effects of climate change

In the Arctic region the low temperature is the greatest challenge facing organisms. Climatic conditions define the physical framework for the existence of life in an area.

The high arctic zone, with average temperature during the warmest months of the year below 5°C, covers the entire Greenland Ice Sheet and the costal region of northern Greenland. The high arctic zone borders with the towns of Upernavik and Uummannaq on the west coast and Ittoqqortoormiit on the east coast of Greenland. But inland the high arctic zone reaches as far south as 61°N.

The low arctic zone, with average temperatures during the warmest months of the year between 5°C and 10°C, covers the coastal areas on both the east and west coast from Cape Farewell to 72°N. The open sea area in the south brings relatively cool summers and mild winters to this area. In the valleys of the deep fiords the average temperature may climb above 10°C in the summer categorizing these as small and isolated areas with a subarctic climate.

Travelling north the average rain fall decreases dramatically. In South Greenland the annual average rain fall is 800 to 1400 mm while northern regions and the Greenland Ice Sheet only receive 200 mm. The Peary Land area in northern Greenland can be categorized as an arctic desert with virtually no rainfall.

Changes in climate are fast and dramatic in the Arctic. The Arctic Climate Impact Assessment (2004) forecasts increases in average temperatures by 2°C in the low arctic areas of South Greenland over the next century, and along with an increase in rainfall the lengthened growing season will bring a more vigorous plan cover. In North Greenland the average winter temperature will increase by 6 - 10°C, but dramatic changes in the average summer temperature are not expected. According to the ACIA report Greenland will see an increase in rain- and snowfall by 10 to 50 per cent.

In Greenland the effects of climate change are visible and have therefore received attention in the international climate debate. Warmer winter presents a challenge to traditional ways of life as unstable ice conditions makes it difficult for hunters and fishermen to perform traditional ice fishing and hunting. As new waters open the dog sledge may be replaced by boat covering larger hunting grounds.

The changes in temperature will affect the wildlife in Greenland. The northeast population of musk ox (*Ovibos moschatus*) and caribou (*Rangifer tarandus*) might be threatened by the climatic changes, while the population in South Greenland is likely to prosper from a more vigorous vegetation cover. Researchers expect the population of polar bear (*Ursus maritimus*) in Northeast Greenland to be challenged by the climatic changes.

Melting permafrost is a future challenge to infrastructural planning and development. Asiaq/ Greenland Survey participates in a project surveying the melting of the permafrost in Alaska and on 6 locations in West Greenland. Based on climate models the researchers hope to predict the extent of melting permafrost in 2050. Generally, housing is based on bedrock, but the melting permafrost is a challenge infrastructure, i.e. roads, runways and sewage systems.

However, the effects of climate change also bring new opportunities to the Greenlandic society. Retreating ice is exposing ancient bedrock enriched with minerals, including diamonds, olivine and zinc, and Greenland is experiencing an increase in mineral exploration activities. The economy largely depends on fisheries and tourism, but new industries are developing with the mineral activities and the plans for an aluminium smelter on the island of Maniitsoq. In South Greenland agriculture is developing as more vegetables can be grown and in the future small scale forestry might develop and current livestock of sheep might be supplemented by cattle.

The international focus on climate change in the Arctic has also brought an increased number of tourists. But the fishing industry is still predominant in the economy of Greenland. Changes in stocks calls for a re-orientation of the industry as northern shrimp (*Pandalus borealis*) has started to disappear from the waters off South Greenland, while large stocks of Atlantic cod (*Gadus morhua*) are reappearing.

8.2 Marine ecosystems and marine protected areas

The marine ecosystems in Greenland are characterized by seasonal ice cover and marked fluctuations in temperature and light. In parts of the region ice cover occurs seasonally, the ice and ice melt have large influence on ecological conditions. When the ice melts, there is typically a sudden increase in light and a burst of plant growth in the form of an ice edge bloom in spring and summer. This supports large populations of fish, marine mammals and birds.

Another typical feature of the marine Arctic is the way in which sea ice, melt water and ice scours physically affect bottom plants and animals on or near the coast. Iceberg scour can cause damage to bottom fauna to depths of 500 meters. Sea ice limits the penetration of light into the ocean, but also curtails the ability of wind to stir up the water. The changes in seasons with freezing and thawing of the ice have profound effects on the hydrographic conditions in the uppermost 50 to 200 meters of the water column and therefore on primary production. In spring a fresh surface layer is formed and augmented by freshwater runoff from rivers and streams. Especially near the coastline a thick layer of fresh water can form, driving away fish.

8.2.1 Large Marine Ecosystems in Greenland

The data presented in the section below is based on research and information made available by the Sea around Us project, based at the University of British Colombia and the National Oceanic and Atmospheric Administration (NOAA), and on recent LME studies as published in an article on the West Greenland Shelf LME and the East Greenland Shelf LME respectively, published by researchers Aquarone and Adams on the LME portal of the NOAA in the autumn of 2008. The West Greenland Shelf LME and the East Greenland Shelf LME

Figure 1. The West Greenland Shelf LME (approximate location). Source: Based on information from NOAA, National Oceanic and Atmospheric Administration, USA. Map copyright of NASA Visible Earth, the SeaWiFS project, NASA/Goddard Space Flight Centre, and ORBIMAGE.

Figure 2. The East Greenland Shelf LME (approximate location). Source: Based on information from NOAA, National Oceanic and Atmospheric Administration, USA. Map copyright of NASA Visible Earth, the SeaWiFS project, NASA/Goddard Space Flight Centre, and ORBIMAGE.

Greenland waters cover two Large Marine Ecosystems (LMEs); the West Greenland Shelf LME (LME no. 18) and the East Greenland Shelf LME (LME no. 19). Both LMEs are considered Class III low productivity ecosystems (< 150 gC/m2-yr) based on primary productivity estimates from SeaWiFS.

The West Greenland Shelf LME (see Fig. 1) begins at Eirik Ridge in Southern Greenland and extends along Greenland's west coast. This LME covers area of 375.000 km2 of which 1.37 per cent is protected. The LME is characterized by its subarctic climate as well as by ice cover in the winter. Greenland shares jurisdiction of the West Greenland Shelf LME with Canada.

The West Greenland Shelf LME is closely connected with the East Greenland Shelf LME. The strong Irminger current of the Greenland Sea carries water down the Greenland east coast and around the southernmost Cape Farewell.

The East Greenland Shelf LME extends along Greenland's east coast to the Eirik Ridge, covering an area of approximately 319.000 km2, of which some 13 per cent is protected. The continental shelf varies in width from 750 km in the north to a mere 75 km in the south, and the costal line is dominated by a large number of fiords.

This LME is influenced by the cold East Greenland current, which flows south along the coast from the polar sea area. The LME is characterized by subarctic climate, seasonal ice cover and marked fluctuations in salinity, temperature and phytoplankton.

A low productivity ecosystem, changes in both sea and air temperature is principal physical driving force of the East Greenland Shelf LME. These climatic variations cause large variability in ice and hydrographic conditions within a year. Therefore plankton production and fish recruitment is affected and brings variations in annual catches of cod and small pelagic fish.

In the summer the melting of the ice has significant effects on ecological conditions, causing large amounts of nutrient salts to be transported into the waters around East Greenland. Owing to these climatic factors and to the high latitude of this LME the seasonal phytoplankton production is of short duration and of limited extent. Primary production is conveyed efficiently to higher tropic levels and supports large populations of fish, marine mammals and seabirds.

There is a relatively long time series of plankton and hydrographic samples allowing an exploration of the links between climate, physical oceanography and abundance of major zooplankton and ichtyoplankton species.

Currents carry cod eggs and larvae around Cape Farwell in southern Greenland, as seen in the influx of cod larvae from Iceland in 2001. There is a need to learn more about the patterns of occurrence of fish larvae and zooplankton over time and space. As part of the monitoring programme NuukBasic, managed by the Centre of Marine Ecology and Climate Effects at the Greenland Institute of Natural Resources, studies on selected fish larvae and zooplankton in relation to hydrographic features are undertaken.

The Health of the LMEs

The waters of the West Greenland Shelf LME are little polluted according to Aquarone and Adams (2008). The population density is generally low and strong currents rapidly remove all waste. No waste water treatment plants are established in Greenland and solid waste is either burned in incineration facilities or depositioned at the open refuse dumps.

Table 1.
Concentration of DDT and PCB in human tissue
Dichloro-Diphenyl-Trichloroethane and Polychlorinated biphenyls measured in µg per gram of human fat.
Women aged 18 to 49.
Source: Johansen and Rydahl, 2007, p. 54.

	DDT	PCB
Northeast Greenland	1.720	4.325
Northwest Greenland	600	1.045
Southwest Greenland	265	360
Greenland, average	610	950
Faroe Islands	600	1.050
Denmark	155	210

Localized elevated levels of lead and zinc have been found in sediments and biota near the Maarmorilik mining area near Uummannaq.

Owing to the remoteness and the low population density, the environmental conditions within the East Greenland Shelf LME are generally good

Studies indicate that the cold Arctic climate creates a sink for mercury and Persistent Organic Pollutants (POPs), and that the already high levels of mercury in the Arctic are not declining despite emission reductions in Europe and North America. Around eastern Greenland levels of some Persistent Organic Pollutants (PCB and DDT) are relatively high in both biotic and abiotic media.

Studies under the Arctic Monitoring and Assessment Programme (AMAP) of the Arctic Council prove that levels of certain heavy metals and POPs are relatively high in a number of marine mammals living in Greenland waters, i.e. ringed seal (*Phoca hispida*), harp seal (*Phoca groenlandica*), minke whale (*Balaenoptera acutorostrata*), beluga whale (*Delphinapterus leucas)* and narwhale (*Monodon monoceros*). Mercury and cadmium can be found in the intestines of these mammals, and the POPs bio-accumulate in both human and animal tissue. The National Environmental Research Institute studies the polar bears and special attention has been drawn to the health of the East Greenland population of bears as the animals here have the highest levels of POPs.

Studies of marine pollution and the effects on human health are also conducted as traditional Greenlandic food is rich on fish, seal and other marine mammals. Studies of human health prove that there is a great variation in the concentration of pollutants in human blood in Greenland, and generally the population living off the sea show high concentrations of both DDT and PCB.

The variations in DDT and PCB levels are explained by a number of factors. Researchers see increased levels of POPs in marine mammals in the waters of East Greenland compared to the waters of West Greenland. But the researchers also find important differences in lifestyles in the towns of Southwest Greenland compared to the small towns and settlements in Northeast and Northwest Greenland. Traditionally, meat from polar bear has been part of the East Greenland diet, whereas the north-western diet includes more whale.

Vulnerable Marine Ecosystems
The knowledge about the existence of Vulnerable Marine Ecosystems (VME's) is very limited. Organisms, e.g. Gorgonian corals, have been found on both the West and East coast. The distribution of accumulations of large sized sponges is patchy and the presence depends to a great extent on the local topography. Some sponge fields, also known as ostur, are known from the east coast (Klitgaard and Tendal 2004).

Through their presence, species like corals and sponges increase the physical heterogeneity of the bottom and the associated fauna is very rich. Intensive trawling rapidly leads to severe depletion of these features. VME's are at present not considered when designating areas closed to trawling.

"VME features may be physically or functionally fragile. The most vulnerable ecosystems are those that are both easily disturbed and very slow to recover, or may never recover"
Source: International guidelines for the Management of Deep-Sea Fisheries in the High Seas. FAO. 2008

8.2.2 Marine Protected Areas

Greenland and Denmark jointly participates in international forums where discussions, works and agreements may influence Greenlandic public affairs.

Greenland has ratified a series of international conventions on protection of wildlife, flora and fauna, e.g. the Convention on Wetlands (RAMSAR), the Convention on International Trade on Endangered Species of wild flora and fauna (CITES), and the Convention on Biological Diversity (CBD). To help ensure mechanisms for protecting the environment and the marine environment the following conventions have been ratified: the London convention on prevention of marine pollution by dumping wastes, the MARPOL convention for the prevention of pollution from ships (excluding annex 4 on wastewater from ships and annex 6 on emissions), the OSPAR convention for the protection of the maritime area against the adverse effects of human activities, the Basel convention on transboundary movements of hazardous wastes and their disposal, the Espoo convention on the assessment of impacts on the environment in a transboundary context (excluding the protocol on strategic environmental assessments), and the Climate convention and the Kyoto protocol on reduction of greenhouse gas emissions.

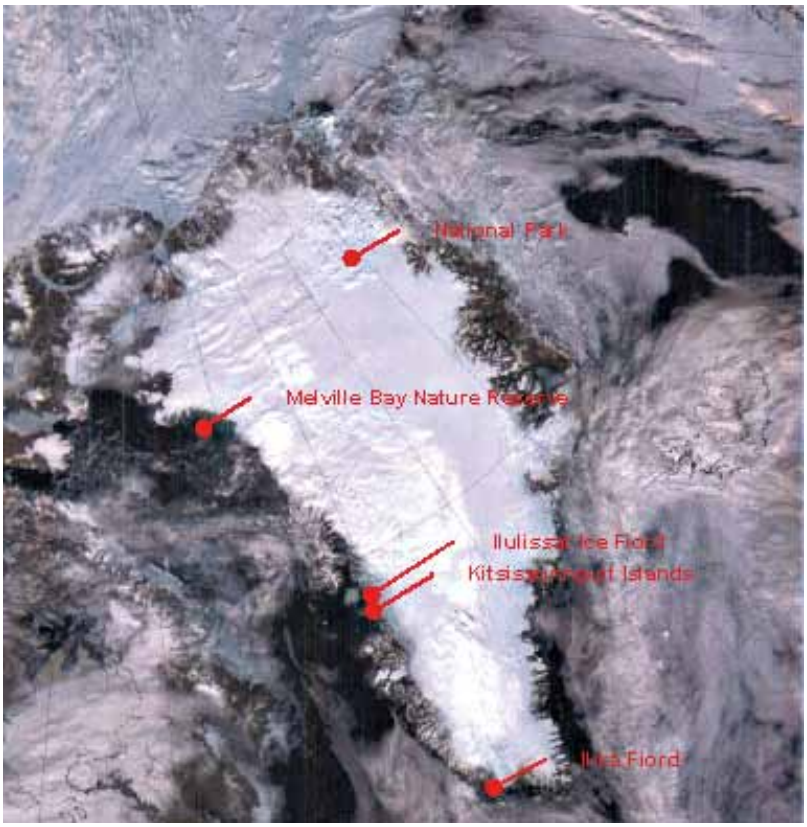

Figure 3. Five protected areas. Map copyright of NASA Visible Earth, the SeaWiFS project, NASA/Goddard Space Flight Centre, and ORBIMAGE.

1 The protected area and year when the conservation was first introduced: Lyngmarken (1954/1986), the National Park of North and East Greenland (1974), the Melville Bay (1980), Arnangar nup Qoorua/Paradisdalen (1989), Akilia (1998), Ilulissat Ice Fiord/ Kangia (2003), Uunartoq (2005), Qinngua (2005), Aust manna valley (2008) and Kitsissunnguit Islands/ Grønne Ejeland

Figure 4. The National Park of North and East Greenland

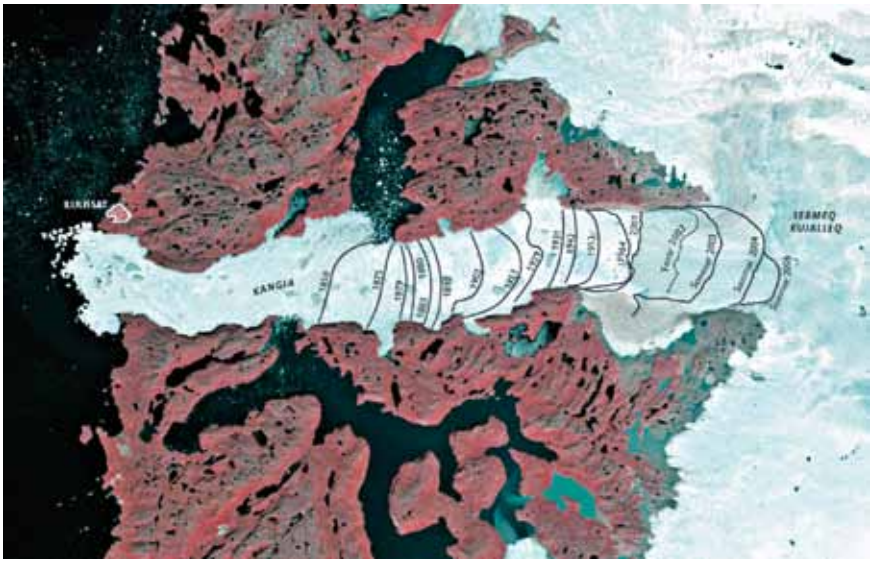

Figure 5. The Ilulissat Ice Fiord and the Sermeq Kujalleq glacier edge, 1850 – 2006.
Source: Geological Survey of Denmark and Greenland, GEUS.

Protected areas

Measures are taken to protect areas both in land and within the 3 nautical mile sea territory where they are of considerable natural, cultural or historic value.

The status on protected areas in 2008:

- 11 protected areas (Nature Conservation Act)
- 11 RAMSAR sites (RAMSAR convention)
- 13 bird protection areas (Government order on the Conservation of Birds)

In eleven areas the Home Rule Government has enforced conservation in accordance with chapter 5 of the Nature Conservation Act, no. 29 of 18 December 20031, while other eleven areas have been designated as protected wetlands in accordance with the RAMSAR convention These areas have international ecological significance and special be taken in protection.

Besides protected areas, protected wetlands there are thirteen bird protection areas listed in the Home Rule Government Order no. 5 of 29 February 2008 on the Conservation of Birds. In these areas activities are regulated to protect birds in important areas for resting, breeding, moulting etc. General regulation of activities near cliffs and islands important to populations of birds apply nationally.

In ecosystem-based oceans management attention must be brought to the following protected areas that include marine habitats: The National Park of North and East Greenland, the Ilulissat Ice Fiord, the Melville Bay, the Ikka Fiord, and the Kitsissunnguit Islands.
The National Park of North and East Greenland

The National Park was laid out in 1974 by the Danish Parliament on recommendation of the former Greenland National Council. In 1988 the National Park was extended westwards and today it covers 972.000 km2. The southernmost point of the National Park is located at 71°N in Scoresby Sound Fiord, while the northernmost point on the island of Odaaq is at 84°N. The National Park today borders on the traditional hunting communities of Ittoqqortoormiit on the east coast and Qaanaaq in northwest Greenland.

Towards the Arctic Ocean and the Greenland Sea the borders run three nautical miles off the baseline, i.e. the line connecting the extreme points of the coast.

The International Court of Justice in 1933 recognized Danish sovereignty and more importantly, recognized that Greenland is one society united by culture and language. Based on the ruling of the International Court of Justice, the Second World War and thereafter the Cold War, the Danish Defence has patrolled the uninhabited areas of northern and eastern Greenland. During the war patrols travelling by dog sledges managed to localize German weather stations, and since 1952 the Sirius Patrol of the Danish Defence has patrolled the National Park area. From a base in Daneborg a patrol of 12 men travels the entire coastline each year.

Stations used by the Ministry of Defence are placed along the National Park coast: Station Nord, Daneborg, Mestersvig, Ella Ø, Danmarkshavn, Kap Moltke and Brøndlund Hus.

In locations within the National Park there are a number of research facilities, e.g. the Zackenberg Research Station, which is an ecosystem research and monitoring facility north of Daneborg in East Greenland, and the US Summit Station, home of the Greenland Environmental Observatory. In 2008 a new series of ice core drillings began at the NEEM Station on the Greenland Ice Sheet just off the National Park border.

The National Park of North and East Greenland is a Managed Resource Protected Area in accordance with International Union for Conservation of Nature (IUCN) guidelines for protected area management. The National Park is covered by the UNESCO Man and the Biosphere Programme.

The Home Rule Government has issued the Home Rule Government Order no. 7 of 17 June 1992 on the National Park of North and East Greenland, with later amendments. The aim of the order is to ensure eco-system conservation, i.e. protecting landscapes, geology, sites of historical or cultural value, and flora and fauna, and to regulate recreational use of the National Park.

The Ilulissat Ice Fiord

The Ilulissat Ice Fiord is the sea mouth of Sermeq Kujalleq, one of the few glaciers through which the Greenland Ice Sheet reaches the sea. Sermeq Kujalleq is one of the most active glaciers in the world and it calves large volumes of ice annually. On an average the Sermeq Kujalleq calves over 35 km^3 of ice annually, but large variations apply.

Being an object for scientific attention for 250 years, the Sermeq Kujalleq glacier has helped to develop our understanding of Ice Sheet glaciology and climate change. The illustration below (Fig. 5) marks the retraction of the glacier edge since 1850.

The Melville Bay

The Melville Bay borders with the coast of Northwest Greenland, opening to the south-west into Baffin Bay.

Home Rule Government Order no. 21 of 17 May 1989 on the nature reserve in Melville Bay, protects the coast and waters of Melville Bay. The border of the nature reserve covers the area between 76° 22' 30''N / 64° 01' 00''W and 75° 40' 30''N / 57° 56' 00''W, but within the nature reserve of Melville Bay an area is laid out as fully protected (zone II).

The Ikka Fiord

Home Rule Government Order no. 11 of 25 April 2000 on the conservation of the inner waters of the Ikka Fiord, protects the waters of the fiord and the remarkable submarine columns formed from ikaite found growing on the bed of the Ikka Fiord. Early research indicates that the water leaking from the columns is meteoric in origin and shows signs of enrichment in the chemicals necessary for ikaite formation during its passage through the Grønnedal Ika complex.

The protected area covers the inner parts of the fiord, from 61°11'N. The public has access to the ikaite columns, but only if measures are taken to protect the columns and the ecosystem. Sailing is permitted if slow and in a boat with narrow drought, but within 50 m of the columns only kayaks and the like can be used.

The Kitsissunnguit Islands

In April 2008 the Home Rule Government issued Order no. 11 of 17 April 2008 on the Conservation of the Kitsissunnguit Islands.

The Kitsissunnguit Islands in the Disko Bay region was designated as a RAMSAR site (site no. 388) in 1988 and the order was issued to promote the protection of the ecosystem and the biodiversity of the islands, in particular the important colony of Arctic tern.

The Institute for Natural Resources in Nuuk and the National Environmental Research Institute have monitored the population of Arctic tern during the last 6 years. The population of Arctic tern on the Kitsissunnguit Islands is important and relatively large, covering approximately one-third of the total population in Greenland. Furthermore, the Kitsissunnguit population is well documented as it has been studied for decades. In 1946 the population was assessed at 50.000 pairs, but today only 18.000 pairs of Arctic tern inhabit the islands. In 2002 researchers found that many chickens died or was weakened by the lack of food, while collection of eggs still took place despite regulations to protect birds. Based on this information and a long process of local stakeholder involvement the conservation of the Kitsissunnguit Islands was introduced in 2008.

8.3 Commercial and non-commercial marine activities

A wide range of activities may influence the marine environment. Below attention is drawn to activities within the fisheries and hunting,

Export	2000		2007	
Greenland, total value of export	296.000		327.000	
Value of export, fish	283.000		285.000	
Northern shrimp		181.000		179.000
Atlantic cod		6.000		11.000
Greenland halibut		49.000		63.000
Crab		31.000		14.000
Other		16.000		18.000

Table 1 Value of export in 2000 and 2005 (in 1.000 €).
Source: The Annual Economic Report of the Greenland Home Rule, 2007.

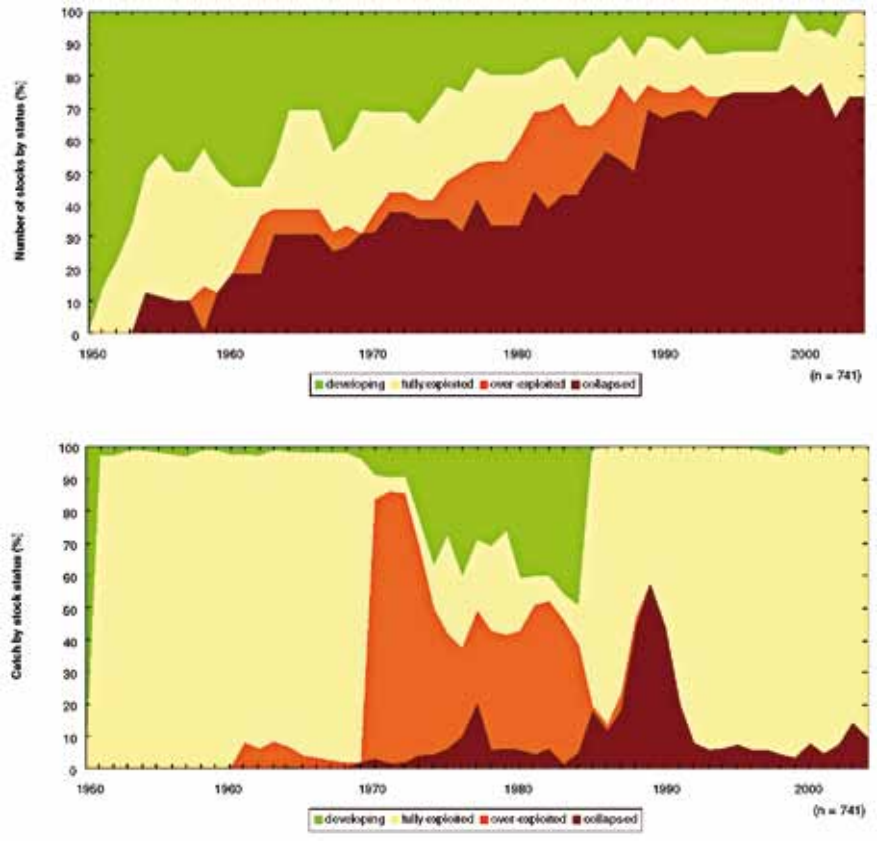

Figure 6. Stock-Catch Status Plots for the West Greenland Shelf LME; showing the proportion of developing (green), fully exploited (yellow), over-exploited (orange) and collapsed (purple) fisheries by number of stocks (top) and by catch biomass (bottom) from 1950 to 2004. Note that (n), the number of "stocks", i.e.., individual landings time series, only include taxonomic entities at species, genus or family level, i.e.., higher and pooled groups have been excluded (See Pauly et al, for definitions)

Source: Aquarone, M.C. and S. Adams. 2008. *West Greenland Shelf – LME #18*; published by NOAA onto the LME Portal and in Sherman, K. and Hempel, G. (Editors) 2008. *The UNEP Large Marine Ecosystem Report: a perspective on changing conditions in LMEs of the world's Regional Seas.* UNEP Regional Seas Report and Studies No. 182 (figure XIX-58.8, p 782). See Pauly et al. *Fisheries in Large Marine Ecosystems: Descriptions and Diagnosis for definitions.*

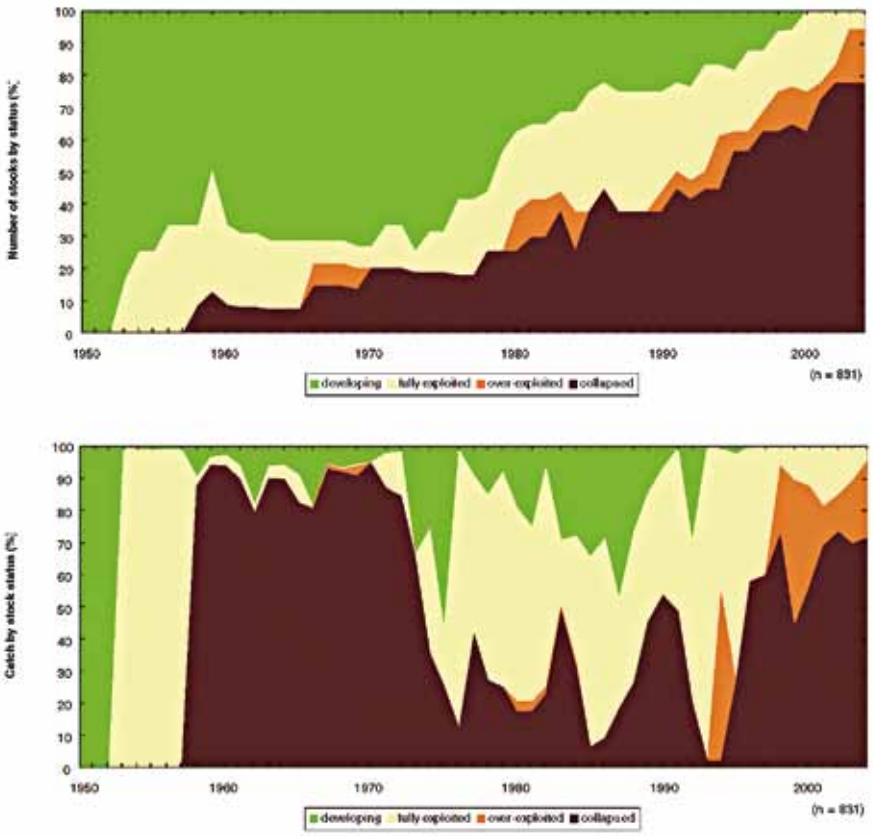

Figure 7. Stock-catch status plots for the East Greenland Shelf LME; showing the proportion of developing (green), fully exploited (yellow), overexploited (orange) and collapsed (purple) fisheries by number of stocks (top) and by catch biomass (bottom) from 1950 to 2004. Note that (n), the number of "stocks", i.e.., individual landings time series, only include taxonomic entities at species, genus or family level, i.e.., higher and pooled groups have been excluded (See *Pauly et al*, for definitions)

Source: Aquarone, M.C., S. Adams, D. Mikkelsen & T. J. Pedersen. 2008. *East Greenland Shelf – LME #59*; published by NOAA onto the LME Portal and in Sherman, K. and Hempel, G. (Editors) 2008. The *UNEP Large Marine Ecosystem Report*: *a perspective on changing conditions in LMEs of the world's Regional Seas.* UNEP Regional Seas Report and Studies No. 182 (Figure Xlll-39.7, p. 549). See Pauly et al. *Fisheries in Large Marine Ecosystems: Descriptions and Diagnosis* for definitions.

mineral resources activities, the transportation of goods and passengers at sea, cruise tourism and finally non-commercial activities with an influence on the marine environment. Regulation and management of these activities will be addressed in sections 8.5.1 - 8.5.6.

8.3.1 Fisheries

The fishing industry has immense importance to Greenland's economy. In 2000 the export of fish and fishing produce made up 95 per cent of the total value of export. Since 2000 the total value of export has increased, leaving the value of export of fish to drop to less than 90 per cent of the total value of export. Employment in the fishing industry is made up by some 2.000 individuals employed with fishing and 3.500 in processing and distribution.

Over the last century the industry has seen important changes as stocks of the most important fish species have fluctuated, as illustrated in figures 6 and 7. The most important commercial species are northern shrimp (*Pandalus borealis*), Greenland halibut (*Reinhardtius hippoglossoides*), Atlantic cod (*Gadus morhua*), northern crab (*Chionoecetes opilio*), lumpfish (*Cyclopterus lumpus*) scallop (*Chlamys islandica*), redfish (*Sebastes mentella* and *Sebastes marinus*), and capelin (*Mallotus villosus*).

The Stock-Catch Status Plots, as presented by Aquarone and Adams, indicate that more than 70 per cent of commercially exploited stocks in the West Greenland Shelf LME have collapsed (Fig. 6, top). However, with 90 per cent of the landings still from fully exploited stocks, specifically from the northern shrimp (Fig. 6, bottom).

Reported landings of commercial fish species show dramatic changes as the importance of Atlantic cod, which dominated the fisheries from 1950 to 1970, has been replaced by the landings of northern shrimp. Today northern shrimp represents more than two-thirds of the reported total catches.

In the 1960s Atlantic cod was the most important fish species in Greenland and annual catches peaked at levels between 400.000 and 500.000 tons in the 1960s. Since then the cod fishing industry has collapsed and according to NOAA low recruitment played an important role in this. While the catches of Atlantic cod declined, however, catches of Greenland halibut and northern shrimp increased.

The periodic fluctuations of cod stocks have been linked to changes in both sea and air temperature. According to Aquarone and Adams a long-term warming of the West Greenland Shelf LME was interrupted by cold events that peaked in 1970, 1983-84 and again in 1996. The decline in cod stocks coincide with cool periods while warmer periods are paralleled by higher stocks. Overfishing and its effects on stock size and stock interactions appear to coincide with climatically-driven variability (Aquarone et al.). Scientists have hypothesised both that variation in larval and juvenile drift to recruitment variability in the West Greenland waters (Buch et al., 1994, Pedersen, 1994), while others find that the present abundance of northern shrimp in the West Greenland Shelf LME may partly be a result of a lower abundance of Atlantic cod and redfish (Horsted 1989). According to a third hypothesis the large by-catch of redfish, Greenland halibut, Atlantic cod and others were caught and discarded in the shrimp fishery of this LME (Pedersen and Kanneworff, 1995).

Introduction of the sorting grid in the shrimp fishery in 2000 limited the bycatch drastically. The shrimp fishery is a relatively clean fishery today and bycatch must be reported in the logbook by kilo. Some vessels in the inshore shrimp fishery are still exempt from the sorting grid.

Greenland halibut is mainly fished in the northern fjords, parts of the fishery is small scale dinghy fishery. Greenland halibut is fished from the ice using dog sledges or snowmobiles in northern Greenland. Northern crab is fished by a few large vessels and numerous smaller ones. The fishery peaked in 2002 and has declined sharply since then.

According to The Sea around Us project (2007) Greenland accounts for the largest share of the ecological footprint in the West Greenland Shelf LME, although a number of European countries accounted for the majority of the footprint in the 1950s and 1960s, where large European fleets fished Greenlandic waters.

Annual landings off the East Greenland coast have seen even more dramatic fluctuations. Reported landings have fluctuated from a low of 11.000 tonnes in 1983 to a high of 225.000 tonnes in 1996. Until the early 1970s the reported landings were dominated by cod (with a small peak again in the 1990s) until the collapse of the stock. Today the commercially fished species are mainly shrimp, capelin and redfish.

The stock-Catch Status Plots indicate a high proportion of collapsed stocks in this LME (Fig. 7, top), and a high contribution of these stocks to the reported landings biomass (Fig. 7, bottom). The jagged appearance of the latter plot reflects fluctuations in the reported landings.

Table 2. Reported wildlife game in Greenland (terrestrial mammal, individuals), 2002 – 2007.
Source: Piniarneq (2009), the Ministry of Fisheries, Hunting and Agriculture. The Piniarneq statistics are available on the Greenland Home Rule homepage, www.nanoq.gl. *Data for the 2007 season only covers the months of January to September 2007.

Terrestrial mammals	2002	2003	2004	2005	2006	2007*
Caribou (Rangifer tarandus)	16.901	18.951	15.248	13.715	15.002	11.463
Musk ox (Ovibos moschantus)	1.478	1.669	1.779	1.955	2.393	2.352
Polar hare (Lepus arcticus)	2.740	2.436	2.183	1.956	2.473	1.357
Arctic fox (Alopex lagopus)	2.428	2.610	1.975	2.234	2.681	1.370
Polar bear (Ursus maritimus)	193	264	225	223	118	156

Table 3. Reported wildlife game in Greenland (whales, individuals), 2002 – 2007.

Source: Piniarneq (2009), the Ministry of Fisheries, Hunting and Agriculture. The Piniarneq statistics are available on the Greenland Home Rule homepage, www.nanoq.gl.
* Data for the 2007 season only covers the months of January to September 2007.
** Data on fin whale and minke whale covers the months of January to December 2007.
*** Data on white whale and narwhale for both 2006 and 2007 is provisional.

Whales	2002	2003	2004	2005	2006	2007 *
Harbour porpoise (Phocoena phocoena)	2.132	2.323	2.963	3.214	2.923	2.549
Killer whale (Orcinus orca)	21	5	14	2	0	3
Pilot Whale (Globicephala melaena)	38	195	265	345	46	230
Fin whale (Balaenoptera physalus)	13**	9	13	14	10	12
Minke whale (Balaenoptera acutorostrata)	149**	198	190	180	181	169
Beluga/ White whale (Delphinapterus leucas)	430***	430	247	157	137	88
Narwhal (Monodon monoceros)	684***	666	595	46	411	383

Table 4. Reported wildlife game in Greenland (seals, individuals), 2002 – 2007.
Source: Piniarneq (2009), the Ministry of Fisheries, Hunting and Agriculture. The Piniarneq statistics are available on the Greenland Home Rule homepage, www.nanoq.gl.
*Data for the 2007 season only covers the months of January to September 2007.

Seals	2002	2003	2004	2005	2006	2007*
Harbour/ Common seal (Phoca vitulina)	187	724	80	437	77	24
Ringed seal (Pusa hispida)	82.505	80.646	77.374	91.604	85.575	52.210
Harp/ Saddleback seal (Phoca groenlandica)	67.725	67.607	72.244	93.194	95.134	60.378
Hooded seal (Cystophora cristata)	4.806	6.353	5.853	4.153	4.799	2.707
Bearded seal (Remmesæl) (Erignathus barbatus)	1.965	1.716	1.366	1.450	1.783	1.224
Walrus (Odobenus rosmarus)	331	284	194	253	145	109

Table 5. Reported wildlife game in Greenland (selected species of birds, individuals), 2002 – 2007.
Source: Piniarneq (2009), the Ministry of Fisheries, Hunting and Agriculture. The Piniarneq statistics are available on the Greenland Home Rule homepage www.nanoq.gl
*Data for the 2007 season only covers the months of January to September 2007.

Birds (selected species)	2002	2003	2004	2005	2006	2007*
Northern Fulmar (Fulmarus glacialis)	46	942	860	750	1.521	867
Eggs from Northern Fulmar		59	95	34	6	54
King Eider (Somateria spectabilis)	7.132	6.096	5.816	4.940	4.623	1.977
Common Eider (Somateria mollissima)	19.788	21.788	18.376	20.871	10.383	9.961
Brünnich's guillemot (Uria lomvia)	117.669	97.047	80.868	83.061	87.449	28.391
Black guillemot Cepphus grylle)	18.369	18.187	16.383	16.235	16.699	3.916
Little Auk (Alle alle)	43.816	28.003	14.408	21.336	23.841	23.970
Eggs from Little Auk		180	220	528	2.175	945
Great black-backed gull (Larus marinus)	69	296	275	207	1.006	685
Eggs from Great black-backed gull	66	186	2.168	2.124	3.470	2.597
Glaucous gull (Larus hyperboreus)	65	195	413	474	804	456
Eggs from Glaucous gull		408	683	948	1.001	834
Riden (Rissa tridactyla)	11.612	16.157	8.353	8.832	8.199	5.635
Rock Ptarmigan/ Grouse (Lagopus mutus)	34.391	19.910	22.547	17.440	16.757	12.496

Projections suggest that climate change over the next century is likely to benefit the most valuable fish stocks at Greenland. This is particularly likely to be the case for the stock of Atlantic cod, which is likely to experience a revival to a level, seen during the warm periods of the 20th century, where it could yield up to 300,000 t on a sustainable basis. However, climate change and increased predation by Atlantic cod could lead to a dramatic fall in the sustainable harvest of northern shrimp by up to 70.000 t. as illustrated below.

Fishing territories

Fishing takes place along most of the Greenland coast with varieties in catches depending on local resources. The larger vessels for offshore fishing (80 BRT or more) are primarily on the west coast of Greenland, covering the Paamiut, Nuuk, Maniitsoq and Sisimiut area. Some 85 per cent of the offshore fishing capacity is placed here. The remaining 15 per cent of the offshore fishing fleet is primarily found in

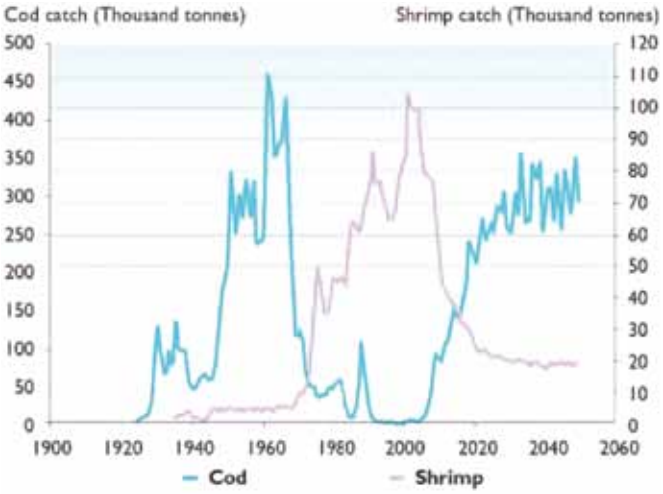

Figure 8. Catch of cod and shrimp from 1900 to 2060, in thousand of tonnes. Source: Emmett (et al.) (2007), based on data from ACIA.

Qasigiannguit, Ilulissat and Upernavik on the west coast, and in Tasiilaq on the east coast. These trawlers are normally larger than 80 BRT and the majority of them fish Northern shrimp. Many trawlers have production facilities on board, but the fishery regulation calls for 25 per cent of the catch to be processed in land.

Most middle sized vessels (less than 80 BRT) travel to local fishing areas not too far off the coast.

Small scale fishing and hunting of seal and whale from open boats takes place along the entire coast and in the fiords. These boats travel to local and regional fishing areas just off the coast. The catch is either traded at the local fish market or used for private consumption.

The Greenland Fisheries Licence Control Authority only registers vessels used for commercial fishing. In accordance with ministerial order no. 5 of January 31 2002 on fishery licence, fishing vessels are registered as either larger vessels for offshore fishing (longer than 24 m) or smaller vessels for fishing inshore (less than 24 m). In 2008 the Greenland Fisheries Licence Control Authority registered 53 vessels for offshore fishing and 519 small and middle sized boats.

8.3.2 Hunting

Locally, hunting is both economically and socially important, but hunting does not contribute extensively to the Greenland national economy. But traditional hunting is of tremendous cultural value to the people of Greenland, passing on from one generation to another the skills and knowledge once needed to survive in the Arctic. Furthermore, hunting supports the traditional diet of Inuit as much meat from wildlife cannot be found in convenient stores.

In a report on occupational hunting, the formal and informal value of hunting to the Greenland economy is estimated at € 52.200.000 annually, making up for less than 4 per cent of the Greenland GDP (Rasmussen, 2005). But full time hunting in common in the northern and eastern parts of Greenland and locally the income from hunting is important to the wellbeing of a community.

A little more than half the value of hunting is registered as trade of bag, either when traded in at the local production facility or sold at the local fish and wildlife market. In the 2005 report the contribution of hunting to the informal economy is some € 25.000.000, as hunting bag generally is used to supplement the family diet, is used as a gift for friends and family or is exchanged in the informal economy.

Hunting statistics

The Ministry of Fisheries, Hunting and Agriculture prepares an annual report on hunting activities in Greenland, the *Piniarneq*. Hunting is regulated and managed by licences, and information in the *Piniarneq* report is based on the statutory reports on bag by all licensed hunters. In the tables below (Table 2 to Table 5) information on game of terrestrial mammals, whales, seals and selected birds are presented for the years 2002 – 2007.

8.3.3 Oil, gas and mineral activities

The Bureau of Minerals and Petroleum (BMP) administers hydrocarbon and mineral activities in Greenland. The bureau handles applications for either mineral, oil or gas licences with a one-door process making it unnecessary for applicants to contact other agencies within the Home Rule Government or the Danish Government.

Mineral exploration and exploitation

The Bureau of Minerals and Petroleum has granted three exploitation licences for mineral activities, but there are expectations of more licence areas in near future. As illustrated below activities are focused in a number of locations on the west coast from Cape Farewell to the Nuussuaq Peninsula, and on the east coast north of Ittoqqortoormiit. Generally, exploitation licences cover small areas of 5 - 8 km2, while exploration licences may cover larger areas.

The Bureau of Minerals and Petroleum use the best international practises. An application for an exploitation licence is based on an EIA report, an environmental monitoring plan and a plan on closure. The latter includes an escrow account with funding for the clean up and re-establishing of the area.

Figure 9. Exclusive exploration and exploitation licences for mineral activities, November 2008. Source: Bureau of Minerals and Petroleum, 2008.

Oil and gas exploration

Greenland has no exploitation of hydrocarbon resources today, but exploration is taking place in 13 offshore licence areas, including an area in the northeast part of the Davis Strait and in the southeast Baffin Bay, an area west of Nuuk and an area to the south and west of Cape Farwell.

Activities related to oil and gas exploration in the above mentioned licence areas, which are expected to have some effect on traffic and navigation security in the West Greenlandic waters, are offshore seismic data acquisition as well as exploration drilling.

Offshore seismic data acquisition is routinely used to identify and assess subsurface geological structures, and the potential presence and extent of any associated hydrocarbon deposits. Data acquired during initial seismic exploration typically assist in defining more prospective areas. This then can identify prospective geological structures and identify the best locations for exploration drilling.

Exploration drilling is an extensive activity which typically will take place during the summer months, using either a drilling ship or a drilling rig. An exploration drilling in the waters off West Greenland will take place in 2010 to 2014 at the earliest.

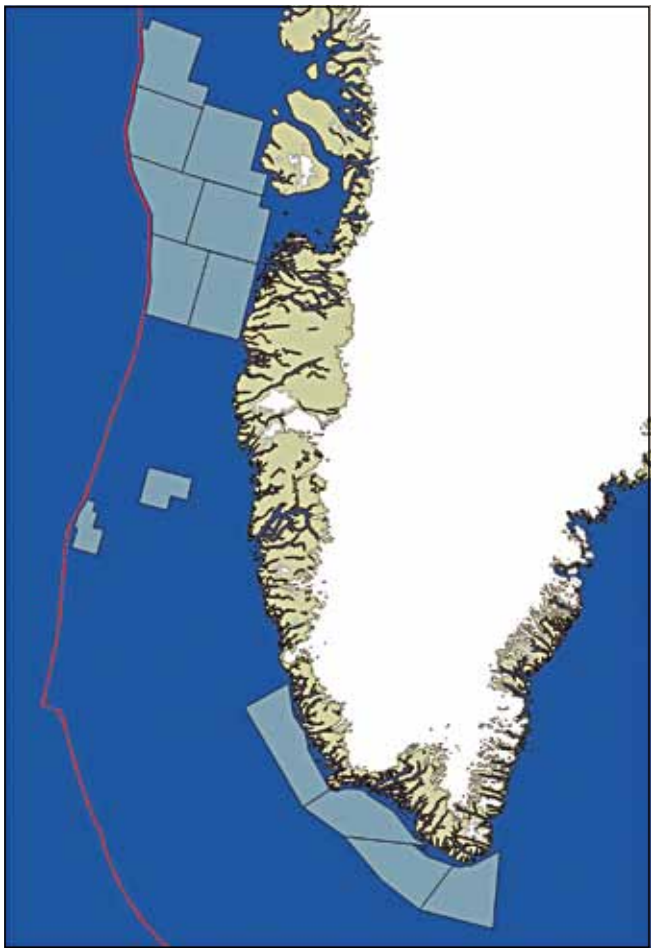

Figure 10. Exclusive oil and gas license areas in West Greenland, 2008. Source: Bureau of Minerals and Petroleum, 2008

Of special interest is the effect shipping of oil and gas will have on the overall navigation security and traffic pattern in Greenlandic waters. However, the time frame for a possible hydrocarbon production from an oil field in the waters off West and Southwest Greenland is more than 15 years. Oil and gas exploitation are most likely to develop in a limited area, but it is possible that oil and gas exploitation from one of the present offshore exploration and exploitation licences can lead to conditions comparable to the North Sea today, where a number of exploitation facilities are dispersed in a larger area.

Mineral resource activities in protected areas In Greenland there is broad political consensus that measures should be taken to develop the mineral resource sector into one of the mainstays of the economy.

Environmental and nature considerations in connection with mineral resources activities are regulated in accordance with order no. 368 of June 18 1998 on the Act on Mineral Resources in Greenland, generally referred to as the Mineral Resources Act. Current legislation on the protection of environment and nature specifically exempt the regulation of activities in connection with exploration and exploitation of mineral resources. Therefore, it is possible to perform mineral resource activities in protected areas. However, in some cases the Mineral Resources Act has stronger protection measures than exclusive nature conservation legislation, for example by designating areas where mineral resource activities are regulated to address conservation needs, e.g. protection of areas important in breeding, calving, moulting and resting.

The Bureau of Minerals and Petroleum has stipulated a set of rules for regulation of environmental and nature considerations of mineral projects in Regulation on Field Work in Greenland.

8.3.4 Transportation

Historically travelling by sea has been the primary way for people to interact, to do trade and most importantly, to make a living. The kayak was used both for travelling and for hunting of marine mammals, while the umiaq, a family size rowing boat, was used for transportation between the winter and the summer settlement. Where ice cover was common dogs and sledges were used both in connection with ice fishing and hunting of marine mammals.

Currently 56.000 individuals live in Greenland, and four in five Greenlanders live in one of the 18 towns along the coast. Only one in five individuals lives in a settlement. The west coast towns and settlements are scattered from the southernmost point to the Melville Bay area north of Upernavik and in the very north around the town of Qaanaaq. By comparison, the east coast is sparsely populated by some 3.500 individuals living in two towns, Tasiilaq and Ittoqqortoormiit, and a small number of settlements. The isolated communities along the Greenland coast are connected by both sea and air traffic. Air Greenland operates a net of routes that connects the regions, but sea traffic is still an important element of the infrastructure.

All vessels registered in Greenland are regulated by the Danish Maritime Authority.

Shipping

Royal Arctic Line serves the entire coast of Greenland with a fleet of five container ships, four general cargo ships, one container and general cargo ship, and a second container and general cargo ship in long-term charter. The main service is between Aalborg, Denmark, and the three major ports on the west coast: Nuuk, Sisimiut and Aasiaat.

On an annual basis Royal Arctic Line travels 140 times between Denmark and Greenland, carrying fish and fishery produce to Europe and bringing back petroleum products, food, manufactured goods, machinery and transporting equipment. Greenland is dependent on imported oil and petroleum products to cover 90 per cent of the energy supply.

In 2006 the value of the export was € 325.000. The primary export; fish and fishery produce is mainly traded within the European market. The value of the 2006 import was € 464.250. The primary import markets are Denmark and Sweden, which make up for 97 per cent of the annual import, while 2 per cent of the import is from the North American market. Icelandic Eimship operates in the waters between Iceland, Canada and the USA, and Royal Arctic Lines serves the route between Reykjavik, Iceland, and Greenland.

Nationally, containers are carried from Nuuk, Sisimiut or Aasiaat to the towns of the west coast. In spring and the early summer the sea ice from the east coast drifts to the waters of South Greenland, creating difficult conditions for shipping, while the north-western waters experience sea ice from December until May or June. Tasiilaq on the east coast is served seven times a year, while Ittoqqortoormiit on the north-eastern coast and the north-western communities of Qaanaaq are only served twice every summer.

Greenland experiences an increase in shipping. Royal Arctic Line has seen an increase in activities by 30 percent within five years. The increase is due to both an increase in the export of fish and shrimp and an increase in the import of consumer goods, machinery and materials for construction.

Beside the Royal Arctic Line service other shipping operators use bulk carriers to carry ore from the mining operations to facilities outside Greenland. Currently there are two mines in operation: Nalunaq Gold Mine in Maarmorilik in the Uummannaq region and Minelco Olivine mine near Maniitsoq. However, the Nalunaq Gold Mine is scheduled to close in 2009.

The Home Rule Government expects increases in shipping as the decline in ice cover, due to climatic changes, open new sailing routes. Furthermore, the planned re-opening of the Black Angle lead and zinc mine in Uummannaq, the plans for a new molybdenum mine in the Malmbjerg area in north-eastern Greenland, and the planned production of aluminium on the island of Maniitsoq are activities which are most likely to further an increase in shipping in Greenlandic waters. For construction large quantities of materials will be imported to built the smelter, two hydropower plants and infrastructure, and when the smelter opens carriers will be needed to ship bauxite to the smelter and to bring aluminium to the markets in both North America and Europe.

Sea travel
Even if air travel predominates in modern Greenland, ferries and small boats still play an important role in connecting communities. In 2008 one ferry and 11 passenger boats travel in Greenlandic waters. These vessels are regulated by the Danish Maritime Authority's regulations for small vessels carrying passengers.

Arctic Umiaq Line operates the only long distance ferry service on the west coast of Greenland, from Narsarsuaq in the south to Ilulissat in the north, visiting 12 towns and settlements on the way. The service operates from April to December, while the ice cover brings the service to a stand-still in the last months of the winter and the early spring.

In the Qaqortoq and Narsaq area and in the Disco Bay area local ferries connect towns and settlements, but operations are sometimes challenged by sea ice. Settlements are served by smaller boats carrying both goods and passengers. Disko Line has 6 passenger boats serving the Ilulissat, Aasiaat and Qeqertarsuaq and even smaller services connects settlements. Royal Arctic Settlement Service provides a service from Qeqertarsuaq to Kangerluk in the Disco Bay area, from Arsuk to Sarfannguaq in Southwest Greenland and in the Tasiilaq district on the east coast. However, privately owned small boats are often used for both fishing and commuting.

8.3.5 Tourism

Tourism activities at sea can be divided into three main categories; man-powered activities at sea, small passenger boat activities and sea cruise activities. The text below focuses on sea cruise activities as they are likely to have the largest consequences for the marine environment in Greenland.

Man-powered activities at sea
Sea kayaking in small groups or in cooperation with a local operator is the primary form of man-powered activities at sea. Generally, sea kayakers and operators have very high standards regarding waste treatment and will leave no sign of their presence, but as sea kayakers can go everywhere with very few limitations there are no actual regulations along most of the south-east and west coast.

Greenland Tourism & Business Council estimates that there are between 500 - 700 sea kayakers per year doing multiple day trips.

Small passenger boat activities
A large number of small motor vessels, often carrying less than 50 passengers, are operated by local tour operators. They usually operate within 50 nm of their base, but some vessels are chartered to travel along the coast. Fishing tourism in the fiords is only carried out on a limited basis.

The Danish Maritime Authority's regulations for small vessels carrying passengers apply to these activities.

Sea cruise activities
Greenland has experienced an increase in cruise tourism over the last decade. This interest has been sparked both by the effort made by Greenland Tourism & Business Council to promote cruise tourism in Greenland and by the international focus on climate change in the Arctic.

Cruise tourism covers a wide range of vessels from small expedition type vessels of 50 to 100 passengers to large ships carrying up to 4.000 passengers. In 2008 more than 50.000 passengers and crew members visited Greenland waters, making more than 350 calls.

Cruise tourism is common all along the coast, but activities are concentrated in the south-western regions from Qaqortoq to Ilulissat. During summer an increasing number of transatlantic cruises from Europe to North America include Greenland calls. Other transatlantic routes run from Canada to the very north of Greenland or from continental Europe via Svalbard in Norway, the Faroe Islands or Iceland across Denmark Strait to the east coast of Greenland.

However, most cruise ships travel within Greenlandic waters. The busiest ports are currently Qaqortoq, Nuuk, Sisimiut and Ilulissat, but Nanortalik, Narsarsuaq, Qeqertarsuaq and Uummannaq are also frequently visited. An increasing number of turnarounds are done in Kangerlussuaq.

Another area of interest is the east coast of Greenland, where Ittoqqortoormiit had 19 arrivals and Tasiilaq 6 arrivals in 2008. North of Ittoqqortoormiit is the National Park, where access is restricted and permits must be attained prior to arrival. Cruise ships can however travel in waters 3 nm off the coast without any permit.

The high north of West Greenland has experienced an increase in cruise ship activities over the last years. Traditionally, the Upernavik and Qaanaaq area has not seen much tourism, but in 2008 10 of the 43 cruise ships in Greenland waters were scheduled to cruise the northern waters.

8.3.6 Non-commercial marine activities

A number of non-commercial activities may influence the marine environment. Some of these activities are of small scale and do not impact the marine environment, while other activities may influence marine environment and nature and may call for measures of protection.

Research activities

Due to a wide range of factors, e.g. the increase in mineral resource activities, the increased awareness of the climate change and the consequences in the Arctic, and research during the International Polar Year (IPY), the number of researchers working in Greenland have increased. Generally, research activities have only a small effect on the marine environment as researchers and expedition teams generally observe high standards of environmental protection.

Research focuses on the marine ecosystems in waters sparsely covered today. When findings are made available to the authorities Greenland benefits from these research activities as management is based on better data. But an effort must be made in order to make research and findings available to the general public.

Small boat ownership

Small boats are used for non-commercial transportation and fishing. There is no register on private ownership of boats, but the Home Rule Government has information on 3.000 – 5.000 small boats and open dinghies (weight < 5 BRT) in use. These boats pose a minor threat to the marine environment and nature while in use, but disposing off small boats, fishing vessels and even tankers is a challenge as there is no national recycling industry.

The authorities receive reports on illegal dumping of boats 2 to 4 times a year.

Waste water

There are no waste water treatment plants in Greenland today. Waste water produced both on land and at sea is disposed off into the ocean. Most households have drains that connect with public sewers, but there are still households with no access to sewerage. These houses often have an open waste pipe allowing washing water to run into the terrain, while toilet water is collected and disposed off into the ocean.

Industrial waste water from the small scale industry is also disposed off into the ocean.
The Environmental and Nature Agency prepares regulations of waste water management and regional waste water planning to be issued in 2009.

8.4 The Greenland Home Rule Government and institutions

The public administration of Greenland consists of a national administration and an extensive local administration, both led by elected assemblies.

8.4.1 The Greenland Home Rule - Namminersornerullutik Oqartussat

For almost thirty years the relationship between Greenland and Denmark has been regulated by the Greenland Home Rule Act no. 577 of 29 November 1978.

Figure 11. The 2009 reform and the four new regions; the North region now named Qaasuitsup Kommunia, the mid region Qeqqata Kommunia, the East-West Kommuneqarfik Sermersooq and the southern Kommune Kujalleq.

The Home Rule was introduced on 1 May 1979 and the Home Rule authorities, i.e. the Greenland Parliament (*Inatsisartut)* and the cabinet (*Naalakkersuisut),* still conduct affairs in accordance with the provisions laid down in the act of 1978.

The Greenland Home Rule Government is divided into seven ministries: the Premier's Office, the Ministry of Finances and Foreign Affairs, the Ministry of Industry and Labour, the Ministry of Education and Culture, the Ministry of Fisheries, Hunting and Agriculture, the Ministry of Family Affairs, and Health and the Ministry of Infrastructure and Environment. Within each ministry there are a number of agencies and departments.

The Bureau of Minerals and Petroleum manages all activities related to the exploration and exploitation of oil, gas and mineral resources. The bureau refers to the Greenland Home Rule Government and to the Danish Government via the Joint Committee on Mineral Resources in Greenland.

In relation to oceans management, the Greenland Home Rule has jurisdiction over activities within 3 nautical miles off the coast, e.g. fishing and shipping, activities related to national and regional planning, infrastructure and transportation, hunting and agriculture, and the conservation and protection of the environment and nature.

Outside the Greenland territory, 3 nm off the coast, ocean management is under Danish jurisdiction.

In ocean management the government seeks advice from a wide range of independent institutions, including Greenland Institute of Natural Resources, Asiaq/ Greenland Survey, and the Danish National Environmental Research Institute (NERI). The administration also has a strong tradition of dialog and exchange of knowledge with the Danish administration.

Home Rule is succeeded by Self-Government

The Danish-Greenlandic Commission on Greenlandic Self-Government, which was established in 2004 to discuss the future relationship between Denmark and Greenland and to identify fields of responsibility that could be transferred to Greenland, concluded its work in 2008. The commission presented to the public a detailed commission report and a draft for an Act on Greenland Self-Government to succeed the Greenland Home Rule Act of 1979.

The people of Greenland endorsed the draft Self-Government Act at a public referendum on 25 November 2008. The Greenland Home Rule is likely to be succeeded by the new Self-Government on 21 June 2009, celebrated as the National Day in Greenland.

The new act recognizes the people of Greenland as a people pursuant to international law with the right to self-determination and includes a provision establishing Kalaallisut, the Inuit language spoken in Greenland, as the official language. Furthermore, the draft act on Self-Government states that Greenland can have jurisdiction and financial responsibility of all aspects of public affairs if the parliament, Inatsisartut, so decides. However, a self-governed Greenland will still be part of the Kingdom of Denmark and share foreign policies with Denmark and the Faroe Islands.

The Self-Government Act also outlines the future economic relationship between Greenland and Denmark. The Danish-Greenlandic Commission agreed that Greenland has the right to the mineral resources in Greenland. In § 5 of the draft Self-Government Act, Greenland will still receive an annual grant of € 430.000.000. But if, in the years to come, the income from activities related to the exploitation of oil, gas or mineral resources climbs to more than € 10.000.000 annually, Greenland will see a 50 cent reduction in the grant for every additional € 1 earned from these activities.

In accordance with the Self-Government Act financial independence from Denmark is realized when the activities in the oil and mineral industry reach € 860.000.000 a year. Talks on the future relationship between Greenland and Denmark will then commence. The people of Greenland can, in accordance with § 21 of the Self-Government Act, decide on independence in a future referendum.

8.4.2 The local administration of municipalities and regions

At the local level, the administrative structure resembles the structure of the national level. Since 1979, Greenland has been divided into 18 municipalities governing local affairs, e.g. schools, waste management, local planning. Each municipality, covering one town and a number of settlements, was governed by a municipal council. In 2009 a structural reform merged the 18 municipalities into 4 regions. The aim of the reform is primarily to reduce public spending and to provide better service to the citizens.

The small municipalities of the northern region are merged with the more populous and prosperous Disco region into the new Qaasuitsup Kommunea (Fig. 11: Avannaa), while Ammassalik and Ittoqqortoormiit will merge with Paamiut and Nuuk in one large region, the Kommuneqarfik Sermersooq (Fig. 11: Kangia-Kitaa). The Qeqqata Kommunea is formed around Sisimiut and Maniitsoq (Fig. II: Qeqqa) and in the south Qaqortoq, Narsaq and Narsarsuaq will merge into Kommune Kujalleq (Fig. 11: Kujataa).

In relation to the marine environment, the municipalities are responsible for the management of waste and sewerage locally and for protection of the marine environment close to the towns and settlements, i.e. the handling of oil spills.

8.4.3 Greenland's economy

The Greenland fishing industry developed late compared to other fishing nations in the Atlantic, e.g. Iceland. Therefore, the Greenland fishing activity was relatively insignificant during the first half of the 20th century, even when compared to the rest of the Greenland economy. But based on underexploited fish stocks, the Greenland fishing industry expanded smoothly until the 1980s. The cod fishery experienced a major expansion in the latter half of the 1970s due to reduction in foreign fisheries activities following the extension of the Greenland fisheries jurisdiction to 200 nautical miles. However, in 1981 there was a major contraction of the cod fishery due to overfishing and low export prices. For three years the Greenland gross domestic product (GPD) decreased by 9 per cent annually. From 1985 there was a second short-lived boom in the cod fishery that led to a corresponding boom in the economy, but this boom was followed by another depression during which the GDP decreased by over 20 per cent.
Time series data for the export value of the fishing industry are available from 1966 till today. These data have been used to estimate the

form and parameters of relationship between GDP and the real export value of the fish products. It is projected that a 1 per cent increase in the export value of fish products will lead to a 0.29 per cent increase in the GDP of Greenland. This equation can be used to predict the economic impact of a change in fish stock availability resulting from climate change.

Scenarios for the future
Emmett Duffy discusses three scenarios for the future of the fisheries and thereby the future of the Greenland economy (Emmett Duffy, 2007). The pessimistic scenario assumes that despite favourable habitat conditions the Atlantic cod will not re-establish permanently in Greenland waters. Instead, there will be periodic highs in the cod fishery followed by lows, and corresponding changes in shrimp fisheries. In the moderate scenario as described by Emmett Duffy, Greenland will see a modest and gradual return of Atlantic cod to Greenland, which in 20 years will be capable of yielding 100.000 t. / year. The increase in the availability of fish leads to a moderate long-term increase in GDP of 6 per cent. A third, optimistic scenario, assumes a return of the Greenland cod stock, initially generated by Icelandic cod larval drift to the levels of the 1950s and 1960s. A full revival would take some decades, but in 30 years the cod stock would be capable of producing an average yield of 300.000 t. a year. This scenario will lead to an ultimate increase in GDP of 28 per cent compared with what would otherwise have been the case.

The social impacts of these future scenarios are important. If the optimistic scenario was to occur and the increase in Atlantic cod harvest was mainly caught by Greenland fishermen and processed for export in Greenland, it would remedy the unemployment situation and create an income for the large group of self- employed fishermen and hunters. A climb in cod fishery might lead to large scale fish processing plants being established in some of the more densely populated regions of Greenland.

The economic and social impacts of changes in fish stock availability depends on the direction, magnitude and rapidity of these changes, but also on society's ability to respond and adjust to new conditions and thereby mitigate the negative impacts of change.

Within the next decade changes are expected in sectors besides the fisheries. American Alcoa plans to open an aluminium smelter in Maniitsoq in 2015, creating employment in both construction and in the operation of the smelter. Establishing an industrial facility in a small community will dramatically increase activities in both Maniitsoq and in the neighbouring communities as the need for both goods and services will increase. In the mineral industry exploration licences may result in new mines being opened, while in the tourism sector steps are taken to maintain the interest in Greenland's unique nature and culture. Finally, more jobs will be created in the public sector if Greenland continues on the road towards increased independence from Denmark.

8.4.4. Enforcement of sea territories

Greenland has a 3 nm territorial sea boundary. The territory includes fiords, harbours and waters within 3 nm off the extreme points of the coast. These waters are protected by the regulations laid down in Act no. 4 of 3 November 1994 on Marine Protection, with later amendments. National Park regulations protects the waters of the National Park area to the 3 nm territorial sea boundary too.

Participating in the monitoring and protection of the sea is Danish Ministry of Defence, i.e. Island Command Greenland and the Sirius Patrol in the National Park, MRCC Groennedal, the Danish Polar Centre, the Environmental and Nature Agency of the Greenland Home Rule, and local authorities.

The Environmental and Nature Agency, in close cooperation with local authorities, run pollution control and clean up after oil spills etc. Contingency plans have been established and the Home Rule has provided oil spill equipment, including oil skimmers, floating barrages, oil absorbent granulate or textile, storage tanks etc. in 11 towns on the West coast and Tasiilaq on the East coast. Currently, the oil spill equipment can only handle small and medium sized spills, and distances and weather conditions are important in managing spills.

Island Command Greenland, based in Groennedal, offer assistance in rescue operations and environmental operations at sea within the Greenland sea territory too.

The Danish sea territory extents from the 3 nm zone to the 200 nm Exclusive Economic Zone (EEZ line). This territory is protected by the Danish Marine Protection Act from 1993 with later amendments. The Danish sea territory is guarded by the Danish State, in particular the Danish Ministry of Defence and Island Command Greenland. Island Command Greenland operates inspection vessels and helicopters to control the territory, participate in rescue operations and the clean up of spills at sea. The Sirius Patrol of the Ministry of Defence monitors activities in the National Park area. The Maritime Rescue Coordination Centre, MRCC Groennedal, monitors sea traffic via the GREENPOS positioning system and initiate rescue operations.

8.5 Policies and approaches in oceans management

Below is a description of applied ocean management policies and approaches in fisheries, in the management of oil, gas and mineral resources, in shipping and tourism and finally in management of nature and wildlife.

8.5.1 Fisheries practices and management status

Fishing and hunting is regulated by the Ministry of Fishery, Hunting and Agriculture. The Greenland Fisheries Licence Control Authority conducts fishery inspection while the Greenland Institute of Natural Resources monitors stocks. The fishing industry tries to balance the possibilities of modern fishing technology with the need to sustain the natural resources. The quota system managed by the Ministry of Fishery, Hunting and Agriculture is a two-tier system which differentiates inshore fishery from offshore fishery of northern shrimp, Atlantic cod and Greenland halibut.Management of the Greenland fisheries focuses on individual species. Greenland has not implemented ecosystem-based management systematically, but measures such as periodical and geographical restrictions apply in some fisheries.

Aim of the management of fisheries
The overall purpose of the current management scheme is to secure a sustainable and responsible fishery that considers the interest of as many as possible.

Central to the management scheme is a quota system, based on annual Total Allowable Catches (TAC's) and biological advice, and rules regarding ownership of fishing vessels. Current management principles inhibits introduction of new fishing capacity, although it does not inhibit enhancement of existing capacity through technological improvements.

For commercial fishing one has to apply for a licence and a quota. Each licence includes restrictions, e.g. maximum quota, time of year, geographical access and technical requirements following the Fisheries Act and government orders of the Home Rule.

Setting the TAC level
In order to keep harvest levels within sustainable limits, TAC's for individual species are based on biological advice from the researchers of the Greenland Institute of Natural Resources. The advice makes use of the best available knowledge and is often based on recommendations from regional and scientific organizations.

The Minister for the Fisheries, Hunting and Agriculture recommends annual TAC's to the government and thereafter the government agrees to accept the recommendations or to suggest alterations.

Stakeholder involvement
Stakeholder involvement is central to the activities of the Fisheries Council. The Fisheries Council brings together representatives from the costal and the offshore fisheries organizations, the workers union (SIK) and the Greenland Institute of Natural Resources.

When a decision cannot be made based on current legislation the stakeholders are involved via the Fisheries Council. But the council also meets on a regular basis to discuss themes relevant to the council

and to bring forward recommendations and opinions to the political level.

Economic modelling
To improve consequence analysis of the Greenland fisheries, an effort is made to develop better economic models these years. Currently, a model for the financially important fishery of northern shrimp is developed to include the fishery of Greenland halibut too. The models seek to cover as many socio-economic factors as feasible, using the best available knowledge. Stakeholders like the Fisheries Council, representatives from the industry and the unions of both employers and employees are involved in providing accurate data for the models.

International cooperation
Greenland is a member of a number of regional organizations and cooperates further through bilateral agreements on both stocks and control issues. The most important organizations are mentioned below:

The Northwest Atlantic Fisheries Organization
(NAFO): The NAFO convention area covers the entire west coast of Greenland where most of the Greenland fishery resources are harvested. NAFO is in the process of modernizing its convention to include principles of ecosystem management. At the 29th annual meeting in Lisbon, NAFO members approved this modernization and each member is now in the process of ratifying the updated convention.

The North East Atlantic Fisheries Commission
(NEAFC): The NEAFC convention area covers the east coast of Greenland and has also been modernized recently to focus more on ecosystems.

The North Atlantic Salmon Conservation Organization
(NASCO): The NASCO works to promote the conservation, restoration and management of salmon stocks. The organization focuses on a single species. Greenland has agreed not to utilize wild salmon stocks commercially.

Cooperation on fisheries management is also facilitated through the North Atlantic Fisheries Ministers Conference (NAFMC) and through the Nordic Council of Ministers (NCMS). Greenland is a member of both forums.

Greenland has bilateral agreements on the exchange of quotas with Norway, Iceland, The Faroe Islands and Russia. Furthermore, Greenland has a fish-for-money agreement with the EU. These agreements include cooperation on control and enforcement issues mainly in the exchange of data. Currently negotiations are ongoing with Canada to engage in formal cooperation.

8.5.2 Oil, gas and mineral practices and management

The mineral resources system establishes that the political responsibility for the mineral resources area is a joint Danish-Greenlandic concern. This infers that Greenland and Denmark have joint decision competence for significant dispositions in the field of mineral resource.

The Joint Committee on Mineral Resources in Greenland
The Joint Committee on Mineral Resources in Greenland has been established as a political forum, consisting of politicians from Greenland and Denmark, in which central issues concerning the mineral resources are debated.

The Joint Committee on Mineral Resources in Greenland consists of five political members appointed by the Greenland Parliament (*Inatsisartut*) and the Danish Parliament, respectively. In addition a chairman is appointed by the Queen after common nomination from the Government and the Greenland Home Rule Government for four-year terms.

The purpose of the Joint Committee is to follow the development in the mineral resources area and to submit recommendations to the Government and the Home Rule Government in e.g. issues on granting reconnaissance and exploitation licences.

The detailed regulation on the mineral resources system are laid down partly in the Greenland Home Rule Act and partly in the Act on Mineral Resources in Greenland, no. 368 of 18 June 1998.

The Bureau of Minerals and Petroleum under the Greenland Home Rule
The Bureau of Minerals and Petroleum under the Greenland Home Rule is responsible for the management of the mineral resources area in Greenland.

The basis for the activities in the mineral resource sector is the ambitious objectives to provide a basis for all mineral resources activities so that these activities can be implemented in consideration of a sound environment and in accordance with the highest international standards for the purpose of protecting the vulnerable Arctic nature. On this background the Bureau of Minerals and Petroleum draws on the expertise of the Geological Survey of Denmark and Greenland (GEUS), the Danish National Environmental Research Institute (NERI) and the Danish Energy Agency (DEA) within the Danish Ministry of Climate and Energy.

Environmental impact assessments
In connection with the opening of frontier areas with technologically challenging conditions the Bureau of Minerals and Petroleum develops Strategic Environmental Impact Assessments (SEIA) as part of the basis of decision in relation to granting licences to the hydrocarbon industry. The SEIA provides an overview of the environment in the licence area and adjacent areas, which may potentially be impacted by the hydrocarbon activities, and identifies major potential effects associated with future offshore hydrocarbon activities. Furthermore the SEIA identifies gaps in knowledge and data, highlight issues of concern, make recommendations for mitigation and planning and identifies general restrictive or mitigative measures and monitoring requirements that must be dealt with by the companies applying for hydrocarbon licences.

However, it is the responsibility of the license holding companies to prepare Environment Impact Assessments (EIA) for their specific activities. The company initiated EIA must cover the entire region that might be affected, including land facilities. It also must cover transboundary aspects, including the impacts of oil pollution on neighbouring countries. The EIA shall include the full lifecycle of activities: exploration, field development, production transport and decommissioning. The EIA must be updated and further developed when needed, e.g. when moving from the explorations to the production phase, or if there is a change in the plans presented in the EIA. The initial EIA related primarily to exploratory drilling shall focus on this activity, but must include assessment of scenarios of possible activities related to production, transport and decommissioning.

The Bureau of Minerals and Petroleum has developed guidelines for preparing an Environmental Impact Assessment report. In developing these guidelines, information on the requirements to EIAs related to hydrocarbon exploration, development, production, decommissioning and transport in other Arctic countries has been studied. Valuable information was found in material from Alaska, Canada and Norway. Furthermore, the guidelines are based on the Arctic Offshore Oil & Gas Guidelines issued by the Arctic Council, and on the OSPAR Guidelines for Monitoring the Environmental Impacts of Offshore Oil and Gas Activities.

Similar EIA guidelines have been prepared for mining companies operating in Greenland.

Environmental assessments of activities related to hydrocarbon exploration offshore West Greenland was initiated in 1992, when the National Environmental Research Institute made a review of the available data which could be used to assess activities related to hydrocarbon exploration in the eastern Davis Strait during summer (Boertmann et al., 1992). Based on this review studies were initiated to improve knowledge of seabird colonies (Boertmann et al. 1996), moulting areas and offshore seabird concentrations (Durinck & Falck 1996, Mosbech et al. 1996). The main ecological issues related to offshore hydrocarbon exploration in Greenland were reviewed (Mosbech et al. 1995) and an initial assessment of potential environmental impacts of hydrocarbon exploration in the Fylla area located in the Davis Strait was conducted (Mosbech et al. 1996). The Fylla area is one of the most productive regions in Greenlandic waters and it represents an important site for birds, marine mammals and fisheries. The most serious

potential impact of oil exploration in the Fylla area is a major oil spill, especially if the spill reaches the coast. To minimize the environmental risk of large oil spills during oil exploration, emphasis is put on planning of activities to avoid operations during the most sensitive periods and in the most sensitive areas, and first of all to operate safely and to prevent accidental spills. To enhance damage control during a spill operational environmental oil spill sensitivity maps covering the West Greenland coastal zone between 62°N to 68°N has been produced (Mosbech et al. 2000).

In continuation of these maps and as part of the preparations for exploratory drilling offshore West Greenland an environmental oil spill sensitivity atlas for the South Greenland costal zone was produced in 2004 (Mosbech et al. 2004a). The objective of this project was to produce an overview of resources vulnerable to oil spills, e.g. biological resources, and to draft responses to oil spills in this region. Furthermore, there exists an environmental oil spill sensitivity atlas for the region between 68°N and 72°N in West Greenland, including offshore waters to the Canadian border (Mosbech et al. 2004b).

Recently, a SEIA of activities related to exploration, development and exploitation of hydrocarbon in the sea off West Greenland between 67°N and 71°N has been produced (Mosbech et al. 2007). The offshore waters and coastal areas is the focus of this SEIA as they may be most affected by activities related to hydrocarbon exploration, particularly from accidental oil spills. The assessment area is very important in an ecological context. Biological production in spring and summer is very high, there are rich benthic communities and large and important seabird and marine mammal populations. Fish and shrimp stocks in the area contribute significantly to the fishing industry in Greenland, and local communities utilise the coastal areas through subsistence hunting and fishing. The assessment had identified where more knowledge is needed to assess possible impacts of activities related to oil and gas exploration and exploitation. A plan for supplementary background studies to fill identified information gaps at the overall strategic level has therefore been developed.

The northwest Baffin Bay, which geologically is an important northward extension of the region between 68°N and 72°N, is considered opened for oil and gas exploration, and therefore another SEIA of this region has been initiated. In that respect, background data are needed and a series of new projects are in the planning phase, some of which represent extensions to the projects from the region just south of the Baffin Bay area.

The East Greenland rift basins have recently been in focus due to the U.S. Geological Survey's assessment of expected undiscovered oil and gas resources in the shelf region. The main targets for oil exploration is from north to south the Danmarkshavn basin, the East Greenland basin including the Jameson Land basin, and the less known Kangerlussuaq basin. However, the Danmarkshavn basin offshore Northeast Greenland is expected to contain the most of the undiscovered hydrocarbon resources.

In relation to a future licence call offshore Northeast Greenland the Bureau of Minerals and Petroleum and the Danish National Environmental Research Institute are working on the development of a SEIA related to exploration, development and exploitation of oil and gas in the sea off Northeast Greenland. Environmental background studies were initiated in 2007 and the studies are expected to strengthen the knowledge base for planning, mitigation and regulation of oil and gas activities in the assessment area. The main issues and some of the preliminary results and analysis from the background study programme are to be incorporated into a preliminary SEIA by the end of 2008. The final SEIA is to be issued in 2010.

8.5.3 Management of shipping

The Maritime Rescue Coordination Center in Greenland, MRCC Groennedal, monitors shipping along the Greenland coast using the GREENPOS ship reporting system. Since 2002 all ships have been obliged to report information, including vessel name and ID, position, destination, personnel, and current weather and ice situation upon entering Greenlandic waters. The ships report their position, course, speed and actual weather information to MRCC Groennedal via GREENPOS every six hours while sailing in Greenland waters. When no report is received and no radio or satellite contact can be made with a ship, a rescue operation is prepared. A final report is sent to GREENPOS upon departure. Aasiaat Costal Radio is used for communication at sea.

Besides reporting to the GREENPOS system any ship registered outside the Kingdom of Denmark has to seek diplomatic clearance before entering the 3 nm territorial waters.

Safety at sea

The Danish Maritime Authority, the Danish Maritime Safety Administration and the National Survey and Cadastre in the 2006 report *Safe Shipping in Greenlandic Waters* made recommendations on the improvement of safety at sea. The recommendations included the use of searchlights, updating charts and mapping of recommended sea passages, the use of ice guides/ local guides onboard, and the development of electronic identification and tracking systems.

Working groups were established to initiate the implementation of the recommendations in Greenland. In 2009 the Danish Maritime Authority plans to issue regulation on mandatory use of searchlights to improve ice detection. Also national regulations, i.e. an order on safety of navigation in Greenland waters, will be issued by the Danish Maritime Authority in 2009.

The National Survey and Cadastre will update charts of Greenland waters in 2007 to 2012, and based on these charts recommended sea passages can be mapped. Focusing on the safety at sea for small boats, campaigns have addressed the importance of basic skills, including landfall, the reading of maps and the use of emergency radios.

8.5.4 Management of cruise tourism

As Greenland experience an increase in cruise ship tourism, the consequences of these activities on both local communities and the Arctic nature must be monitored. As large numbers of cruise ship tourists visit the small communities of Greenland. They bring trade, but they also necessitate an increased need for nature conservation and regulation on access to vulnerable nature and the need for improved waste management in towns and settlements. In developing cruise ship tourism and in meeting the challenges of these activities the municipalities are important as they provide services locally.

Almost all cruise ships report planned calls well in advance to the local port agents. In the annually published Cruise Manual Greenland Tourism & Business Council recommends ports capable of handling ships of a certain size, but ultimately the operators and the captains of the cruise ships decide weather to follow these recommendations.

The marine environment

The marine environment is protected by the Marine Protection Act, no. 4 of 3rd of November 1994 with later amendments, while waters outside the 3 nm zone is protected by Danish legislation. The Marine Protection Act prohibits dumping of materials and waste and allows for regulation on discharge of waste water from ships. The marine environment within the National Park and the marine nature reserve in Melville Bay are furthermore protected by the regulations issued for these areas.

Denmark is a member of the International Maritime Organization (IMO), and international conventions on protection of the marine environment are effective too. The operators of large cruise ships observe the international conventions on marine protection.

Greenland Tourism & Business Council states that most small expedition cruise operators that visit Greenland are members of the Association of Arctic Expedition Cruise Operators (AECO). AECO members agree that expedition cruises and tourism must be carried out with the utmost consideration for the vulnerable environment, local cultures and cultural remains as well as the challenging safety hazards at sea. Greenland Tourism & Business Council and the Environmental and Nature Agency of the Home Rule are involved in developing guidelines for expedition cruises in the Arctic.

Cruise ships and safety at sea
The consequences of an accident involving a cruise ship at sea may however be more important as both rescue operations and clean up can be challenged by harsh weather conditions and long distances. Currently, measures are introduced to improve safety at sea, as described above in section 8.5.3, and these measures are significant to cruise ship operators too.

Cruise ships report information on position etc. to Island Command Greenland via the GREENPOS system, but there is no regulation on routes. As some waters are still poorly charted Island Command Greenland recommend that all ships sailing in these waters travel in groups of two or more for safety reasons. This again is not a formal regulation.

8.5.5 Nature management

The administration of nature management is shared between the Ministry of Infrastructure and Environment and the Ministry of Fishery, Hunting and Agriculture within the Greenland Home Rule.

8.5.5.1 Wildlife management

The Ministry of Fisheries, Hunting and Agriculture has issued a series of regulations on hunting, including the Greenland Home Rule Act no. 12 of 29 October 1999 on hunting with later amendments, and a series of ministerial orders regulating the quota regulated hunt for single species, including the walrus, polar bear, white whale and narwhal. Regulated are also the hunt for caribou (*Rangifer tarandus*), and musk ox (*Ovibos moschantus*).

At present, Greenland has not implemented ecosystem-based wildlife management. Wildlife management today focuses on harvest management of individual species. This, however, do involve some aspects of ecosystem-based management through cross-sectoral involvement of relevant authorities and stakeholder consultation.

The Greenland government is in the process of developing procedures for ecosystem-based management that will take account of available financial resources and seek to meet the overall management aims for Greenland's living resources.

International cooperation
Greenland is represented in a number of international forums that provide recommendations for management of wildlife species. Only recommendations made by the International Whaling Commission (IWC) are legally binding.

The International Whaling Commission (IWC): Greenland is represented in IWC via Denmark. The aim of the IWC is to conserve whales and to ensure sustainable harvest levels.

The North Atlantic Marine Mammal Commission (NAMMCO): Greenland, together with Norway, Iceland and Faeroe Islands, is a member of NAMMCO. NAMMCO works for regional protection, rational management and research on marine mammals in the North Atlantic. Canada is not a member of NAMMCO and it has therefore been necessary to establish forums for bilateral collaboration on shared populations of marine mammals, i.e. the Joint Committee for Narwhal and Beluga between Canada and Greenland and the working group for joint management of the polar bear.

The Joint Committee for Narwhal and Beluga between Canada and Greenland (JCNB): The JCNB provides biological and management advice for shared populations of narwhal (*Monodon monoceros*), beluga (*Delphinapterus leucas*) and walrus (*Odobenus rosmarus*) in the sea between Greenland and Canada.

The Conservation of Arctic Flora and Fauna (CAFF): CAFF is one of the six permanent working groups within the Arctic Council. The aim of the working group is to address the conservation of Arctic biodiversity and to promote practices which ensure the sustainability of the Arctic's living resources. Greenland chairs CAFF in 2006 - 2009.

The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES): CITES was laid out by the Washington Convention in 1977, and Greenland participates in CITES. The CITES administration is managed by the Environmental and Nature Agency of the Greenland Home Rule, and there is cooperation with the Forestry and Nature Agency in Denmark.

The International Union for Conservation of Nature (IUCN): Greenland participates in the IUCN.

Bilateral agreements: Each year the Greenland Home Rule Government provides mandate to bilateral consultations between Greenland and other countries regarding common stocks of fish and marine mammals. The Home Rule Government provides mandate for signing agreements from case to case.

Harvest management process
The management of Greenland's living resources is divided between three ministries: the Ministry of Fishery, Hunting and Agriculture, who is responsible for the management of commercially exploited fish species, terrestrial mammals and marine mammals (including polar bears), the Ministry of Infrastructure and Environment responsible for international agreements and conventions regarding biodiversity (ext. IUCN) and nature conservation, and the Ministry of Industry and Labour, who is responsible for trophy hunting, sport fishing and other tourism activities related to wildlife, e.g. whale watching.

Biological advice on harvest management
The Greenland Institute of Natural Resources provides management advice through participation in the scientific committees of the relevant international organizations, such as IWC, NAMMCO or JCNB. For populations not covered by international agreements, such as musk ox and caribou, the Greenland Institute of Natural Resources provides scientific advice upon request from the managing authority.

Upon request from the managing authority, the Greenland Institute of Natural Resources provides advice on sustainable harvest levels and other regulatory mechanisms for all species under quota management, except advice on larger whales as they are the responsibility of the IWC. Advice on sustainable harvest levels makes use of the best available knowledge and often it is based on recommendations from international forums.

Based on advice on sustainable harvest levels, harvest statistics and user knowledge, the Ministry of Fisheries, Hunting and Agriculture produces a first draft of suggested harvest management decisions. It is the responsibility of the managing authority to decide how much weight is put on the different knowledge sources. The relevant minister has the final say and can overrule any harvest management suggestions made by relevant administrations.

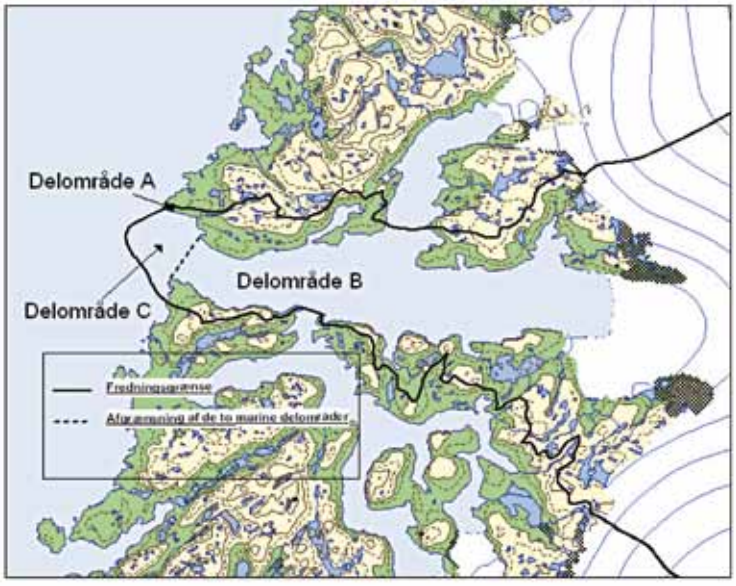

Figure 12. Protection of the Ilulissat Ice Fiord
Source: The Ministry of Environment and Nature, Environmental and Nature Agency in government order no. 10 of 15 June 2007.

Stakeholder consultation in harvest management
The primary stakeholders are organized in the full time hunters' organization (KNAPK), the organization for spare time hunters (TPAK), but the organization for the Greenland municipalities (KANUKOKA) is also involved. Other relevant agencies are the Ministry of Infrastructure and Environment, the Environmental and Nature Agency and the Greenland Institute of Natural Resources.

The first draft of harvest management decisions is subjected to an internal hearing process through relevant departments within the Home Rule administration. Relevant corrections are made and the second draft is then presented to the Hunting Council, who provides recommendations based on their discussion.

The council consists of two representatives from KNAPK, one representative from TPAK, and one representative form KANUKOKA. Based on the recommendations of the council amendments are made to the second draft. The third draft is hereafter subjected to an external hearing process though the KNAPK, the TPAK, the KANUKOKA and the Greenland Institute of Natural Resources.

Final harvest management decision
Upon receiving answers from the external hearing process, final harvest management decisions are made and approved by the Minister of Fisheries, Hunting and Agriculture. Upon signing by the minister, the harvest management decisions are presented in government, and if accepted the management decisions are published on the Home Rule website and through press releases.

The Tulugaq campaign on sustainable use of the living resources
In 2002 – 2004 the Tulugaq campaign on sustainable use of the living resources was issued by the Home Rule Government. The aim of the campaign was to start a dialogue on the use of living resources in Greenland based on scientific knowledge and to thereby to secure a sustainable use of the 40 to 50 species generally hunted in Greenland.

An important element of the campaign was to involve hunters along the coast in the dialogue on and improvement of sustainable use of living resources. Therefore seminars, meetings for local stakeholders and authorities, and public town hall meetings were held locally. At the seminars and meetings the need for both stakeholder involvement and improved cooperation between agencies and scientists was mentioned, as well as the need for a clear policy on the administration of licences for hunting quota managed species, and improved training for hunters.

As part of the Tulugaq campaign both folders and posters and a homepage with information on sustainable use of living resources was published, reaching out for both children and the general public. A series of factual folders was produced on 7 individual species; common eider (*Somateria mollissima*), Brünnich's guillemot (*Uria lomvia*), Arctic tern (*Sterna paradisaea*), narwhal (*Monodon monoceros*), white whale (*Delphinapterus leucas*), walrus (*Odobenus rosmarus*), and polar bear (*Ursus maritimus*).

8.5.5.2 Nature conservation

An area can be registered as a protected area by the Home Rule Government, but both local municipalities and non-governmental organizations working for the protection flora and fauna, can suggest for an area to be designated as protected. The Environmental and Nature Agency prepares a draft for the conservation of an area involving the stakeholders, and sees that the plans are advertised in the media at least two months before the conservation becomes effective. A plan for a conservation of an area must illustrate the purpose and the extent of the conservation, plans for monitoring and care, and details on the future management of the area.
In the sections below attention is paid to the management of five protected areas with marine habitats.

The National Park of North and East Greenland
National Park management and monitoring is shared between authorities in Greenland and Denmark: The Environmental and Nature Agency of the Greenland Home Rule, the Danish Defence (MRCC Groennedal and the Sirius Patrol) and the Danish Polar Centre in Copenhagen.

Access to the National Park
Access to the National Park and the Greenland Ice Sheet is regulated by the Danish Executive order on access to and conditions for travelling in certain parts of Greenland, no. 1280 of 7th of December 2006, and guidelines on access, no. 113 of 7th of December 2006.

The Danish Polar Centre administers access to the park for researchers and visitors, granting permits for any sailing in the National Park and travels of more than 24 hours duration in the land areas. Permanent residents can, however, access the park area for ordinary traffic and travelling on the occasion of usual hunting and fishing activities without a permit. The application for travel permits in the National Park and areas regulated by the executive order must provide information on travel route, supplies and equipment, planned activities etc. Conditions aiming at avoiding any rescue operation, such as travel restrictions in terms of time or geographical area, and the requirement of bringing emergency equipment, may be stipulated in the permit.

As many researchers visit the National Park and the Greenland Ice Sheet valuable information on remote areas of Greenland are collected. Therefore, researchers, participants in expeditions and tours are asked to write a travel report.

During the application process the Danish Polar Centre hear the Greenlandic authorities, through the Environmental and Nature Agency, who involve other relevant institutions. When a project in the National Park or on the Greenland Ice Sheet may have consequences for the environment, an environmental operation permit is issued. In 2008, the Environmental and Nature Agency has issued environmental operation permits to a number of research projects, including the recovery of downed planes, ice core drilling projects and a traverse connecting research camps on the Ice Sheet. In the permit the storage of fuel and environmentally hazardous materials, the handling of waste and the clean up of the area is regulated.

The Home Rule in 2008 prepared a report on the future administration of access to the National Park and the Greenland Ice Sheet. Recommendations have been made to transfer the administration of access to the National Park and the Greenland Ice Sheet, as regulated by Chapter 1 of the executive order, from the Danish Polar Centre to the Environmental and Nature Agency of Home Rule Government as of 1st of January 2010.

Protection of the National Park
Protection of the National Park is administered by the Home Rule Government.

The Mineral Resources Act allows for exploration and exploitation licences to be issued for an area within the park, but the National Park committee can ask that measures are taken by the licence holder to protect the nature and wildlife of the National Park.

Other activities within the park are regulated by the National Park government order. For instance fishery is only allowed by rod or pilke, and only the personnel at the stations in the park, e.g. the Sirius Patrol personnel, are allowed to hunt for seal, grouse and hare. Residents in the municipalities near the park, Qaanaaq and Ittoqqortoormiit, can engage in traditional activities like hunting using dog sledges, kayak or motorized boats. But hunters must report on their activities to the local authorities. And to protect the wildlife of the park mammals and birds may not be disturbed by visitors in the park. No eggs can be collected, and only dogs used for dog sledges may be brought into the park. Mineral resources activities in the National Park Mineral resources activities will not have a significant impact on nature protection in all parts of the park, but the Bureau of Mineral and Petroleum notice that there are vulnerable areas within the National Park. Exploitation activities may lead to long term conflict with nature and environmental considerations, but many conflicts can be reduced through the requirements laid down by the authorities in connection with approval of planned activities.

Management of biological nature protection interests can be carried out using a model to designate biological protection areas – hot spots – and buffer zones. Within the hot spots and buffer zones the National

Environmental Research Institute develop regulation mechanisms for activities that must be either regulated or excluded for periods of time where individual species are particularly vulnerable.

The following initiatives are suggested with regard to mineral resources activities in areas with a special need for nature protection: existing background knowledge must be much better than it is today; Environmental Impact Assessments must be carried out for the entire life cycle of an activity from exploration and exploitation to closure; and finally a computer-based GIS tool should be developed, integrating both nature protection interests and impacts from mineral resources activities.

The Strategy Plan for the National Park
In addition to conservation interests, there are other interests in the National Park area, e.g. economic interests in relation to tourism and the exploitation of mineral resources, traditional use interests and recreational interests. Due to the many interests a strategy plan for the National Park is being developed by the Environmental and Nature Agency in cooperation with the Bureau of Minerals and Petroleum and other agencies introducing zonation.

As part of the Strategy Plan for the National Park, the Home Rule Government is developing zonation of the National Park to ensure conservation interests and prove opportunity for economic development. In accordance with § 20, the National Park area can be divided into separate zones: zone 1) especially valuable and vulnerable, zone 2) areas that are important and sensitive, zone 3) areas including a site of cultural, historical or natural interest, and finally zone 4) open water areas of ecological importance. The Home Rule Government can regulate access to and activities within these zones.

Research institutions provide the background data on nature, geology, history and culture, and all relevant stakeholders are involved in the zonation process.

Management of the Ilulissat Ice Fiord
The Greenland Home Rule Government Order no. 10 of 15 June 2007 on the protection of the Ilulissat Ice Fiord protects the scenic beauty and the natural historic, cultural historic and other values of the area. The 2007 government order replaced a less restrictive government order, no. 7 of 25th of March 2003.

In the government order zonation is applied in protection and management. The area is divided into one land zone – zone A – and two marine zones – zone B and zone C – as illustrated in Fig. 12. Restrictions apply to activities in zone A, but the area is open to the public and visited by many guests each year. In zone B navigation is prohibited, except for navigation in connection with commercial fishing and hunting and search and rescue operations. And in zone C access is restricted to vessels smaller than 1.000 GRT. Tourist operators must bring guides with knowledge of the regulations protecting the flora and fauna of the Ilulissat Ice Fiord when travelling in the protected areas.

The Ilulissat Ice Fiord was accepted as a UNESCO World Heritage area in 2004. Therefore a management plan for the Ilulissat Ice Fiord is currently being developed. The purpose of the management plan is to protect the area by various actions. Ilulissat Kommunea, the municipality, monitors the area while the authority lies in the Environmental and Nature Agency of the Greenland Home Rule.

Commercial Greenland halibut fishing by small vessels is intensively conducted in the Ilulissat Ice Fiord and the annual halibut quota is determined by the Greenland Home Rule. The annual quota is determined by biological guidance presented to the Ministry of Fisheries, Hunting and Agriculture, Greenland Home Rule.

Management of the nature reserve of Melville Bay
The nature reserve is administered by the Environmental and Nature Agency of the Home Rule Government.

In the nature reserve access and activities are regulated. Travel by land or boat, air travel in altitudes below 500 meters, and hunting, fishery and collection of eggs is prohibited. But like the regulation of the National Park, traditional hunting of marine mammals from boats or dog sledges is permitted in areas outside zone II.

The only exception to the above is activities regulated by the Mineral Resource Act. Exploration and exploitation of mineral resources can be permitted, in accordance with § 9 of the government order on the nature reserve in Melville Bay.

Management of the Ikka Fiord
The Ikka Fiord is administered by the Environmental and Nature Agency of the Greenland Home Rule. Access to the inner Ikka Fiord is not regulated, but visitors are requested to assist in the protection of the columns and to travel carefully in the fiord.

Management of the Kitsissunnguit Islands
The Home Rule Government order on the conservation of the Kitsissunnguit Islands was adopted in 2008, but in the process that led to the conservation of the islands local hunters and fishermen, the local communities, and researchers were involved. The many interests in the area are reflected in the conservation as activities in the area are regulated by zones, seasons and activities. By inclusion of interests and the detailed zonation and regulation the Home Rule Government aim to receive local support for the conservation and to secure among others the population of Arctic tern and the rich biodiversity of the islands.

The Kitsissunnguit Islands are still open to the public, but in spring and summer access is restricted to smaller groups and only to the area covered by zone 3, which covers the south-eastern islands. In the three zones of the conservation are no hunting, fishing or collection of eggs can be conducted from May till October, except for the fishery of one single species in zone 3 from 1st of May till 10th of June.

The conservation is administered by the Environmental and Nature Agency, while the Ministry of Fishery, Hunting and Agriculture administer and control fishery and hunting. Local authorities in Qasigiannguit and Aasiaat observe the regulations in the area.

8.6 Conclusion: challenges in ecosystem-based oceans management

Elements of ecosystem-based ocean management have been introduced, but an integrated ecosystem-based ocean management is still to be developed in Greenland. In the above passages the management and practices in fisheries, shipping and tourism, mineral resources activities, nature conservation and wildlife management is predominantly characterized as management by single species or activities with aspects of stakeholder involvement.

In fisheries and wildlife management as well as in nature protection and conservation stakeholder involvement is decisive as stakeholders often bring important data to the management process. Furthermore, the involvement of stakeholders brings support to the implementation of protective measures, i.e. restrictions on access and activities. In the long process towards the conservation of the Kitsissunnguit stakeholder involvement was comprehensive. As a result of the dialogue diversified zonation protects vulnerable zones on the islands while leaving the islands open to the public too. The effects of the conservation on the health of the population of Arctic tern are still to be evaluated, but hopes are that restrictions are observed.

The important success element in moving towards ecosystem-based ocean management is the achievement of sustainable use of resources.

In wildlife management resources have been committed to implementing a comprehensive plan on wildlife management, including aspects of ecosystem-based management. Furthermore, a working group is currently developing a strategy plan for the National Park of North and East Greenland introducing zonation in management. But in moving towards ecosystem-based management there is a need for both data and resources to secure a long term wildlife monitoring.

The main obstacle is the lack of a national strategy for the use of ecosystem-based management in Greenland, including the lack of a national strategy for nature conservation and species management.

There is a need to develop desired aims for nature conservation and species management in line with international conventions and national policies.

Furthermore, there is a need to develop a strategy and a long term plan for monitoring. A cost effective monitoring strategy which ensures the best possible basis for management decisions using a variety of monitoring methods, i.e. scientific methods, harvest statistics, local based monitoring etc, must be developed. As described in the above sections stakeholder involvement is practiced in management, but in general eco-systems based management is challenged by the lack of a strategy on stakeholder involvement and the use of stakeholder information in the management process.

Guidelines on ecosystem-based management in all relevant sectors are also to be developed. Central to these guidelines are elements such as management aims, monitoring plans, stakeholder involvement, data requirements, decision making processes and measures to ensure good collaboration between agencies.

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Ecosystem-based Ocean Management in the Canadian Arctic

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1. Overview of Canadian Arctic

1.1 Natural environment and oceanography

Canada's northern coastline, including Hudson Bay and James Bay, has a total length of 180,000 km which counts for almost the three quarters of Canada`s total coastline and makes Canada the country with the world`s longest coastline. Over 1 million km^2 of shelf waters occur within Canada's 200-mile exclusive economic zone (EEZ). The Arctic coast is characterized by a wide variety of cold climate ecosystems, including salt marshes, tidal flats, fjord systems, river deltas, and sea ice. The Arctic Ocean provides an important mixing function between Atlantic and Pacific waters and many scientists believe it to be a critical component in the global ocean circulation belt. The waters of the western Artic Ocean mix directly with warm waters arriving from the Pacific Ocean, while the waters of the eastern Arctic Ocean interact with the Atlantic. Currents flowing in and out of the arctic are thought to play a large role in determining global climate. For example, the Baffin and Labrador currents, carrying large amounts of freshwater on their surface from melting ice, help direct the warmer North Atlantic current towards northwestern Europe which moderates their climate. Major arctic currents include the clockwise gyre in the Beaufort; the flow of polar water southeast through the Archipelago; the West Baffin Current, which carries ice south along the east coast of Baffin Island in summer; the counter-clockwise gyre in Hudson Bay; and the opposing eastward and westward tidal currents in Hudson Strait. Locally, the currents may maintain open water areas – polynyas – for much or all of the year. The largest of these, the North Water in north Baffin Bay, is large enough to allow an early and persistent phytoplankton bloom (Welch, 1995). Marine mammals, such as narwhal and beluga that do not migrate south, remain in the polynya during the winter months. Sea ice provides a birthing and weaning habitat for ringed seals, resting sites for walrus, and hunting grounds for polar bear. Arctic polynyas provide an oasis for a multitude of arctic species, including whales, seals, walrus and birds. The Canadian northern environment is considered harsh, and its ecosystems are fragile and vulnerable to perturbations and environmental forcers. The Arctic has long been considered the area where global climate changes will first be observed. Freshwater input into Canadian arctic waters is primarily from the Mackenzie River and the Nelson River drainages, respectively, the second and fourth largest watersheds in North America. These drainages carry some pollutants from agricultural, industrial and municipal areas into the north although the majority of contaminants in the north are still believed to be brought in via atmospheric long-range transport. The Mackenzie River carries important nutrients that make its delta and estuary one of the most productive in the Arctic. Naturally occurring mercury released from thawing permafrost is thought to be contributed to the Beaufort through the Mackenzie drainage. The long arctic marine food chains encourage the bio-magnification of any pollutants, especially in top marine predators. Compared to other parts of the planet however, the Arctic Ocean remains relatively pristine.

Canada's North supports a variety of plants, birds, fish, mammals, and other species that have adapted and thrived under northern conditions. Cliff shorelines, salt marshes, tidal flats, and estuarine areas provide the breeding, nesting and feeding grounds for colonies of seabirds. Most of the Arctic's lower trophic species (e.g., zooplankton, arthropods, copepods, bivalves, and others) are wholly dependant on the abundance and distribution of the ice algae, kelp, and phytoplankton. Important marine and anadromous fish species include arctic cod, several species of sculpin and arctic char. Invertebrate and fish species in turn act as forage for marine mammals including walrus and several species of seals and whales.

Seabirds and marine mammals are the main biological products of Canadian arctic seas. Arctic cod are key to the arctic marine food web. It has been estimated that 148,000 tonnes of cod are consumed annually by seabirds and marine mammals in the Lancaster Sound region alone. Arctic cod, amphipods, and herbivorous copepods are in turn eaten by millions of seabirds concentrated in Jones and Lancaster sounds, on the east coast of Baffin Island, and in Hudson Strait/northern Hudson Bay, where thick-billed murres, northern fulmars, black-legged kittiwakes, black guillemots, gulls, dovekies, and loons feed. The majority of these birds are colonial nesters on island cliffs, requiring special protection from disturbance during the nesting season. A diverse bird community uses coastal and offshore waters in the Beaufort Sea. Many species migrate long distances from wintering areas as far south as the Antarctic to breed and fledge young in high-latitude regions. Six major species groups are represented: ducks; geese and swans; murres and guillemots; gulls; terns and jaegers; loons; and shorebirds. Seabird abundance is lower than in the eastern Canadian Arctic, however the region provides critical habitat for Arctic ducks and geese. Critically important habitat for birds exists in both offshore and coastal areas (DFO, 2008).

Arctic cod and other prey also support several million resident ringed seals and less abundant bearded seals throughout the Arctic, along with migratory harp seals, beluga whales and narwhals in the eastern Arctic and beluga whales in the western Arctic. Walrus feed on clams and sea urchins throughout Hudson Bay and David Strait and in the high Arctic area of Baffin Bay near Jones and Lancaster sounds (Welch, 1995; DFO, 2008)

Three discrete stocks of bowhead whales summer in Canadian waters, including populations in Davis Strait, Foxe Basin/northern Hudson Bay and the western Arctic. Bowhead whales filter-feed on zooplankton, probably large copepods, chaetognaths, pteropods, and ctenophores Population size was most recently surveyed in 1993, with 8200 bowheads estimated to be in the western Arctic stock. This comprises >90% of the world's bowhead whales (DFO 2008). Bowhead whales have been harvested at the rate of one every two to three years in the eastern arctic. However, the eastern arctic harvest may increase substantially in the near future due to a continued rebuilding of that stock and new population estimates. There has been no harvest of bowhead whales in the western arctic since 1996.

Genetic analysis has identified numerous stocks of beluga whales from the North American Artic, including seven stocks from Canada and four from Alaska. The eastern Beaufort Sea stock, the largest in Canada, is thought to be well over 20,000 animals. Beaufort Sea belugas share common wintering areas in the Bering Sea with whales from several other stocks (DFO, 2008).

Polar bears have a circumpolar distribution, but they are not evenly distributed throughout the Arctic. Of nineteen discrete populations of polar bears in the Arctic, 14 occur in or are shared by Canada. Two populations have been identified in the eastern Beaufort Sea. Their distribution is determined by the presence and distribution of various types of ice cover, and by the distribution and abundance of ringed seals (DFO, 2008).

The immense size of the Arctic Ocean results in a variety of ecological features that vary from one region to another, depending on environmental and climatic conditions as well as the direction of and distance from prevailing oceans currents. Marine ecological regions (ecoregions) were delineated in Canada's EEZ based on geological, physical oceanography, biological and ecological criteria to support the implementation of the ecosystem-based integrated management national approach (Powles et al., 2004). Six ecoregions were identified within the Canadian Arctic Ocean (Fig. 1). The main ecological features that characterize each of these ecoregions are summarized here after:

- **Arctic Basin Ecoregion**
  This area, devoid of any shoreline, is generally characterized by having depths >1000m. The 200m depth contour close to the adjacent High Arctic Archipelago ecoregion has been used to draw the boundary between these ecoregions. Much of the area is covered by permanent ice which results in low primary production and the quasi-absence of marine mammals and seabirds in this eastern part of the Arctic Basin. Very limited information is available concerning fish and benthic communities (Welch 1995).

- **Beaufort–Amundsen–Viscount Melville–Queen Maud Ecoregion**
  Most of the depths are <200m with some very shallow waters in certain parts of the ecoregion. The northern part is characterized by pack ice, whereas seasonal ice predominates in the southern part. A characteristic of this region is the shallow waters between Viscount Melville and Lancaster Sound. In the past, this feature was associated with a permanent plug of ice that was thought to act as physical boundary to the West-East movement of marine

mammal populations (narwhals, belugas). Permanent ice begins at the northern edge of the ecoregion which also corresponds to a general boundary for marine mammals and seabirds (Welch 1995)

- **High Arctic Archipelago Ecoregion**
  This ecoregion is characterized by a high degree of enclosure due to the number of islands and narrow straits with relatively shallow waters. The entire region is covered by permanent ice which explains its low primary production. The ecoregion is also characterized by a quasi-absence of top predators like marine mammals and seabirds. Seals are only observed in the southeastern part of the Archipelago and the species distribution of seals was used to determine the boundary between this ecoregion and the Lancaster Sound Ecoregion. There is also very limited information on fish and benthic species inhabiting this region (Welch 1995).

- **Lancaster Sound Ecoregion**
  This ecoregion is characterized by depths <1000m. It is a relatively enclosed area covered by seasonal ice. A large polynya starts at the mouth of Lancaster Sound and extends northward along the Eastern coast of Ellesmere Island. There are also several small recurrent polynyas in this region. The primary production of the region is relatively high and abundant marine mammals (belugas, narwhals) and seabirds migrate seasonally to the Sound and the Eastern coast of Baffin Island (Welch 1995).

- **Hudson Complex Ecoregion**
  This ecoregion is formed by Hudson Bay, James Bay, Foxe Basin, Hudson Strait and Ungava Bay and is characterized by a high degree of enclosure. Ice cover is seasonal and two major polynyas have been observed in Hudson Bay and Foxe Basin. These relatively shallow waters are under the influence of important tides and huge amounts of fresh waters coming from the eastern part (Québec) of Hudson Bay control mixing. Primary productivity is relatively high, mainly in coastal areas, and supports a diversity of fauna. Ecological assemblages of seabirds and marine mammals indicate that Hudson Bay, Foxe Basin and Hudson Strait are three natural sub-ecoregions that may eventually be considered for planning and management purposes (Welch 1995).

- **Baffin Bay–Davis Strait Ecoregion**
  This ecoregion is delineated eastward by the continental shelf line, which separates it from offshore deep waters (> 1000 m). The ecoregion is covered by seasonal ice in winter and is influenced by tides and fresh waters. Deep-water temperatures are relatively colder than in the southern adjacent region. Primary production is relatively high, mainly in waters surrounding the northern and eastern part of Baffin Island, and generally declines when moving offshore. Bottom water temperatures were used to identify the southern boundary of this ecoregion because there is clear evidence that this boundary corresponds to the distribution limits of numerous species of shrimp, groundfish, marine mammal and seabirds (Welch 1995).

1.2 Social and economic context

Northern Canada, that portion of Canada north of 60º, contains approximately 40% of Canada's landmass, yet its population base was less than 0.3% of Canada's total population of 31 million in 2003. The majority of northern communities are concentrated along the Mackenzie River watershed in the Northwest Territories (NWT), and along the Hudson Bay and Baffin Island coastlines in Nunavut.

Oceans have been a dynamic growth sector for the Canadian economy over the last few decades. In the Canadian Arctic, transportation (largely seasonal and local), oil and gas exploration, ecotourism, commercial fishing and subsistence harvesting (i.e. fishing and hunting) all contribute to the ocean-based northern economy.

The marine sector consists of private industries, organizations, and various levels of government that depend on the ocean environment as a medium for transportation, operation, innovation or recreation, or as a source of extractable resources. Impacts of the marine sector are substantial—about 5% to 10% of the total NWT economy and more than 10% of the Nunavut economy. Impacts in Nunavut are dominated by the subsistence or traditional sectors with 170 tons of marine mammals and fish (edible weight) harvested in NWT and 1,450 tons of marine mammals and fish (edible weight) harvested in Nunavut. In addition, subsistence has great cultural and social value and provides food, clothing, fuel oil and other necessities. The commercial fishery for Greenland halibut and shrimp in the Baffin Bay-Davis Strait-Hudson Strait areas generate in excess of $12-14 million to the economy of Nunavut with approximately $7.5-9.5 million entering the wage economy (Brubacher Development Strategies, 2004). The seabed holds substantial offshore oil and gas reserves. There is also a growing industry surrounding arts and crafts, e.g. Inuit sculpture.

There is not a comparable marine sector in Yukon as the northern marine coastline of this Territory is largely unpopulated. However, ecotourism has had an enormous impact in Yukon, particularly in the increased number of tourists to Herschel Island Territorial Park and Ivvavik National Park. It is expected that the marine sector will play an enhanced role in the Yukon economy as future offshore oil and gas activities increase.

1.2.1 Public sector, including Aboriginal Governments and Communities

Public governments, both federal and territorial, are some of the largest investors in Canada's northern territories. The federal government is one of the largest single sources of expenditures made in the North (GSGislason & Associates Ltd., 2003), and supports numerous mandated activities, including research. Federal departments with a strong presence in the North include the Department of Indian and Northern Affairs Canada (INAC), Department of Fisheries and Oceans (DFO), Transport Canada (TC), Environment Canada (EC), Parks Canada Agency (PCA), and Department of National Defence (DND).

Territorial departments with responsibility for fish and wildlife include Environment and Natural Resources in the NWT, and Economic Development (Fisheries and Sealing Division) in Nunavut. In addition, Inuit co-management and economic development activities are addressed under land claims agreements (GSGislason & Associates Ltd., 2003). The federal government has devolved responsibility for all programs and services, including land and resources, to the Yukon. Yukon's Department of Environment has responsibility for fish and wildlife and its Department of Energy Mines and Resources has responsibility for onshore oil and gas.

Aboriginal governments and communities in the territories have management responsibilities as well. Land claims settlements in the territories have also provided governance structures. For example, under the 1984 Inuvialuit Final Agreement (IFA), the Inuvialuit received substantial management and co-management responsibilities for marine mammals, fish and wildlife in the Inuvialuit Settlement Region (ISR) of the Western Arctic. The 1993 Nunavut Land Claims Agreement (NLCA) was central to the creation of Nunavut as a territory on April 1, 1999 and includes provisions for resource co-management. Each territory has a variety of aboriginal economic development agencies to guide and enhance economic opportunities. (GSGislason & Associates Ltd., 2003). In Yukon, 11 out of the 14 First Nations have negotiated land claims and self-government agreements and have responsibility for economic development within each of their jurisdictions.

1.2.2 Private sector

The important private sector components differ in Canada`s three territories: the oil and gas industry is the major private sector marine sector in NWT; arts and crafts, fisheries, and shipping are the major private sector marine industries in Nunavut, and commercial ecotourism is the main private marine activity occurring along the Yukon coast.

Oil and Gas industry
The North is estimated to hold approximately 30% of Canada's remaining potential in oil and natural gas, or about 8.7 billion barrels of oil and 163 trillion cubic feet of natural gas. The Mackenzie Delta-Beaufort Sea hydrocarbon basin in the Western Arctic is estimated to hold 67% of northern potential for oil, and 36% of northern potential for natural gas. Two-thirds of this total is offshore (Voutier, 2008).

Challenges to the development of this sector include responding to regulatory requirements, meeting community expectations, addressing environmental concerns, ensuring requirements for infrastructure are met, and financial considerations. Legislation such as the Canadian Environmental Assessment Act (CEAA) and the Species-at-Risk Act (SARA) have introduced additional standards that impact performance requirements for all aspects of oil and gas exploration and development. The Yukon Environmental and Socio-Economic Assessment Act (YESSA) applies to the Yukon shoreline and certain defined nearshore adjacent areas should future oil and gas activities onshore be directionally drilled to offshore reserves. Typically, hydrocarbon development requires extensive seismic activity, drilling in coastal and offshore areas, the construction of artificial islands and pipelines systems, a demand for granular deposits (i.e., gravel and sand), a dramatic increase in all-season and winter roads, marine shipping and aviation, and risk of pollution and oil spills. Development also results in an increased need for waste disposal and sewage treatment in communities and camps. Yet other challenges to industry will include addressing regulatory concerns related to impacts which might affect physical, chemical and biological patterns such as changes in water circulation and the introduction of aquatic invasive species (DFO, 2008; Voutier, 2008).

Fisheries

Commercial fishery potentials in true polar Canadian waters are small. The commercial fishery for arctic char is worth about $1.2 million annually; the domestic char fisheries have an approximate equivalent value. Greenland halibut, commercially called turbot, are found in deep Baffin Bay and Davis Strait waters in commercial quantities and support a successful shore-based winter fishery worth $1 million annually out of Pangnirtung, south Baffin Island in Cumberland sound. Two species of commercially valuable shrimp (*Pandalus borealis* and *P. montagui*) are harvested from south Davis and Hudson strait waters. Scallops have been found off south Baffin Island and in Hudson Bay, although the commercial potential is probably small (Welch, 1995). The value of the offshore turbot and shrimp fishery to Nunavut is estimated at $7.5-9.5 million and provides more than 300 seasonal jobs; often in areas where few other employment opportunities exist.

1.3 Marine transportation

Marine shipping in the Canadian Arctic is growing steadily. Population growth is increasing the demand for deliveries of goods and materials. Northern communities have the highest rate of population growth in Canada, and one of the highest in the world: 16 percent per decade. The mining sector is another major user of marine transport in the Canadian North. Mining activity remains strong and is expected to grow. Development of oil and gas resources in the Mackenzie Delta will place additional demands on transportation. Canada is building up its marine transport capacity to be the primary means for supplying its communities and resource development activities in the North. Marine transport is now a stable, independent commercial sector (Oceans Futures, 2006).

Given the changing climate it is expected that the ice will continue to retreat farther from coastlines in summer, that it will break up earlier and freeze up later, and will become thinner and more mobile. There is a growing expectation that the reduction in sea ice will result in longer navigable seasons, which in turn will allow increased access to northern natural resources, and therefore increased economic activity. However, a reduction in sea ice increases the risk of shipping accidents and spills associated with an increased volume of shipping traffic. The Northwest Passage (NWP) may also experience some ice-free periods during which navigation would become relatively easy, opening the possibility of the use of the Arctic as an efficient shipping route between the northern Atlantic and Pacific Oceans (Brigham and Ellis, 2004).

Legislation, governance and management

Management of activities within Canadian marine waters has largely developed on a regional basis and is therefore diverse and not always as integrated and coordinated as it should be. For example, there are about 50 federal statutes directly affecting oceans activities and >80 provincial laws affecting coastal and marine planning (Mageau et al. in press). The *Oceans Act* (1996) was enacted to address this issue and facilitate the development of a coordinated approach and policy framework to integrated ocean management in Canada.

Many areas of Canada's North are managed though agreements between the federal and territorial/provincial governments. As well, Canada's north is managed under agreements negotiated with the Aboriginal residents. This new generation of treaties in Canada began with the *James Bay and Northern Quebec Agreement* of 1975. They are referred to as Comprehensive Land Claim Agreements (CLCA). These agreements spell out the nature of the arrangement between the Government of Canada and Aboriginal groups regarding such areas as self-government powers (including control over social services such as education and health), compensation payments, environmental assessment, protected areas, land use regulations, and Aboriginal ownership or co-management of land and resources in parts of the land under the agreement (Berkes, 2007).

Land claims agreements in Canada, including the *Inuvialuit Final Agreement* and the *Nunavut Land Claims Agreement*, set up power and responsibility sharing arrangements for the use of land and resources, including marine resources. Many of the agreements have one or more chapters that do this in some detail. They all set up co-management bodies where the parties to the agreement come together (Berkes, 2007).

Legislation aimed at protecting Arctic marine ecosystems and addressing conservation issues includes Federal, Territorial and Provincial legislation. Federal acts include the *Oceans Act*, the *Arctic Waters Pollution Prevention Act*, the *Canada Shipping Act, 2001*, the *Fisheries Act*, the *Canada National Marine Conservation Areas Act,* the *Canada National Parks Act*, the *Canadian Environmental Protection* Act, 1999, the *Canadian Environmental Assessment Act,* the *Canada Wildlife Act,* the *Migratory Birds Convention Act, 1994,* and the *Species at Risk Act.*

The main Federal authorities which have responsibilities in the management of activities, and protection of marine ecosystems and their resources in the Arctic include the following:

- **Department of Fisheries and Oceans (DFO):**
  DFO has the legal responsibility to conserve fish habitat and commercial stocks in Canada under the *Fisheries Act* and by so doing it discharges some of Canada's national and international obligations to maintain the integrity of arctic marine ecosystems. Under the *Oceans Act*, DFO is mandated to protect and conserve marine ecosystems, their biodiversity and productivity, including the establishment of marine protected areas (MPAs), and maintain marine environmental quality, while promoting the integrated management of human activities and sustainable development in Canada's estuarine, coastal and marine environments, including in Arctic waters.

- **Canadian Coast Guard (CCG):**
  CCG is a National Special Operating Agency of the Department of Fisheries and Oceans that provides essential marine safety and environmental protection services to Canadians. The CCG also provides the marine support needed by DFO and other federal government departments for the protection of the marine and aquatic environment, public safety and security on the water, marine science and fisheries resource management and to meet other Government of Canada maritime objectives.

- **Environment Canada (EC):**
  EC has the mandate to preserve the quality of the natural environment; conserve Canada's renewable resources and biological diversity, as well as carry out meteorology and ice services**,** prepare for and prevent environmental emergencies, and report on the state of the environment. EC is also authorized to manage and regulate the introduction of pollutants into the marine environment, under the *Canadian Environment Protection Act*, and section 36 of the *Fisheries Act*. The multi-faceted pollution prevention effort in northern waters also includes controls on disposal at sea and pollution from land-based sources. The Department's responsibilities pertaining to the conservation and management of migratory birds under the *Migratory Birds Convention Act* extend to the conservation and management of Arctic seabirds. The *Species at Risk Act* provides the Minister

of the Environment with the authority to protect nationally listed wildlife species at risk, and provide for the recovery of endangered or threatened species. The *Canada Wildlife Act* enables the Depart ment to establish Migratory Bird Sanctuaries, National Wildlife Areas, and Marine Wildlife Areas to protect a wide diversity of habitat of national and international importance.

- **Parks Canada Agency:**
  This federal agency, which reports to the Minister of Environment, is mandated to protect and present nationally significant examples of Canada's natural and cultural heritage, and to foster public un derstanding, appreciation and enjoyment of these special places. This includes establishing representative systems of national parks, national historic sites and national marine conservation areas. As such, national marine conservation areas, as well as coastal and marine components of national parks are an important component of environmental protection in the Canadian Arctic.

- **Transport Canada (TC):**
  TC is responsible for oceans safety and pollution prevention. It administers the provisions of the *Canada Shipping Act* which include regulation of navigation, as well as ship source pollution prevention, including control of ballast waters. Transport Canada is also responsible for the *Navigable Waters Protection Act*, the *Arctic Waters Pollution Prevention Act* and the *Marine Liability Act*, all of which have implications for shipping in the Arctic.

- **Indian and Northern Affairs Canada (INAC):**
  INAC is the principal federal department responsible for meeting the federal government's constitutional, political and legal respon sibilities in the North, with legislative and policy authority over most of the North's natural resources, Yukon and Aboriginal governments. Its role in the North is extremely broad and includes settling and implementing land claims, negotiating self-government agreements, advancing political evolution, managing natural resources, protecting the environment and fostering leadership in sustainable development both domestically and among circumpolar nations.

In the following sections, we detail the legal and policy framework as well as major national initiatives that have been put in place by the Government of Canada to implement the ecosystem approach to integrated management in Canada's three oceans, including the Arctic Ocean.

Oceans Act
The *Oceans Act* (1996), which entered into force in 1997, is really the starting point for Canada's Federal Government to develop a nationally coherent oceans policy framework. The *Act* provides the broad context for the development of an ecosystem approach for marine ecosystem conservation, and stresses the importance of maintaining biological diversity and productivity in the marine environment. The *Act* provides a mandate to develop related programs and regulatory instruments; e.g. integrated management of human activities in oceans, designation of Marine Protected Areas (MPAs), and to develop tools to maintain the marine environmental quality (e.g. MEQ objectives, guidelines or standards). Department of Fisheries and Oceans is the lead federal Department for implementing all the *Oceans Act* programs and instruments.

Canada's Oceans Strategy and the Integrated Management Policy
In addition, the *Act* calls for the development of an overarching strategy for oceans management: Canada's Oceans Strategy (COS, 2002a) was developed after a broad public consultation process and is based on the three key principles: integrated management, sustainable development and precautionary approach. Its overall goal is "to ensure healthy, safe and prosperous oceans for the benefit of current and future generations of Canadians" (COS, 2002a). The Strategy's companion document (COS, 2002b) provides the policy and operational framework for integrated management (IM) of human activities in Canada's oceans and coastal areas. EBM and ecosystem conservation are core principles within the IM approach.

Federal Marine Protected Areas Strategy
The *Oceans Act* also calls for the establishment of a national network of marine protected areas (MPAs). In order to guide the building of this network, the Federal MPA Strategy was released in 2005 (FMPAS, 2005). It provides the direction to the three federal partners that have legislative authority in marine conservation, DFO (*Oceans Act* MPAs), DOE (Marine Wildlife Areas) and Parks Canada Agency (National Marine Conservation Areas), to develop a more systematic approach to marine protected areas planning and establishment in Canada, by using a rigorous and knowledge-based approach to site selection while maximizing ecological output.

For example, a number of protected areas which contribute to the overall protection of coastal and marine wildlife and habitats are in place or contemplated in the Canadian North. With respect to the federal authorities, these include:

- Seven of Canada's 42 national parks established under Parks Canada's legislation are located along Arctic waters and include a coastal and/or marine component: Quttinirpaaq, Sirmilik, Auyuittuq, Ukkusiksalik, Aulavik, Ivvavik, and Wapusk. In total, these parks protect over 4740 km of coastline and 6870 km^2 of marine waters.
- Nine of Parks Canada's 29 marine regions are found in Arctic waters and each of these will eventually be represented by a national marine conservation area (NMCA). Though no NMCAs have yet been established in the Arctic, discussions are underway with the Government of Nunavut and Inuit organizations to initiate a feasibility study for an NMCA in Lancaster Sound (Figure 1).
- Fourteen Migratory Bird Sanctuaries and 2 National Wildlife Areas established under Department of Environment's legislation are located along the Arctic coast and protect and 13,500 km^2 of marine waters. A number of candidate National Wildlife Areas are also underway (Niginganiq, Qaqulluit and Akpait, all along Baffin Island) which will add approximately 4500 km^2 of protected marine waters.
- One Marine Protected Area (MPA) located in the Canadian Beaufort Sea, the Tarium Niryutait MPA, is currently in the process of being designated as such under the Oceans Act. Fisheries and Oceans Canada is leading the process. The candidate MPA consists of 3 separate coastal areas: Shallow Bay, East Mackenzie Bay near Kendall and Pelly Island and Kugmallit Bay, collectively referred to as the Tarium Niryutait MPA which will protect one of the world's largest summering population of Beluga whales and its habitat. This area is also a productive ecosystem with habitat unique to the region and numerous species (ringed seal, bearded seal, polar bear, fish, seabirds and coastal waterfowl (over 130 bird species). The MPA covers approximately 1800 km^2.

Oceans Action Plan (2005-2007) and the Large Ocean Management Areas (LOMAs)

In 2004, the Government of Canada committed to a two-year funded (2005-2007) Oceans Action Plan (OAP) to achieve a series of deliverables grouped under four thematic pillars: 1) International Leadership, Sovereignty and Security, 2) Integrated Management for Sustainable Development, 3) Health of the Oceans and 4) Ocean Science and Technology (OAP, 2005). A number of key deliverables identified within pillars 2 and 3 of the Plan were to advance the EBM approach. In addition to the designation of a number of MPAs, the Plan identified five priority Large Ocean Management Areas (LOMAs) in Canada's three oceans (Figure 2): *Eastern Scotian Shelf Integrated Management* area; *Gulf of St.Lawrence Integrated Management* area; *Placentia Bay-Grand Banks Integrated Management* area; *Pacific North Coast Integrated Management* area; and *Beaufort Sea Integrated Management* area. These LOMAs have served as pilots to test and apply science-based management tools specifically developed for advancing and implementing EBM.

Integrated management in the Beaufort Sea has been implemented as a collaborative planning process led by the Department of Fisheries and Oceans (DFO) to address oceans management issues in the Beaufort Sea LOMA, including the coastal, estuarine, Arctic islands and off-

shore areas, and when appropriate collaborate with on-shore management activities. Later in this chapter, we will focus on the Beaufort Sea LOMA as it is currently the only management area located in the Arctic Ocean.

Health of the Oceans (2007-2012)
In 2007, the Government of Canada launched a 5-year oceans plan, the so-called *Health of the Oceans* agenda to take over the 2005-07 OAP. This new oceans agenda will enable DFO to continue to work with its federal, provincial, territorial, Aboriginal, ENGOs and international partners for advancing the ecosystem approach to oceans management in Canada, with a focus on the protection and conservation of marine ecosystems; for example, the designation of new MPAs to progressively build Canada's network of MPAs; advancement of the Regional Strategic Environmental Assessment concept by integrating assessment tools developed for ocean management (i.e. at regional/LOMA level) with project-specific impact assessments conducted under the CEAA for major projects in Canada, including the Arctic; and enhancing Canada's capacity for oil spill responses, particularly in the Arctic. The existing five LOMAs will continue to provide the spatial management context within which this new ocean agenda will focus over the next five years.

2. Ecosystem-Based Ocean Management Initiatives

2.1 National scale: the Ecosystem-Based Management operational framework

Definition and guiding principles
In the Canadian context, Ecosystem-Based Ocean Management involves managing human activities in such a way that marine ecosystem health is not significantly impacted. EBM is made operational, and its achievement becomes possible and measurable, when the significant components or the ecosystem (areas, species, properties) are identified as conservation priorities that, in turn, are translated into ecosystem conservation objectives to define the bounds within which the sustainable development can be achieved.

This operational definition is aligned with a series of guiding principles: EBM is holistic and cross-disciplinary, based on the best knowledge available, a phased implementation process, nationally developed and regionally implemented, area-based, objective-based, applied within the broader context of Integrated Management, incorporates the precautionary approach and adaptive management principles.

In practice, ecological considerations are taken into account at each step of the integrated management process in order to achieve scientifically defensible ecosystem-based management and ensure long-term marine conservation (Fig. 3; shaded boxes). Science-based management tools have been developed over time to meet specific management needs as identified at each step of the process. The result is the EBM framework presented in Figure 4. Some elements of this framework set the foundation for both marine spatial planning and an area-based management approach (ecoregions, Large Ocean Management Areas, Ecologically and Biologically Significant Areas, in addition to Marine Protected Areas) and are detailed in the following paragraphs.

- **Marine Ecoregions**
  The first step is the delineation of marine ecological regions, i.e., those regions of the oceans that are characterized by large-scale ecological features**.** The intent is to use these features for the establishment of LOMAs so that ecosystem considerations can be accounted for in the planning, decision-making and management of these areas. The delineation process is guided by science-based criteria for the identification of patterns of ecological homogeneity (ecoregions), as well as major discontinuities between them (Powles et al., 2004). This process resulted in the delineation of seventeen marine ecoregions in Canada's three oceans: four ecoregions in the Pacific Ocean, seven in the Atlantic Ocean and six in the Arctic. The six Arctic ecoregions are the largest and, as a whole covered a larger area than the Pacific and Atlantic ecoregions (Fig. 1). Indeed, limited data in certain regions of the Arctic did not allow scientists to identify smaller ecological units. In addition, some very large basins work as a single ecosystem, and so were considered as one ecoregion.

- **Large Ocean Management Areas**
  Ecoregions' boundaries are not definitive and can be revisited when and where needed as more scientific knowledge is gathered, mainly in data-poor areas. It is also important to note that LOMA boundaries are drawn using a mix of ecological and administrative considerations (COS, 2002b). Consequently, LOMA boundaries are not expected to perfectly follow the natural patterns observed in the marine environment, although ecoregions are the foundation layer for their establishment. In addition, the scale at which the delineation process is conducted is an important issue. For example, during the marine ecoregion delineation process, natural substructures were identified within certain ecoregions (Powles et al., 2004); these substructures were observed at a scale too fine to be useful for the identification of large ecoregions and LOMAs. However, ecoregions' substructures would certainly be the best spatial units for informing the identification of management areas at smaller scale, and so coping with local environmental issues, e.g. coastal management areas (COS, 2002b).

- **Ecosystem Overview and Assessment Report**
  Once the integrated management area is established, oceans planners, managers and stakeholders need to be provided with the ecological information relevant to EBM (Fig. 3; step 2). The best available knowledge has to be incorporated from the outset of the planning process to inform subsequent steps. It should come from two main sources, the western science as well as local and traditional ecological knowledge.

  The OAP (2005) identified a number of key deliverables to en hance the knowledge and assessment of marine ecosystems and help the identification of conservation priorities within the five priority LOMAs: i) the preparation of Ecosystem Overview and Assessment Reports (EOAR) for assessing and reporting on marine ecosystems within the management areas; ii) the identification of Ecologically and Biologically Significant Areas (EBSAs); and iii) the development of Ecosystem Objectives for informing IM planning in LOMAs. These tools and products were really the "building blocks" on which the EBM framework has been developed in Canada (Fig. 4).

  A national guidance document for the preparation of Ecosystem Overview and Assessment Reports (EOAR) was developed (Fig. 3 & 4; step 2). The EOAR is based on a preliminary review of current ecological knowledge. The first part of the report is descriptive and provides basic ecological information through a series of thematic chapters. This part also includes an integrative chapter on ecosystem relationships. The second part of the EOAR is an integrated ecosystem assessment, based on the information compiled and reported in the overview; it reviews human activities—and associated stressors—that may have significant negative impacts on the ecosystem, including an assessment of potential cumulative impacts. It analyzes and evaluates the actual conditions of the ecosystem's health, highlighting which areas and species managers should pay attention to, either because those areas and species have a key role in the ecosystem, or because they have been affected by human activities. This ecological assessment is the main source of information provided to guide managers in setting conservation measures at the LOMA scale.

- **Ecologically and Biologically Significant Areas**
  The identification and mapping of "Ecologically and Biologically Significant Areas" in each LOMA was guided by the framework and criteria previously developed through a national workshop of experts (DFO, 2004). The framework consists of three criteria *(uniqueness*, *species aggregations* and *fitness consequences)* that qualify an area as "significant". In other words, they are the dimensions along which a given marine area is evaluated with regards to its ecological or biological significance. In addition to these first order criteria, two additional criteria, the *resilience* and *naturalness* may be considered when evaluating the significance of the areas against the main criteria. These additional criteria allow us to take into account the sensitivity of the area, its ability to recover from a perturbation, and the degree to which the area is undisturbed.

- **Ecologically Significant Species and Community-Properties**
  Similarly, national guidelines and criteria were developed to help the identification of "Ecologically Significant Species" and "Ecologically Significant Community-Properties" (DFO, 2006). Criteria related to the importance of the trophic and structuring roles of species within the ecosystem were identified: forage species, highly influential predators, nutrient importing or exporting species, primary producers and decomposers, and structure-providing species. These categories of species would qualify as ecologically significant. Here again, two additional considerations, the rarity and sensitivity of the species, were identified as important when applying the ecologically significant species' framework. Invasive species and toxic phytoplankton were also considered within the framework, although in this case, their ecological signifi cance resides in the fact that they can cause significant damage to marine ecosystems. In this case, management actions aim at controlling and limiting as much as possible their abundance and dissemination in the marine environment.

- **Degraded Areas and Depleted Species**
  In a risk-based management context, oceans managers have to adopt a greater-than-usual degree of risk aversion to areas, species or properties that are more significant than others. Ecosystem features that have been affected by human activities to an extent where they can no longer play their structural or functional roles in the ecosystem have to be identified within ecosystem overview and assessment reports. Degraded areas and depleted species are those ecosystem components that are of concern from a management perspective. Degraded areas, for example, altered habitats, contaminated sites, eroded shoreline, areas of hypoxia, and sites facing recurrent eutrophication, are those areas that would re quire targeted management measures such as restoration or control of pollution sources. Depleted species are those species for which a scientific assessment is essential and a recovery strategy and full protection may be required to ensure the survival of the species or the population. Endangered and threatened species listed under the *Species at Risk Act* are obviously part of this category. Depleted stocks of commercial species may also be considered here as they are of concern for integrated oceans management.

- **Ecosystem Objectives**
  Objectives for EBM, or Ecosystem Objectives (EOs), are then developed around non-human components of the ecosystem described above, and incorporated into IM plans along with other objectives (Fig. 3 & 4; step 3). The EO setting process has been guided at the national level to ensure consistency across the country, and has been done at the LOMA level to capture ecosystem-scale considerations. The fine-tuning of management plans to address local and/or specific environmental issues will require EOs to become operational by adding increasing specificity into objectives statements. It is expected that the set of ecosystem objectives developed for the IM-LOMA plan, when fully developed, will contain two categories of ecosystem objectives: 1) objectives set for conservation purposes, and 2) objectives targeting the desirable state of the ecosystem.

- **Conservation Objectives and Limits**
  Conservation-oriented EOs are associated with appropriate eco logical indicators and thresholds defining the biological limit of the system–those "conservation limits" that should never be compromised or exceeded in order to ensure a healthy ecosystem over time. Conservation limits are reference points that set the bounds of the system within which other management objectives should be established. Conservation objectives are solely based on science, including traditional knowledge, and are developed from the identification of conservation priorities (Fig. 3 & 4; step 3). Conservation objectives have been developed in each LOMA following the national guidance (DFO, 2007a). The next step is to make these ecosystem conservation objectives operational through the LOMA IM plan, and manage activities accordingly to ensure the objectives are met.

- **Social, Cultural and Economic Considerations**
  The establishment of "desirable state" EOs combines ecological with social, cultural and economic considerations, in contrast to science-based conservation objectives. It is expected that this category of EOs will be identified by the IM "players", ocean stakeholders, users and planners, to define an agreed-upon state of the ecosystem to be reached in a given future. However, the necessary condition to achieve the sustainable use of oceans space and resources commands that those desirable targets be set within the bounds of conservation limits.

  Parallel to defining conservation limits, DFO is also working with key partners to ensure that social, cultural, and economic considerations are addressed. Integrated oceans management, as defined in the Canadian oceans policy context (COS, 2002b) is a comprehensive, collaborative and inclusive process that enables us to simultaneously take into account all these necessary aspects, as well as the interdependencies of viable coastal communities, marine ecosystem health, and sustainable use of ocean resources. Specifically, work is being done to use an interdisciplinary, multi-partnered approach to creating a base understanding of our coastal areas. This information will help to determine social, cultural, and economic trends, pressures, vulnerabilities, and opportunities. As a next step, relevant social, cultural and economic objectives that respect ecosystem objectives and conservation priorities will be developed (Fig. 3 & 4 step 4).

- **Ecosystem Indicators**
  Once incorporated into an IM plan, EOs will be monitored through marine environmental quality or ecosystem health indicators. Lists of indicators can be easily found in the literature reviewing integrated coastal/oceans management initiatives worldwide; (see for example IOC, 2003). The real challenge is to select the most relevant indicators while keeping their number as low as possible within effective suites of indicators that are workable and meet the needs of integrated oceans management (IOC, 2006). DFO is identifying criteria and developing a framework to select the most appropriate ecosystem indicators that would meet the common needs of management sectors. A national suite of ecosystem indicators will be then developed for meeting the various needs of the management: to monitor and report on the status and trends of marine ecosystems, to track key ecosystem functions, to assess the effectiveness of management actions and to inform decision-making.

- **Adaptive Management**
  Adaptive management is a key principle of the EBM/IM approach. Based on lessons learned and best practices from the regional implementation in LOMAs, the EBM described above will be refined over time, guidelines and products will be revisited when it becomes necessary, i.e. when major science gaps are filled and new ecological knowledge is produced, or when our understanding of the EBM concept and the application of principles make significant progress. Beyond science issues, adaptive management may be also required in future if new priorities come up from societal pressure or shift in the risk tolerance, or if we need to adapt to changing environmental conditions.

- **Sector-specific initiatives**
  In addition to identifying significant components and conservation priorities in LOMAs, ecosystem considerations have been also inserted into sector-specific policy and regulatory instruments to ensure those significant ecosystems are not jeopardized by human activities and are timely and appropriately protected. Sector-specific initiatives are put in place for addressing emerging issues or regulatory gaps in the domestic oceans policy framework. They may be established for addressing both, national or regional issues, as illustrated by the following examples:

- DFO's Fisheries and Aquaculture Management sector is developing a *New Resource Management Sustainable Development Framework* which includes a series of new policies to minimize impacts of fishing activities[1]; these policies deal with emerging fisheries, forage species fisheries, sensitive benthic marine areas, the use of precautionary approach, etc.

1 The draft framework and new policies are available for review and public consultation: http://www.dfo-mpo.gc.ca/communic/fish_man/consultations/RMSDF-CDDGR/index_e.htm

2 Available at: http://www.dfo-mpo.gc.ca/oceans-habitat/oceans/im-gi/seismic-sismique/statement-enonce_e.asp

- In 2006, Transport Canada released the *Ballast Water Control and Management Regulations* under the *Canada Shipping Act, 2001* to reduce the risk of harmful aquatic species being introduced into Canadian waters through ballast waters; among other measures, the regulations specify alternative ballast water exchange zones that were defined based on a scientific basis.

- In 2005, the Government of Canada, in collaboration with the Provinces of Newfoundland and Labrador, Nova Scotia, and British Columbia, released the *Statement of Canadian Practice for Mitigation of Seismic Noise in the Marine Environment*[2] to formalize and standardize the mitigation measures used in Canada with respect to the conduct of seismic surveys. These guidelines are based on the scientific knowledge available and derived from best practices.

- At the regional level, ecosystem-based fisheries management measures include area closures for protecting fish stocks or non-targeted species; for example off Eastern Scotian Shelf, two *Coral Conservation Areas* have been closed to all fishing efforts since 2001 and coral conservation plans have been developed. These conservation initiatives were complemented by the establishment of *The Gully Marine Protected Area* located in the same ecoregion and protecting the biodiversity, incl. species at risk, of a deep-water canyon ecosystem.

1.1 Local and regional scale: The Beaufort Sea LOMA example

1.1.1 Regional implementation of the national framework

Prior to the current move toward ecosystem-based management of marine resources, DFO's procedure for protecting the marine ecosystem began with management plans for individual stocks, the first step being stock assessment, followed by a fishing plan specifying total allowable catch (TAC). DFO has been working at these plans and presenting results to the joint management boards, which have not been able to conduct the research themselves. Plans for marine mammal stocks include the Canada/US Beluga Plan; the Beaufort Sea Beluga Management Plan; the Southeast Baffin Beluga Plan; the Eastern Hudson Bay Beluga Plan; and the Western Arctic Bowhead Plan, which was precipitated in part by the political need to have some sort of management plan in place before taking bowheads in the Beaufort Sea (Welch, 1995). The implementation of an ecosystem approach will result in more effort to incorporate ecosystem considerations into sector-specific management in order to fully achieve the ecosystem-based management of oceans activities.

The Beaufort Sea LOMA is one of the five pilot areas in which an ecosystem-based integrated ocean management approach is being implemented (OAP, 2005), and the only one of these management areas that is located in Arctic waters. It is also the only LOMA in which a co-management regime exists: The Inuvialuit Land Claim Agreement for the Inuvialuit Settlement Region (ISR) was signed in 1984 and both the Inuvialuit and the Government of Canada share resource management responsibilities in the land claim area. The following paragraphs describe in more detail how the national framework has been applied to the Beaufort Sea LOMA and the Arctic context.

Delineating the Beaufort Sea marine ecoregion and planning area
The biogeophysical characteristics of the Canadian Western Arctic are relatively well known compared to other Canadian Arctic areas and have been the base for identifying marine ecoregions (Powles et al., 2004). The Canadian Beaufort Sea is one of the 6 ecoregions identified in the Arctic waters (see previous section). The boundaries for the Beaufort Sea LOMA were established by the Regional Coordination Committee, an interagency group which provides coordinated decision-making, oversight, direction and review for the development and implementation of an IM plan for the LOMA. The planning area encompasses the marine portion of the ISR (Figure 5) which partly covers the Beaufort Sea ecoregion and incorporates ecosystem-scale features, patterns and trends. Covering 1,514,746 km^2, it is the largest of Canada's five LOMAs.

Understanding the Beaufort Sea ecosystem
An ecosystem overview was drafted using the best available information for the area, drawing on scientific knowledge and TEK (DFO, 2008). This basic ecological information has been reviewed by co-managers, technical experts, partners, and communities. The report'scontent follows the standard Table of Contents developed for national consistency while taking into considerations regional specificities of Arctic marine ecosystems. This document is considered a 'living' document and will be updated periodically as more is learned. A companion plain language summary report has also been developed for distribution to the public (Schuegraf and Dowd, 2007). It is intended to make both documents available via the internet.

In the Beaufort Sea, dominant physical processes include sea ice extent and duration; the Mackenzie River inflow which supplies nutrients, sediment, and warm freshwater to the Beaufort Shelf; and oceanographic currents and upwelling driven by local and large-scale factors. Though there are at present no estimates of the size of the Arctic cod population in the Beaufort Sea, it is known that there are many food web linkages to Arctic cod, an important consumer of zooplankton and small fish, and prey for vertebrate consumers. This relationship emphasizes the critical role Arctic cod play in the Arctic ecosystem, and their significance could be an important factor to consider when forecasting impacts of climate change and increased development on the ecosystem of the Beaufort Sea. (DFO, 2008)

Assessing the state of the Beaufort Sea ecosystem
Within the assessment part of the EOAR (Table 1), some sections, in particular those dealing with ecologically significant areas and species have involved significant partner engagement. One scientific workshop with experts from various fields and organizations documented what is known or hypothesized about the significance of areas and species of the Beaufort Sea. As well, a community workshop involving representatives from various Inuvialuit organizations and the 6 ISR communities was held to identify which areas were ecologically significant. During this workshop traditional knowledge was recorded on maps. As a follow-up, focus group sessions were also conducted in each of the communities with representatives from local organizations (e.g. youth, elders, hunters and trappers, renewable resources, parks) and TEK was once again documented. Findings from these consultations and previous work (e.g. Community Conservation Plans, oral histories, harvest studies) have been synthesized in Table 2.

Managing human activities in the Beaufort Sea
The purpose of this work is to develop and implement an IM plan for the Beaufort Sea LOMA. The vision is to ensure the Beaufort Sea ecosystem is healthy, safe, and prosperous for the benefit of current and future generations. The *Inuvialuit Final Agreement* (IFA) (Canada, 1993) and the Oceans Action Plan (2005-2007) set the framework for a governance structure and the creation of a Regional Coordination Committee (RCC) for integrated oceans management in the Beaufort Sea. The RCC is co-chaired by senior members of Canada's Department of Fisheries and Oceans and the Inuvialuit Aboriginal Government In addition to the RCC, the governance structure for collaborative planning process is also comprised of a broader group of stakeholders who participate in a Beaufort Sea Partnership (BSP) to exchange information and ideas, and make recommendations to the RCC. Various Working Groups and a Secretariat conduct the day-to-day work required to support the larger governance structure. The need for greater involvement of the national intergovernmental committees on oceans has become apparent as the regional governance structure evolves. Conservation objectives, along with social, cultural and economic objectives have been developed in consultation with communities, partners and co-managers.

Specifically, conservation objectives for Beaufort Sea LOMA focus on maintaining marine biodiversity, productivity and habitats. To ensure these objectives are being met, responsible authorities will identify indicators and thresholds, and develop monitoring programs. Where possible these objectives and indicators are building on previous or current initiatives within the ISR such as the Tarium Niryutait Marine Protected Area, ISR Community Conservation Plans, and ongoing community-based and scientific monitoring programs. The Beaufort Sea LOMA integrated management plan will identify priority objectives and responsible agencies. It will also outline strategies for

achieving management priority objectives. Adaptive management will underpin the IM plan, so courses of actions will be revised when objectives are not being met.

1.2.2 Stakeholder consultation process and governance aspects

EBSA identification in the Beaufort Sea LOMA presented a number of challenges. These included the need to incorporate traditional and local knowledge; a significant lack of scientific data; significant seasonal and geographic bias in existing data and a bias towards knowledge of species that are important to the communities for subsistence fishing and hunting. Workshops were held with the scientific and local communities to help identify potential EBSAs. The areas identified were then evaluated and ranked against the criteria and guidance developed nationally (DFO, 2004). Results are presented on figure 6. Significant species and community properties key to maintaining ecosystem structure and function were also identified for enhanced protection under Canada's implementation of ecosystem-based approach to management, here again following national guidance provided by scientists (DFO, 2006). Candidate species were identified through consultation with local community members and the scientific community (results are summarized in Tables 2, 3 and 4). More information and scientific rationale supporting these results can be found in the Beaufort Sea Ecosystem Overview and Assessment Report (DFO, 2008).

Aboriginal control over the environment in the land claims areas is in the form of independent and joint jurisdiction, with aboriginal rights and responsibilities legally specified. Each of the comprehensive claims agreements has a section or sections that specify responsibilities for fisheries and wildlife management, and creating co-management boards as the main instruments of resource management. The agreements establish institutional structures in the form of management boards and joint committees. Some of the agreements specify the use of aboriginal traditional knowledge in the process of co-management (Berkes, 2007).

The experience in the North is that the development of co-management strongly parallels the emergence of aboriginal land claims. Partnerships and participatory management, not only in fisheries and wildlife but in a range of areas–integrated coastal management, protected areas, ecosystem and human health, contaminants research, environmental assessment, climate change– follows increasing local and regional political power in the North emerging from self-government. These developments have led to the incorporation of local values, priorities, and traditional environmental knowledge as mechanisms for participatory decision-making (Berkes and Fast, 2005). More recently, the Regional Coordination Committee (RCC) referenced earlier was established as the primary governance body for the Beaufort Sea LOMA.

2.2.3 Challenges and opportunities

The Beaufort Sea is subject to the harsh Arctic climate which is characterized by extreme seasonal variability in environmental factors such as ice cover, temperature range, winds and river inflow (Carmack and MacDonald, 2002). Although marine life is adapted to this extreme environment, these conditions certainly make the Beaufort Sea's ecosystem vulnerable to human-induced stressors. From an EBM perspective, two overriding challenges for the Beaufort Sea LOMA exist: a lack of knowledge of offshore areas and the entire area during the winter season; and the global nature of the major ecosystem stressors including climate change and contaminants.

There are also many exciting opportunities and successful experiences to report. These include the creation of the first Oceans Act MPA in Canadian Arctic waters, the Government of Canada/Inuvialuit Fisheries Joint Management Committee (FJMC) for the co-management of several fish and marine mammal stocks, and collection of ecological knowledge through partnerships for scientific research and monitoring (e.g. Beaufort Sea Habitat Mapping Program, Beluga Harvest Monitoring Program). Relationships are being forged at all levels, from local to regional and international scale, through such venues as the Beaufort Sea Partnership, Arctic Council and International Polar Year. So far, this integrated, holistic and ecosystem-based approach to oceans management has been well received and supported by the people of the Beaufort Sea region.

2.3 Transboundary Cooperation and EBM

Canada has entered into various regional and bilateral agreements which aim to foster environmental cooperation across political boundaries. Agreements supportive of ecosystem-based management fall into two main categories: environmental protection and marine living resource conservation.

2.3.1 Environmental Protection

Cooperation in transboundary environmental protection has been facilitated through the Canada-Denmark Agreement for Cooperation Relating to the Marine Environment,[I] the North American Agreement on Environmental Cooperation[II] and bilateral agreements relating to the environment with the United States and the Russian Federation.

Canada–Denmark Agreement for Cooperation Relating to the Marine Environment

While the Canada-Denmark Agreement, concluded in 1983, predates the emergence of the ecosystem approach in international law, the agreement nevertheless has a broad goal of protecting the marine environment in shared waters of the Nares Strait, Baffin Bay and Davis Strait. Parties agree to provide information and to consult over any works or undertakings which may create a significant risk of transboundary pollution. Parties agree to cooperate in identifying appropriate routing areas for vessels operating outside territorial waters. The agreement also pledges Canada and Denmark to ensure that installations engaged in exploration for or exploitation of seabed natural resources are constructed, placed, equipped, marked and operated so the risk of marine environmental pollution is minimized.

Annexes to the Agreement set out joint contingency plans for pollution incidents in the region. Annex A covers pollution incidents from offshore hydrocarbon exploration or exploitation and provides for exchange of information on agencies and officials responsible for pollution emergency responses. Annex B, as amended in 1991, establishes a joint contingency plan for shipping incidents.[III]

North American Agreement on Environmental Cooperation

The North American Agreement on Environmental Cooperation, concluded in 1993 by Canada, Mexico and the USA, established the Commission for Environmental Cooperation (CEC) and while the Commission has not specifically focused on the Arctic, it has facilitated various initiatives relating to Arctic biodiversity protection. In 2003 the CEC through its Council adopted a Strategic Plan for North American Cooperation in the Conservation of Biodiversity (CEC, 2003). The Plan established a framework for promoting cooperation in conserving North American regions of ecological significance and North American migratory and transboundary species. The Strategic Plan lists 14 CEC priority conservation regions of North America with two specific Arctic regions included, namely Arctic Tundra/Archipelago and Arctic Coastal Tundra/North Slope.

The CEC has facilitated and coordinated the North American MPA Network (NAMPAN) with an aim of identifying priority conservation areas (PCAs) that should be considered for protection in light of shared marine migratory species crossing national boundaries. Initial work has focused on identifying marine conservation areas in the Baja California to the Bering Sea region (a.k.a. the *B2B* initiative) and a 2005 report identified 28 PCAs including two in the Bering Sea ecoregion, specifically the Pribilof Islands and Bristol Bay in Alaska. (Morgan et al. 2005).

The CEC has also supported a project on Marine Species of Common Conservation Concern. An initial set of three marine species (Pacific leatherback turtle, pink-footed shearwater and humpback whale) were selected in addition to three terrestrial species for development of North American Conservation Action Plans (NACAPs). For the humpback whale, which may be found in Arctic waters, a NACAP was published in 2005 (CEC, 2005). The Action Plan documents existing research initiatives and threats relating to humpback whales and suggests various trinational actions such as sharing information among countries about sources and impacts of anthropogenic sounds and identifying the principal regions and time periods posing the greatest risk of ship strikes to humpback whales.

In 1999 the CEC launched the North American Bird Initiative (NABCI) with an overall goal of enhancing cooperation among existing bird conservation organizations and initiatives to achieve effective protection of all North American birds.[IV] NABCI partners have delineated ecoregions (Bird Conservation Regions) across North America, including the Arctic, with ecoregions defined by common biophysical elements, such as soil type, vegetation and associated bird species.[V] NABCI complements other international bird conservations efforts such as those under migratory bird treaties and the North American Waterfowl Management Plan (NAWMP 2004).

Canada–Russian Federation Agreements
Canada and the Russian Federation have cooperated in environmental protection pursuant to various agreements. The Canada-Russian Federation Treaty on Concord and Cooperation,[VI] entering into force on April 4, 1993, sets out an overall framework for cooperation and in Article 10 specifically recognizes the need to protect fragile ecosystems.

The Canada-Russian Federation Agreement Concerning Environmental Cooperation,[VII] entering into force May 8, 1993, provided the legal foundation for establishing a Canadian-Russian Mixed Environmental Commission with a mandate to meet at least once every two years. The Commission is tasked with enhancing cooperation on a broad range of topics including atmospheric environmental issues, management of toxic chemicals, environmental technologies and *conservation of ecosystems, including establishment of nature reserves, and protection of habitat and rare flora and fauna* (emphasis added).

The Canada-Russian Federation Agreement on Cooperation in the Arctic and the North,[VIII] entering into force June 19, 1992, provided the legal basis for establishing a Canada-Russia Mixed Commission on Cooperation in the Arctic and the North with a mandate to meet at least once every two years. The Agreement lists priority areas for cooperation which include, among others, land use planning and management, effects and transport of contaminants, fisheries science and technology, and northern policy and legislation.

The Canada-Russian Federation Agreement on Economic Cooperation[IX], entering into force on December 7, 1994, is aimed at promoting trade and investment cooperation as well as science and technology exchanges. Among the listed priorities for cooperation are energy (particularly oil and gas development and safety issues in nuclear power generation), mining, transport infrastructure and environmental protection. The Canada-Russia Intergovernmental Economic Commission has been established to further cooperative collaborations and an Arctic and North Working Group has been specifically tasked with promoting bilateral promotion of sustainable Northern development.[X]

Canada–United States Agreements
Although Canada and the United States continue to disagree over the location of the ocean boundary in the Beaufort Sea and over the legal status of the Northwest Passage, they have facilitated limited environmental cooperation through two key agreements. In 1977 Canada and the United States agreed to establish a joint marine contingency plan for the Beaufort Sea.[XI] The plan sets out regional contacts and procedures in case of spills of oil and other noxious substances and has been periodically revised most recently in 2003.[XII] The Canada-United States of America Agreement on Arctic Cooperation,[XIII] adopted in 1988, is aimed at facilitating navigation of icebreakers in Arctic waters and encourages sharing of research information in order to advance understanding of the Arctic marine environment.

2.3.2 Marine living resource conservation

Cooperation in transboundary marine living resource conservation has been facilitated through the Agreement on the Conservation of Polar Bears,[XIV] the Canada-Greenland Memorandum of Understanding on the Conservation and Management of Narwhal and Beluga,[XV] the Convention for the Conservation of Salmon in the North Atlantic Ocean,[XVI] and the Convention on Future Multilateral Cooperation in Northwest Atlantic Fisheries.[XVII]

Agreement on the Conservation of Polar Bears
Canada, along with Denmark, Norway, the Russian Federation and the United States, is a Party to the Polar Bears Agreement concluded in 1973. The Agreement in Article II recognizes the need for an ecosystem approach and the Agreement has been a catalyst for protecting polar bear habitats in Canada. Article II provides:

> Each Contracting Party shall take appropriate action to protect the ecosystems of which polar bears are a part, with special attention to habitat components such as denning and feeding sites and migration patterns, and shall manage polar bear populations in accordance with sound conservation practices based on the best available scientific data.

Canada-Greenland Memorandum of Understanding on the Conservation and Management of Narwhal and Beluga
Through a 1989 MOU, the Department of Fisheries and Oceans of Canada and the Greenland Home Rule Government agreed to establish a Canada/Greenland Joint Commission on the Conservation and Management of Narwhal and Beluga (JCNB). At its tenth meeting held in Iqaluit, Nunavut, Canada, 9-11 April 2006, the JCNB recommended that an ecosystem-based approach be considered in the management of narwhal including interaction with its prey and predators.[XVIII]

In 2006, Canada moved to protect narwhal over-wintering grounds, including deep-sea corals in Southern Baffin Bay. The area is an important fishing ground for Greenland halibut, an important food source for narwhal. DFO's Fisheries and Aquaculture Management sector decided to close a significant portion of the Southern narwhal over-wintering grounds to fixed and mobile gear fishing – as part of the 2006-2008 Fisheries Management Plan for Greenland Halibut in the Northwest Atlantic Fisheries Organization (NAFO) Statistical Area OA (DFO, 2007b).

Applying the precautionary approach, a key component of the ecosystem approach, to narwhal and beluga harvests off West Greenland has been an ongoing challenge. In 2006 the JCNB expressed grave concerns over the high beluga harvest in West Greenland in light of scientific advice suggesting no more than 100 belugas per year should be taken to have an 80% chance of halving the decline in beluga numbers by 2010.[XIX] The West Greenland quota for 2006/2007 was fixed at 160 and increased to 165 for 2007/2008[XX] and 250 for 2008/2009.[XXI] The JCNB also highlighted that the West Greenland narwhals are depleted to about one quarter of historical abundance and noted scientific advice suggested that total removal in West Greenland should be no more than 135 individuals.[XXII] The West Greenland narwhal quota for 2006/2007 was eventually set at 217 and quotas for 2007/2008 and 2008/2009 were set at 300.[XXIII] There continues to be substantial disagreements between scientists and hunters over beluga and narwhal abundance.

Convention for the Conservation of Salmon in the North Atlantic Ocean
The Convention for the Conservation of Salmon in the North Atlantic Ocean (Salmon Convention), entering into force in October 1983, is relevant to Arctic waters since the Convention aims to conserve salmon stocks , migrating beyond areas of fisheries jurisdiction of coastal states, throughout their migratory range in the Atlantic Ocean north of 36^{O} latitude. Canada is a member of the North American and West Greenland Commissions established as regional forums for cooperation and consultation in addressing the management of transboundary salmon populations. (Fig. 8).

Although Parties to the Convention have not explicitly adopted the ecosystem approach, they have emphasized the need to follow a precautionary approach and the need to protect and restore ecosystems on which salmon depend. Through the North Atlantic Salmon Conservation Organization (NASCO), the umbrella organization for regional cooperation, Parties forged a 1998 Agreement on Adoption of a Precautionary Approach (NASCO 1998) and a subsequent 1999 Action Plan for Application of the Precautionary Approach (NASCO 1999).

Recognising the numerous local activities impacting salmon habitat, such as hydro-electric development, irrigation projects, forestry, land-drainage and pollution, Parties in 2001 adopted the NASCO Plan of Action for the Application of the Precautionary Approach to the Protection and Restoration of Atlantic Salmon Habitat (NASCO 2001). The Habitat Plan of Action sets out two overarching commitments, the

need by each Party and its relevant jurisdictions to establish salmon river inventories and the need to develop national salmon habitat protection and restoration plans. Each relevant jurisdiction is urged to apply the precautionary approach through habitat plan implementation by placing the burden of proof on proponents of potential habitat impacting activities. Coordination of national habitat plans to deal with transboundary issues is also urged.

The NASCO Plan of Action encourages national reporting. Parties are requested to report to NASCO on progress towards implementation of habitat plans "on an ongoing basis". In 2005 Canada reported to NASCO on various measures being taken to protect salmon habitat including: establishment of a $30 million (Cdn) Atlantic Salmon Endowment Fund to support community groups in improving river habitats and strengthening watershed planning; continuation of a national no-net-loss policy on fish habitat; and provisions under the *Fisheries Act* prohibiting harmful alteration or destruction of fish habitat unless authorized.[XXIV]

The International Atlantic Salmon Research Board has been established to encourage and facilitate cooperation and collaboration on research related to marine mortality in salmon. The Research Board has initiated the Salmon at Sea (SALSEA) Programme to address its current priority, the migration and distribution of salmon at sea with particular reference to feeding patterns and predation, in order to better understand ecosystem factors contributing to salmon marine mortality. SALSEA is a broad, multi-year programme involving the coordination of existing research, as well as the development and implementation of new studies (NASCO 2004).

Convention on Future Multilateral Cooperation in Northwest Atlantic Fisheries

The Convention on Northwest Atlantic Fisheries, of which Canada is one of 12 Parties, has to date played a minimal role in advancing ecosystem-based management in Arctic waters. Although the Northwest Atlantic Fisheries Organization (NAFO) has a management mandate in the 'Regulatory Area,' defined as the Convention Area beyond the limits of coastal state fisheries jurisdiction, only tiny sections north of 60° in Statistical Division 1E and 1F (Fig. 9) fall within NAFO's management jurisdiction. In light of the apparent absence of fisheries in these areas, NAFO has not so far imposed regulatory measures (Fischer, 2007). NAFO has, however, played an advisory role for stocks under its Convention occurring only in the EEZs of coastal jurisdictions of Canada and Greenland.

NAFO is in the process of transitioning towards implementation of the ecosystem approach. At the 2007 Annual Meeting in Lisbon, Portugal, NAFO Parties agreed to major amendments to the NAFO Convention including a commitment to apply an ecosystem approach to fisheries management (NAFO 2007c). In light of the new ecosystem mandate, NAFO's Scientific Council has established a Working Group on Ecosystem Approach to Fisheries Management and the Working Group has been tasked with identifying ecoregions within the NAFO Convention Area and with developing ecosystem health indicators (NAFO 2008a).

An Ad Hoc Working Group of Fisheries Managers and Scientists on Vulnerable Marine Ecosystems (VMEs) was formed in 2008 to complement the role of the Working Group on Ecosystem Approach. The Ad Hoc Working Group has been tasked with making recommendations on effective implementation measures to prevent significant adverse impacts on VMEs (NAFO 2008b).

NAFO in collaboration with the International Council for the Exploration of the Sea (ICES) has also established a Working Group on Deep-water Ecology (WGDEC). The Working Group has been active in studying deep water ecology in the North Atlantic and has identified coral distributions in the Baffin Bay/Davis Strait area (ICES 2008).

The NAFO Scientific Council Standing Committee on Fisheries Environment (STACFEN) is continuing to assess the impacts of climate change on the NAFO Convention Area which includes Arctic waters. The 2006 NAFO Annual Climate Status Summary for the Northwest Atlantic highlighted various points including, among others:

- Annual mean air temperatures were above normal over the entire NAFO Convention Area from West Greenland to the Gulf of Maine with record high values occurring over Labrador and Southern Baf fin Island.
- Sea-ice coverage in West Greenland waters, the Gulf of St. Law rence and on the Scotia Shelf was lighter than normal.
- Warm ocean conditions observed during 2003 to 2006 off West Greenland coincided with an increase in the production of haddock and cod (NAFO 2006).

3. Conclusion

The legal context and policy framework to support ecosystem-based ocean management exist in Canada. A national framework and series of science-based tools have been developed to move from EBM concepts and theory to a regional implementation. At the moment, EBM is not implemented everywhere in Canada's oceans and current efforts are being applied in a limited number of priority management areas, the so-called LOMAs. Full implementation of the ecosystem approach and adequate protection of significant components of Canada's marine ecosystems, including the Arctic, will take time and additional resources due to the size and complexity of the marine environment under consideration. This is the reason why EBM is being implemented incrementally in Canada. In this respect, and based on what has been reported in this chapter, we can reasonably say that Canada is "on track" in developing a nationally coherent science-based framework, applying rigorous tools and conducting systematic assessments that set the foundation to an ecosystem-based oceans management. In the Beaufort Sea LOMA, which is currently the only management area located in Canada's Arctic, EBM practices and tools are being developed. It is still too early however, to observe tangible results and benefits from this new way to achieve ocean management. Nevertheless, we expect that in the long run, EBM will ensure that Beaufort Sea marine ecosystem health is maintained as socio-economic development occurs in this region. The current approach will be refined and adjusted based on lessons learned during the development phase, progress in our ecosystem knowledge as well as evolving concepts. Although the EBM approach and tools have been developed for domestic purposes and implemented in the Beaufort Sea, they could be exported to other areas eventually.

On the other hand, while the existing array of Canada's transboundary agreements and arrangements in the areas of marine environmental protection and living marine resource management are supportive of the ecosystem approach, Canada has yet to fully develop and implement the ecosystem approach in transboundary governance practice. A network of marine protected areas has yet to be forged in the Arctic. An integrated planning approach has yet to be extended across national boundaries with the United States in the western Arctic and Denmark (Greenland) in the eastern Arctic.

In this respect, the application of Large Marine Ecosystems (LMEs) concept to advance the ecosystem approach in the Arctic (AMSP, 2004) will help address monitoring and assessment issues in international shared waters to further manage based on ecosystem considerations (see the LME section in USA chapter for background information on LMEs). Both approaches, the LME and Canada's EBM have been developed consistently up to date and are complementary initiatives (Siron *et al.,* 2008). Using the LME approach is an effective way to bridge domestic initiatives and go beyond national jurisdictions. It provides the circumpolar community with a common spatial and governance framework that transcends political boundaries for international or bilateral collaborations in EBM at larger regional scales and Arctic-wide.

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Table 1. Standard Table of Contents of Ecosystem Overview and Assessment Report (EOAR) prepared for LOMAs.

EOAR standard Table of Contents
Executive Summary
Introduction and General Information Credits and study administration, project definition, scope of the report, study methods
PART ONE : Ecosystem Overview – Status and Trends
Geological System • Marine geology and geomorphology • Sedimentology – processes and sediment biogeochemistry Oceanographic System • Atmosphere/ocean exchange • Physical oceanography • Physical–chemical properties of seawater Biological System • Flora and fauna (planktonic, benthic, pelagic communities; main taxonomic groups) • Habitat use and functional areas Ecosystem Relationships • Physical–biological linkages • Biological interactions – Ecosystem structure and dynamics
PART TWO : Ecological Assessment, Conclusions and Recommendations
Identification of key ecosystem features • Ecologically and biologically significant areas • Ecologically significant species and community properties Threats and impacts on ecosystem • Impacting activities and associated stressors • Global stressors and their local impacts • Impacts of stressors on key ecosystem features • Assessment of potential cumulative impacts • Natural variability versus anthropogenic changes Identification of affected ecosystem components • Areas of concern • Species of concern
Conclusions – Recommendation to management • Main environmental issues in the area • Science gaps, uncertainties and reliability • Identification of priorities for actions
References
Resources and Expertise
Glossary
Annexes

Table 2. Identification of Ecologically and Biologically Significant Areas (EBSAs) in the Beaufort Sea LOMA. The table compiles results from the community, scientific and evaluation workshops. Evaluation results are coded as follows: Areas classified as EBSAs (+); data deficient areas (*), and area that was finally rejected as an EBSA.

Community Workshop	**Scientific WorkshopEBSA**	**Evaluation Results**
1. Herschel Island	1. Herschel Island	1. Herschel Island/Yukon North Slope (+)
2. Yukon North Slope	2. Mackenzie Trough	2. Mackenzie Trough (*)
3. Kendall Island	3. Mackenzie Shelf Break	3. Beluga Bay (+)
4. Kugmallit Bay	4. Mackenzie Plume	4. Kugmallit Corridor (+)
5. Husky Lakes	5. Husky Lakes	5. Beaufort Shelf Break (*)
6. Liverpool Bay	6. Liverpool Bay	6. Husky Lakes (+)
7. Cape Kellett	7. Amundsen Gulf	7. Liverpool Bay (*)
8. Sachs Harbour	8. Cape Bathurst Polynya	8. Horton River (*)
9. Southern Darnley Bay	9. Prince Albert Sound	9. Langton Bay (–)
10. Pearce Point	10. Minto Inlet	10. Hornaday River (+)
11. Horton River	11. Viscount Melville Sound	11. Pearce Point (*)
12. Eastern Franklin Bay		12. De Salis Bay (+)
13. Walker Bay		13. Thesiger Bay (+)
14. Albert Islands		14. Walker Bay (*)
15. Kagloryuak River		15. Minot Inlet (*)
		16. Albert Islands/Safety Channel (+)
		17. Cape Bathurst Polynya (+)
		18. Kagloryuak River (*)
		19. Viscount Melville Sound (*)
		20. Banks Island Flaw Lead (*)
		21. Shallow Bay (+)

Table 3. List of species identified as candidate Ecologically Significant Species in the Beaufort Sea LOMA. (Note that for phytoplankton, zooplankton and birds, the overall taxonomic group or community is considered as ecologically significant)

Species/Community	Scientific Name	Rationale species or the community as ecologically significant)
Ice algae community	Primary producers	
Herbivorous zooplankton community		Key grazer species and key forage species
Herbivorous zooplankto	Limnocalanus macrurus	Key forage species
Ice-associated amphipod		Key forage species
Mysids	Mysidae	Key forage species
Arctic cod	Boreogadus saida	Key forage species
Arctic charr	Salvelinus alpinus	Influential predator; nutrient importing and exporting species
Arctic cisco	Coregonus autumnalis	Key forage species; nutrient importing and exporting species
Beluga whale	Delphinapterus leucas	Influential predator; nutrient importing and exporting species
Bowhead whale	Balaena mysticetus	Influential predator; nutrient importing and exporting species
Ringed seal	Phoca hispida	Influential predator; nutrient importing and exporting species
Sea Ducks		Influential predators; nutrient importing and exporting species; rare or sensitive species
Polar Bear	Ursus maritimus	Influential predator

Table 4. Rare, depleted and sensitive species and their corresponding conservation status in the Beaufort Sea LOMA. Species' conservation status come from: the Species at Risk Act (SARA), the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) and the Species 2006–2010 General Status Ranks of Wild Species in the Northwest Territories (NWT).

Group	Common Name	Scientific Name	SARA	COSEWIC	NWT
Bird	Northern pintail	Anus acuta			Sensitive
Bird	Brant	Branta bernicla			Sensitive
Bird	Long-tailed duck (Oldsquaw)	Clangula hyemalis			Sensitive
Bird	White-winged scoter	Melanitta fusca			Sensitive
Bird	Common eider	Somateria mollissima			Sensitive
Bird	King eider	Somateria spectabillis			Sensitive
Bird	Thick-billed murre	Uria lomvia			Sensitive
Bird	Ivory gull	Pagophila eburnean	Special Concern	Endangered	At Risk
Bird	Ross's gull	Rhodostethia rosea	Threatened	Threatened	Sensitive
Bird	Red phalarope	Phalaropus fulicaria			Sensitive
Marine mammal	Bowhead whale[1]	Balaena mysticetus	Special Concern	Special Concern	Sensitive
Marine mammal	Polar Bear	Ursus maritimus		Special Concern	
Marine mammal	Grey whale[2]	Eschrichtius robustus	Special concern	Special Concern	
Fish	Northern Dolly Varden[3]	Salvelinus malma			Sensitive
Fish	Pigheaded prickleback (Blackline)	Acantholumpenus mackayi		Data deficient (2003)	
Fish	Northern Wolffish	Anarchichas denticulatus	Threatened	Threatened	

[1]Bering-Chukchi-Beaufort populations, [2]Eastern North Pacific population, [3]Rat River and Big Fish River Populations

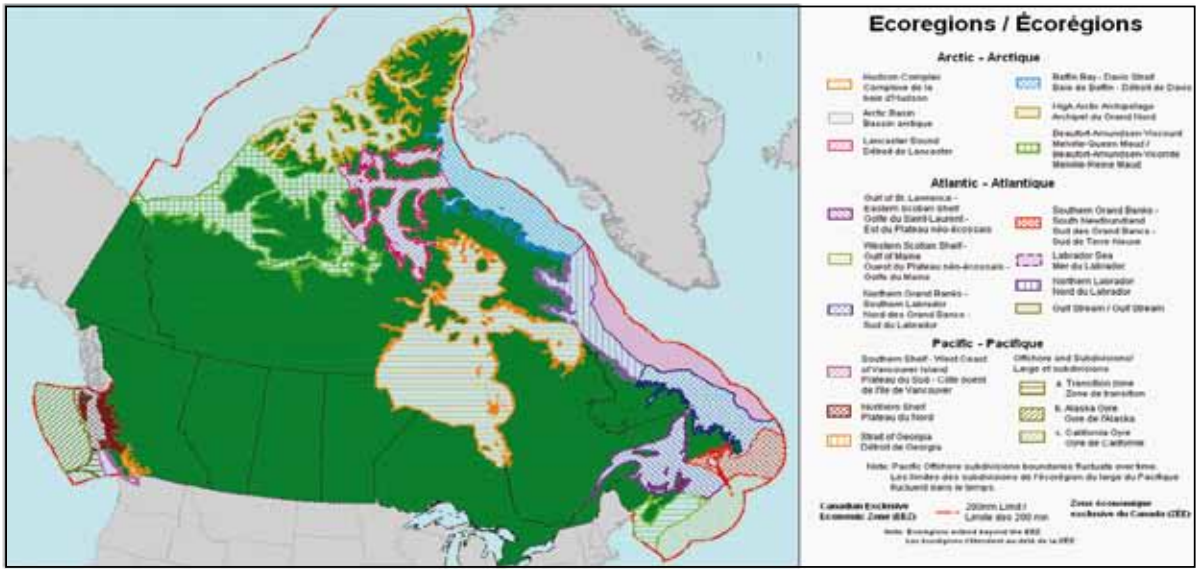


Figure 1. Map of Canada's marine ecoregions

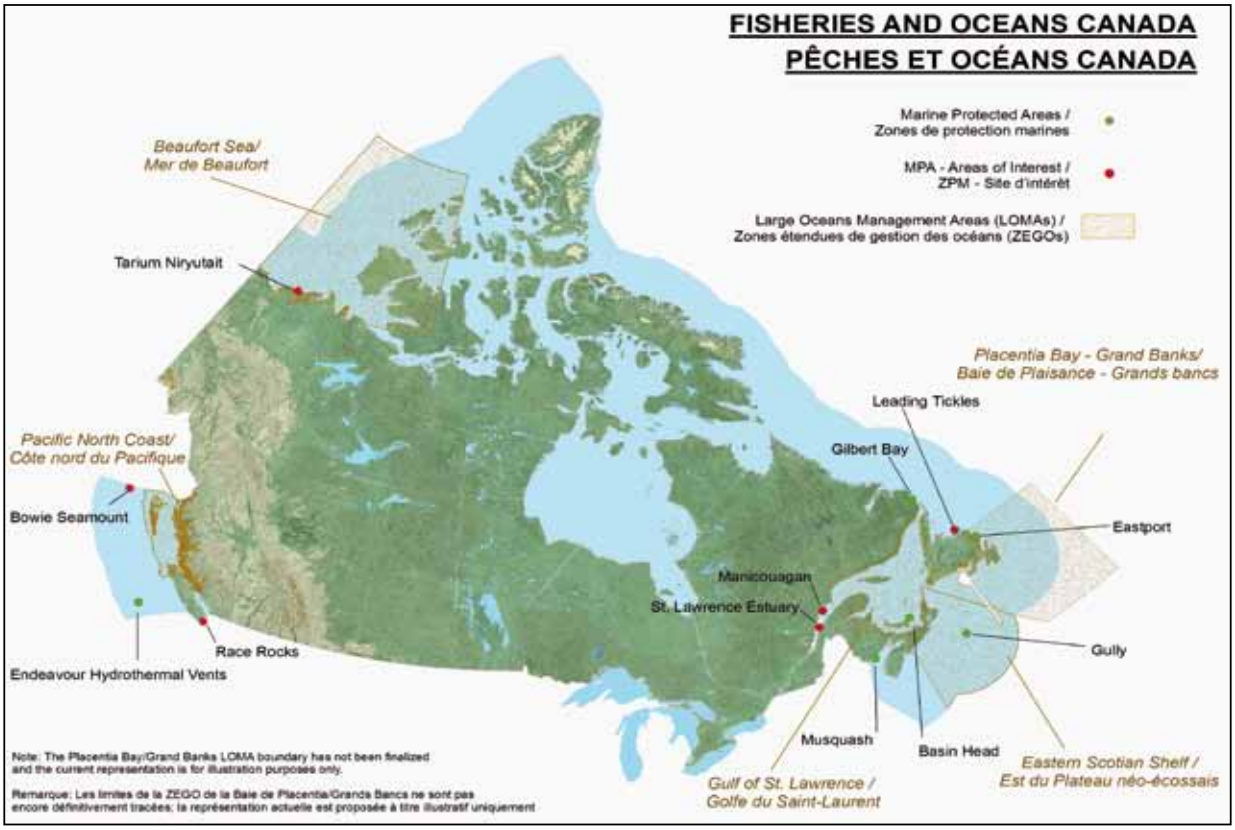


Figure 2. Area-based ocean management in Canada: Large Ocean Management Areas (LOMAs) and Marine Protected Areas (MPAs)

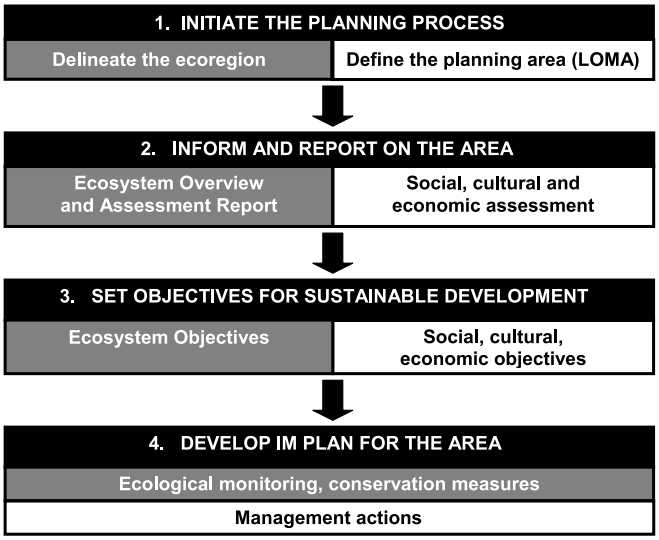


Figure 3. Key steps of the integrated ocean management planning process

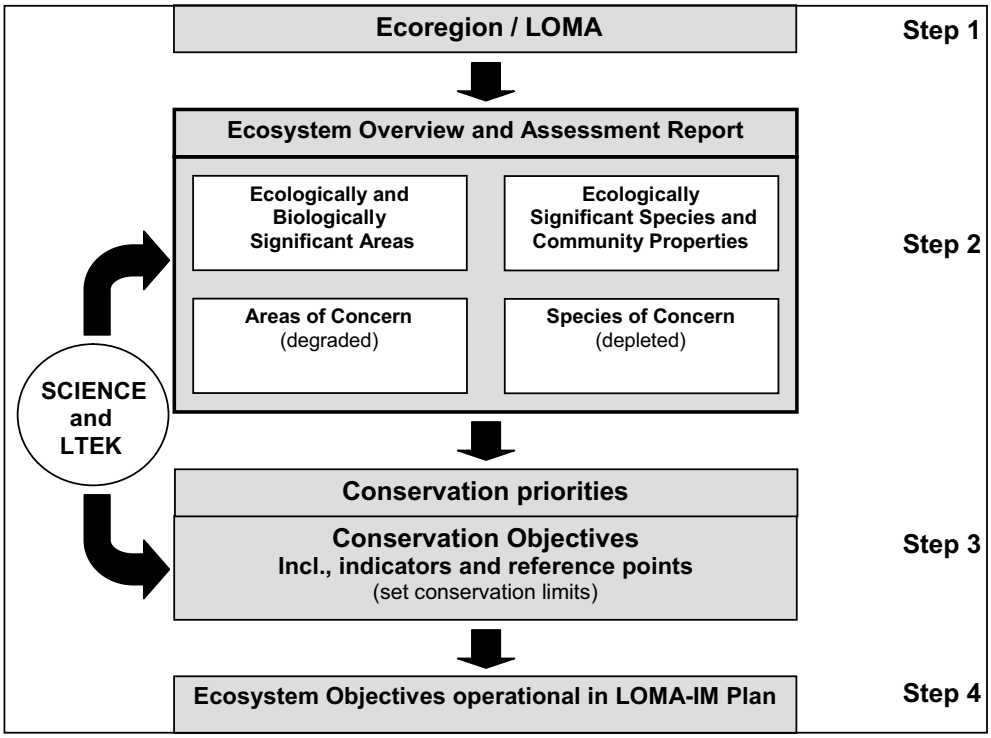


Figure 4. The Ecosystem-Based Management (EBM) framework

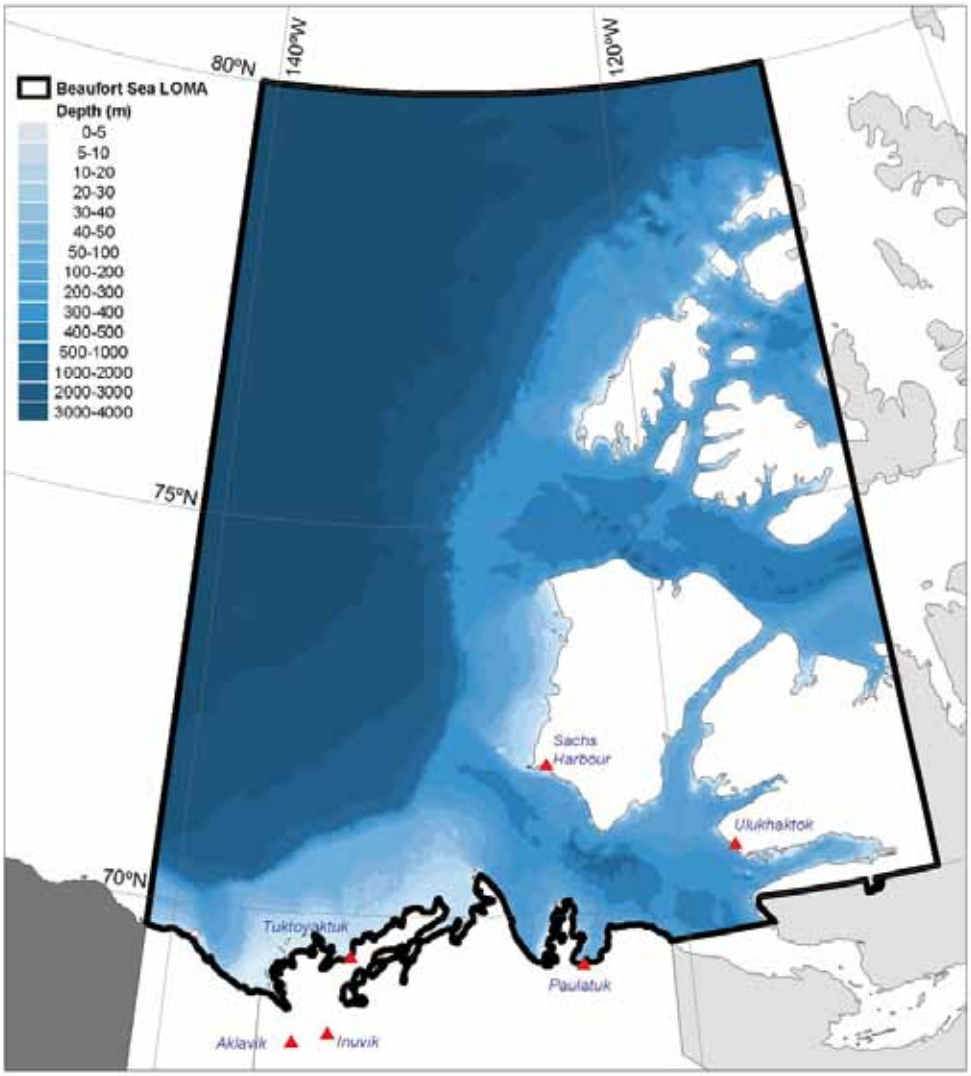


Figure 5. Map of the Beaufort Sea Large Ocean Management Area

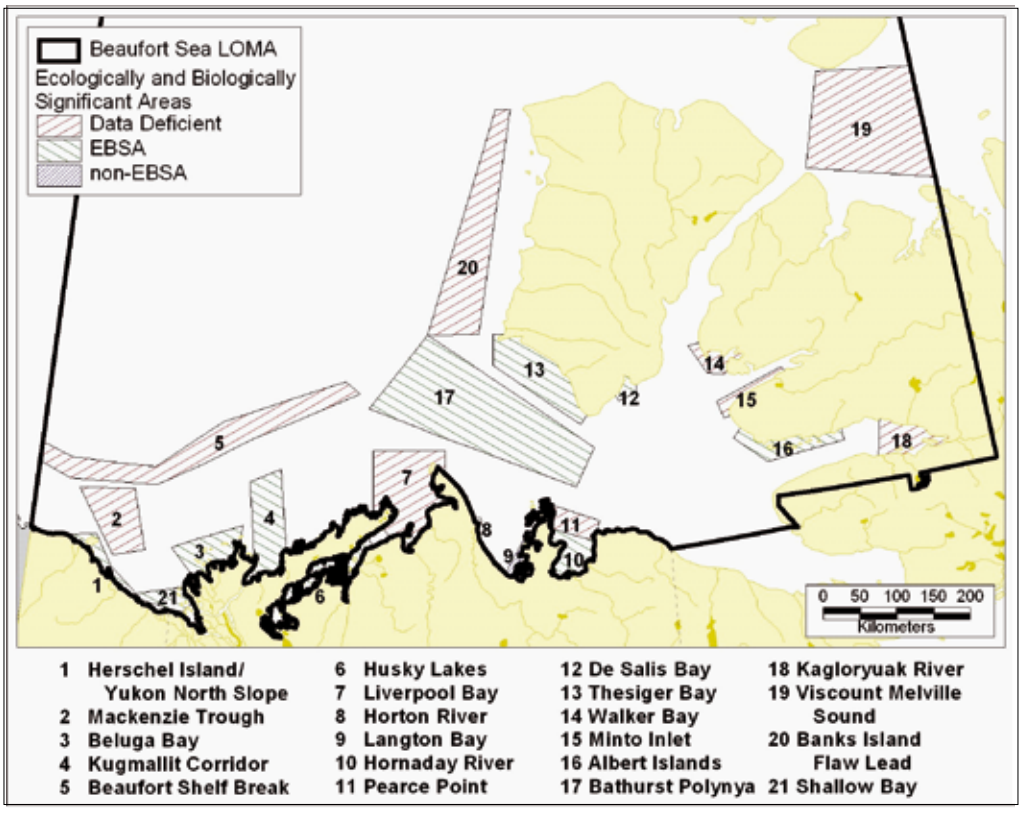


Figure 6. Map of ecologically and biologically significant areas (EBSAs) in the Beaufort Sea Large Ocean Management Area

Figure 8. Convention Area and Regional Commissions of the North Atlantic Salmon Conservation Organization (NASCO).

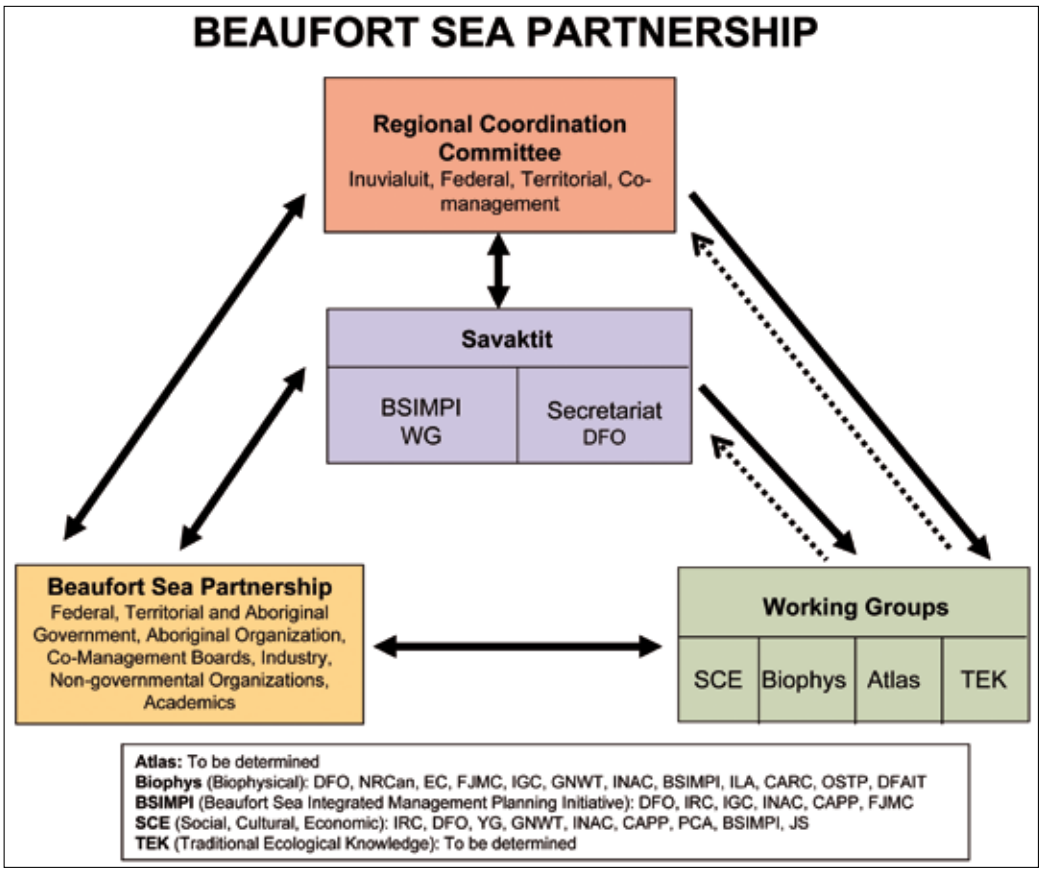


Figure 7. Governance structure put in place for integrated management and planning in the Beaufort Sea Large Ocean Management Area.

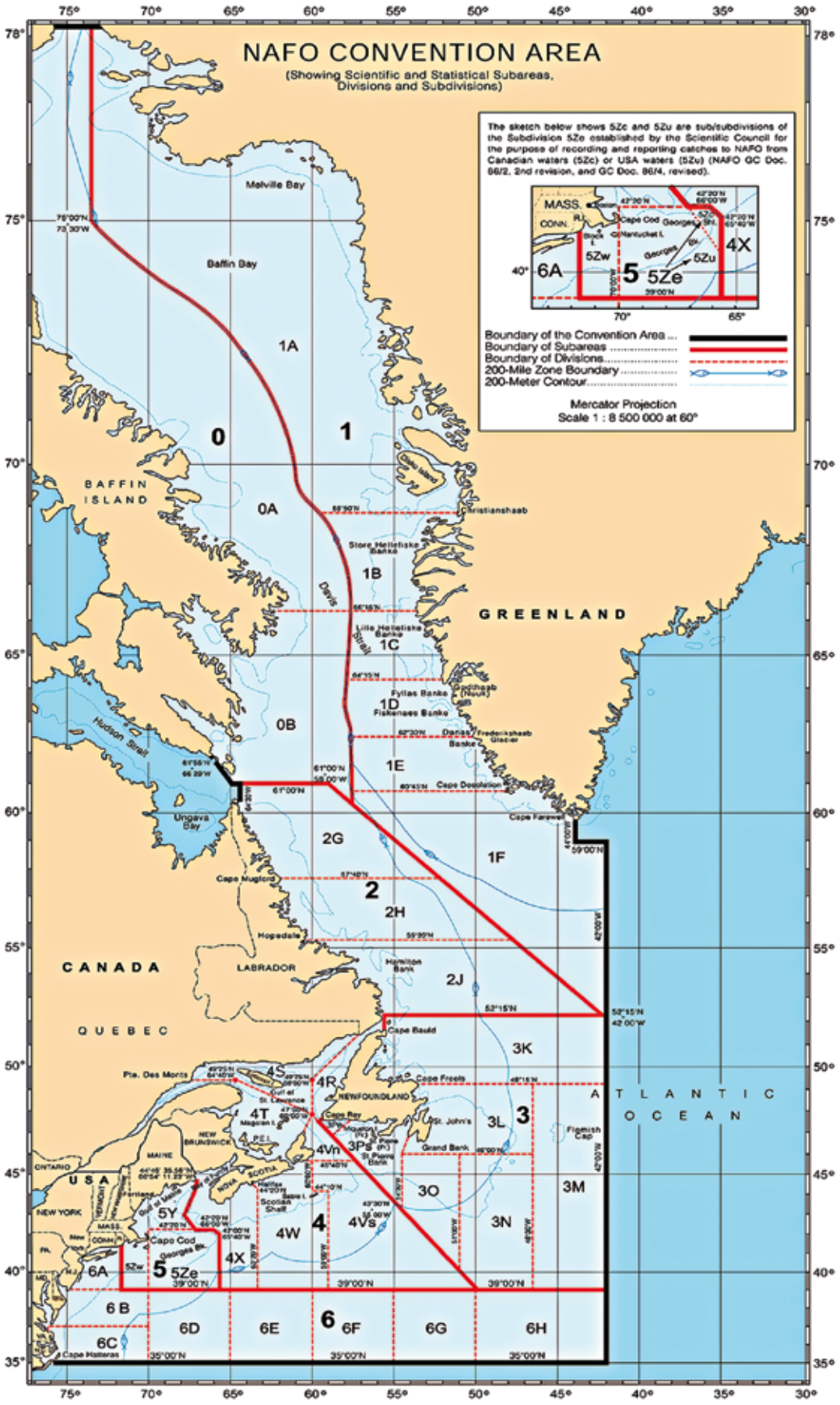


Figure 9. Northwest Atlantic Fisheries Organization (NAFO) Convention Area

REPORT SERIES NO 129

USA

An Integrated Approach to Ecosystem-based Management

Introduction

This paper has been prepared in response to the Arctic Council's call for descriptions of national experience in application of the ecosystem-based approach to oceans management in the Arctic region. In the United States, the development of ecosystem-based marine management is national in scope and applied regionally. Therefore, this paper describes the national approach. In addition, the paper describes related regional initiatives that, over time, will interface with marine ecosystem-based approaches. As well, the paper describes the international Large Marine Ecosystem program, to which the US has been a major contributor.

The concepts of integrated ocean management and ecosystem-based management have been evolving in the US over the past forty years. The two concepts are closely intertwined. Integrated ocean management (IOM) may be defined as "a decision-making process that relies on diverse types of information to determine how ocean and coastal resources or areas are best used and protected" (NOS, 2007). IOM is only useful if conducted within the context of identified ecosystems. Thus, IOM and the more recently developed concept of Ecosystem Based Approach to Ocean Management (EBOM) are inextricably linked. EBOM is an integrated approach to management that considers the entire ecosystem, including humans (Box 1).

Box 1: Scientific Consensus Statement on Marine EBM

Ecosystem-based management is an integrated approach to management that considers the entire ecosystem, including humans. The goal of ecosystem-based management is to maintain an ecosystem in a healthy, productive and resilient condition so that it can provide the services humans want and need. Ecosystem-based management differs from current approaches that usually focus on a single species, sector, activity or concern; it considers the cumulative impacts of different sectors. Specifically, ecosystem-based management:

- emphasizes the protection of ecosystem structure, functioning, and key processes;
- is place-based in focusing on a specific ecosystem and the range of activities affecting it;
- explicitly accounts for the interconnectedness within systems, recognizing the importance of interactions between many target species or key services and other non-target species;
- acknowledges interconnectedness among systems, such as be tween air, land and sea; and
- integrates ecological, social, economic, and institutional perspectives, recognizing their strong interdependences.

Cite: Scientific Consensus Statement on Marine Ecosystem-Based Management, 2005

While we understand that the focus of the Arctic Council study is the Northern Ocean, the framework the US has designed for ocean management is comprehensive and flexible enough to apply to all ocean waters under US jurisdiction. Therefore, this paper will describe the US experience in moving toward an integrated approach to ecosystem-based ocean management by (1) explaining the enabling US federal oceans governance superstructure which facilitates ecosystem-based management; (2) discussing the National Oceanic and Atmospheric Administration's (NOAA's) ecosystem approach to management; (3) linking this work to related and complementary regional collaboration initiatives and (4) international Large Marine Ecosystem activities.

The US is still working to implement its ecosystem approach to ocean management. This paper lays out the mechanisms designed to promote the ecosystem approach and some of the elements already in place.

I. Improving Ocean Governance

The US has established a system for overseeing the coordination of marine research and management activities. This system anticipates future needs for the integration of complex ecosystem components, myriad data types, and diverse stakeholder interests into planning and decision-making processes that transcend traditional programmatic, agency, geographic, and jurisdictional boundaries. The system was established pursuant to the US Ocean Action Plan of 2004.

US ocean governance is organized under the Committee on Ocean Policy (COP). The COP is a cabinet level body made up of numerous department heads and chaired by the Council on Environmental Quality (CEQ), located in the Office of the President. The Executive Order that created the COP states that the purpose of the committee is to:

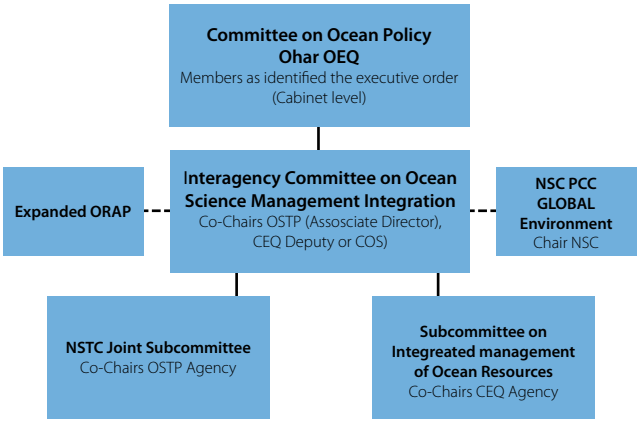
1 Coordinate the activities of executive departments and agencies regarding ocean-related matters in an integrated and effective manner to advance the environmental, economic, and security interests of present and future generations of Americans; and

2 Facilitate, as appropriate, coordination and consultation regarding ocean-related matters among Federal, State, Tribal, and local governments, the private sector, foreign governments, and international organizations.

To aid it in executing this mission, the COP has set up an ocean governance structure that includes the committees and subcommittees shown in Box 2 below.

The two following sections will describe the roles of the Joint Subcommittee on Ocean Science and Technology (JSOST) and the Subcommittee on Integrated Management of Ocean Resources (SIMOR).

Box 2: US Ocean Governance Structure



NSC: National Security Council
PCC: Policy Coordinating Committee
OSTP: Office of Science and Technology Policy,
NSTC: National Science and Technology Council
ORAP: Ocean Research and Advisory Panel

A. Ocean Research and JSOST

The initial tasks for JSOST were identifying research priorities and developing a strategy for responding to scientific challenges. Working closely with the ocean research community, JSOST developed *Charting the Course for Ocean Science in the United States for the Next Decade: An Ocean Research Priorities Plan and Implementation Strategy.* Released on January 26, 2007, this 10-year plan for the Federal role in ocean science is focused on ocean forecasting, scientific support for ecosystem-based management, and ocean-observing capabilities, and identifies six major societal themes and 20 related research priorities (Box 3). To initiate progress on the 20 research priorities, the plan promotes strategies for addressing four near term priorities:

1 Forecasting the Response of Coastal Ecosystems to Persistent Forcing and Extreme Events

2 Comparative Analysis of Marine Ecosystem Integration

3 Sensors for Marine Ecosystems

4 Assessing Meridional Overturning Circulation Variability: Implications for Rapid Climate Change

Importantly, the plan outlines an implementation strategy that defines roles for Federal agencies, international entities, research and educa-

tional institutions, the private sector, NGOs, and local, tribal, state and regional governance. The strategy emphasizes the importance of merit based- peer review; using existing implementation mechanisms, creating partnerships, balancing new developments with sustained efforts, and pursuing national priorities through scaled implementation. By establishing a framework that coordinates all of these components within a focused research agenda that addresses clearly defined problems at appropriate scales, JSOST has made great progress toward one of the greatest challenges in the continued development of EBOM: the need for integrated science to support integrated management. By including not just the scientific community, but stakeholders and governments as well, this plan ensures that relevant ecological, sociological, and economic information will feed into the ocean management process. Further, the approach detailed in this plan can be used as a template for a parallel plan for ocean management.

Box 3: JSOST Societal Themes

Theme 1: Stewardship of Natural and Cultural Ocean Resources

Theme 2: Increasing Resilience to Natural Hazards

Theme 3: Enabling Marine Operations

Theme 4: The Ocean's Role in Climate

Theme 5: Improving Ecosystem Health

Theme 6: Enhancing Human Health

B. Ocean Management and SIMOR

The broad purpose of SIMOR is to "strengthen the effectiveness of interagency efforts at all levels while respecting existing authorities and jurisdictions" (SIMOR, 2005). To that end, SIMOR has developed a Work Plan focused on four Work Priority Areas (Box 4). The Work Plan, released in March, 2006, discusses challenges and discusses next steps for progress in each of the four Work Priority Areas.

Box 4: SIMOR Work Priority Areas

- Support Regional and Local Collaboration
- Facilitate Use of Ocean Science and Technology in Ocean Resource Management
- Enhance Ocean, Coastal, and Great Lakes Resource Management to Improve Use and Conservation

Enhance Ocean Education

In each of these areas, the plan identifies gaps in integration and coordination of science and management, and between different layers of management. While not as detailed or comprehensive as JSOST's ocean science strategy, the SIMOR Work Plan does outline an implementation approach for EBOM.

The new US ocean governance structure raises the profile of marine resource management, and is designed to allow for a more responsive and comprehensive treatment of large-scale problems related to the marine environment. As the following section will show, ongoing Federal initiatives fit nicely into this framework, and will be better able contribute to EBOM once they are coordinated through SIMOR.

II. NOAA's Ecosystem Approach to Management/EBM

While many Federal initiatives incorporate ecosystem principles into management practices, the most important of these in the marine environment is the National Oceanic and Atmospheric Administration's (NOAA) adoption and application of an Ecosystem Approach to Management for oceans and coasts. In response to the 2004 U.S. Ocean Action Plan, NOAA has developed and pursued an ecosystem approach to the management of marine resources under its jurisdiction. Using the principles of Ecosystem- Based Management (Box 1), NOAA's Ecosystem Goal Team, has the responsibility of developing strategies that ultimately accomplish two objectives:

1 Healthy and productive coastal and marine ecosystems that benefit society, and

2 A well informed public that acts as a steward of coastal and marine ecosystems

In pursuing these outcomes, NOAA integrates the contributions of nine programs that have research and management responsibilities that affect ecosystems (Box 5).

Box 5: Programs Supporting NOAA Ecosystem Goal Team

- Habitat	**- Fisheries management**
- Corals	- Protected species
- Coastal and marine resources	- Ecosystem observations
- Ecosystem research	- Aquaculture
- Enforcement	

In addition, NOAA has defined the boundaries of eight ecosystems to serve as management units for different areas of coastal and ocean waters adjacent to the US or its territories (Box 6). Note that the Alaska Ecosystem Complex includes four Large Marine Ecosystems (LMEs): Beaufort Sea, Chukchi Sea, Bering Sea, and Gulf of Alaska.

The NOAA regional ecosystems also serve as the units of analysis for Integrated Ecosystem Assessments (IEAs), which are NOAA's primary means of implementing the ecosystem approach. IEAs are spatially based, scalable assessments that have three major components: (1) monitoring, (2) analysis of status and trends in space and time, and (3) integration and forecasting. IEAs are an appropriate vehicle to convey information about the structure and function of ecosystems and to evaluate the impacts of current and proposed stressors. By collecting and analyzing biological, oceanographic, and socioeconomic data, analyzing it in the context of past management strategies and current human behaviors, and predicting future trends, NOAA is using the IEA process as a proactive tool to identify long term research needs and resource management priorities, and support the ecosystem approach.

Box 6: NOOA Regional Ecosystems

It is extremely important to emphasize the nested nature of ecosystems, and consequently, of ecosystem assessments and management programs. Within a large regional ecosystem exist many systems that function on smaller scales, including watersheds, estuaries, wetlands, and reefs. Analysis of these sub-systems is crucial to the assessment of larger coastal and marine areas. Further, communication and cooperation between local, regional, and national managers and stakeholders is absolutely necessary to ensure a comprehensive, integrated approach

to management. Finally, sound management of nested ecosystems not only contributes to success in addressing problems at a larger scale, but also may provide a model for managing similar systems elsewhere. (See Box 7)

Box 7: Nested Ecosystems and Management Strategies

The Channel Islands National Park and National Marine Sanctuary are located off the coast of California, within the California Current Large Marine Ecosystem. Traditionally an important area for commercial fishing and recreation, over-harvesting of commercially important species such as abalone and spiny lobster led to severe degradation of the park ecosystem by the 1990s, including the loss of over 80% of giant kelp forests (Davis, 2005). Through a process that brought together scientists, stakeholders, and officials from various levels of government, a network of marine reserves was established based on ecosystem criteria. It is hoped that this network will allow the ecosystem to recover while having a minimal negative short-term socioeconomic impact.

With its explicit link to the US ocean governance structure which will be described below, NOAA provides input that informs the ocean management process, while receiving feedback on how it can improve the support functions of the ecosystem approach. This two-way information exchange facilitates the integration of NOAA's work with that of other Federal agencies, as well as lower levels of government and other aforementioned parties critical to IOM, while ensuring that ocean management efforts will be ecosystem-based.

III. Regional Collaboration

Supplementing and complementing the ecosystem-based approach, the US has historically attempted to use regional bodies for ocean resource management. Regional collaboration has been tried in various contexts in the US, with mixed results. Federally led multi-state watershed management initiatives like the Chesapeake Bay Program and the Gulf of Mexico Program have had limited success, largely because of the difficulty of addressing land use issues. However, in the context of inshore coastal fisheries, regional fishery management councils comprised of representatives from states that share fish stocks have proven more effective.

In addition, NOAA has created a framework for domestic regional collaboration with regions that correspond to large marine ecosystems (LMEs) (Box 8). The 10 LMEs of the United States are regions of the ocean starting in coastal areas and extending out to the seaward boundaries of continental shelves and major current systems. They take into account the biological and physical components of the marine environment as well as terrestrial features such as river basins and estuaries that drain into these ocean areas. Development of the framework for regional collaboration employed a set of explicit criteria (Box 9), including consideration of the relationships between NOAA and various stakeholders, and amongst the stakeholders themselves, to divide the US into eight regions to serve as the base units for fostering stronger collaboration with governments and stakeholders, and among its own programs (Box 10). These regions correspond closely to the LME units mentioned above.

The three priorities NOAA has identified for regional collaboration (hazard resilient coastal communities, integrated ecosystem assessments, and integrated water resource services) all have the potential to be key components of EBOM. Coordinating these regionally-based management projects with broader initiatives conducted at ecosystem scales links Federal managers with state and local authorities in activities that combine place-specific concerns and expertise with ecosystem level science and planning.

Box 8: US LMEs

LMEs correspond to natural features. The 10 Large Marine Ecosystems of the United States are regions of the ocean starting in coastal areas and extending out to the seaward boundaries of continental shelves and major current systems. They take into account the biological and physical components of the marine environment as well as terrestrial features such as river basins and estuaries that drain into these ocean areas.

U.S. Department of Commerce, National Oceanic and Atmospheric Administration, July 2004. "NOAA Fisheries Service's Large Marine Ecosystems Program: Status Report". NOAA Technical Memorandum NMFS-NE-183, page 1.

Box 9 – Selection Criteria for NOAA Regional Collaboration Management Units

- Public perception of regional identity and state jurisdictions - Federal
- Existing NOAA capabilities partners - Regional
- Ecosystem-related boundaries ageability of regions - Size man
- Geographic dimensions of programmatic priority areas

Another ongoing regional initiative is the development of regional ocean councils. In 2005, the New England Governor's Conference formed The Northeast Regional Ocean Council (NROC).
The primary intent of NROC is to link together and cultivate regional ocean management and science institutions and programs for the Gulf of Maine, Long Island Sound, and southeastern New England. Recently NROC produced a draft 1-year work plan that proposes it will focus on ocean energy resource planning and management; ocean and coastal ecosystem health; maritime security; and coastal hazard response and resiliency. The work plan contains the following actions:

- Submit an appropriations request from the New England governors to support the Gulf of Maine Council on the Marine Environment and the proposed Northeastern Sounds Ecosystem Alliance;
- Create a regional entity for southeastern New England's sounds par allel in purpose and scope to the Gulf of Maine Council on the Marine Environment;
- Convene a Northeast Regional Ocean Congress to establish short-term regional ocean management priorities;
- Seek an additional resolution from the NEGC/ECP annual meeting for the Oceans Working Committee to issue an annual ocean management priorities statement; and, Create Action Plans around the priority issue areas

Box 10: The Framework for NOAA Regional Collaboration

The US has made support of NROC a priority, and has assigned work group leads from the Federal agencies responsible for both living and non-living coastal and marine resources. The New England Governor's Conference has also reached out to the Eastern Canadian Premiers, and the two groups have signed a resolution pledging cooperation on ocean governance issues under the framework of the NROC.

Other similar programs on the regional scale include the Gulf of Mexico Regional Partnership (GMRP), and the Great Lakes Regional Collaboration (GLRC), which were commissioned by the US Ocean Action Plan, and link Federal agencies and state governors with their counterparts in Mexico and Canada respectively. Building upon the work already being conducted by the Gulf of Mexico Alliance, the GMRP draws on Federal government resources to improve coordination between states, and with the six Mexican states that border the Gulf through the *Accord of the States of the Gulf of Mexico.* Also a priority in the SIMOR work plan, GMRP convened a working group comprised of representatives from 13 Federal agencies and numerous state officials in 2005, which resulted in the release of the *Governors' Action Plan for Healthy and Resilient Coasts* the following year. This document identifies the following key areas of regional cooperation:

Water quality for healthy beaches and shellfish beds;
- Wetland and coastal conservation and restoration;
- Environmental education;
- Identification and characterization of Gulf habitats, and
- Reductions in nutrient inputs to coastal ecosystems.

Pursuit of these objectives, coupled with increased collaboration with international partners, will improve the management of natural resources, coastal communities, and environmentally sensitive areas in and around the Gulf of Mexico.

The GRLC is a wide-ranging, cooperative effort to design and implement a strategy for the restoration, protection and sustainable use of the Great Lakes. Through GRLC, states have teamed with the US Environmental Protection Agency and NOAA to develop a *Strategy to Restore and Protect the Great Lakes,* which addresses such regional concerns as invasive species, non-point source pollution, coastal zone management, habitat-species linkages, sedimentation, toxics, sustainable development, data/information integration, and environmental indicator identification/development. By involving managers representing the entirety of the Great Lakes complex, including Canadian partners, the GRLC enables a treatment of these issues that is comprehensive, rather than piecemeal.

The three projects described above not only address the challenge of coordinating across jurisdictional boundaries within the US, but also take the first steps toward accomplishing the larger goal of achieving regional cooperation across national boundaries. Harmonizing management of the marine environment amongst countries that share a common ecosystem or resource pool will lead to more effective policies governing the balance between exploitation and protection. This type of cooperation is critical, especially given the importance to ecosystems of migratory species and large-scale processes like ocean currents, circulation patterns, and climate interactions. By starting with our neighbors to the North and South, and engaging stakeholders as well as governments, the US seeks to create a model that it can extend to other regional partners in the future.

IV. International Approaches

A. Large Marine Ecosystems (LMEs)

The U.S. Administration's Ocean Action Plan (OAP) indicates that the "*U.S. will promote, within the United Nations Environment Program's regional seas programs and by international fisheries bodies, the use of the Large Marine Ecosystems (LME) concept as a tool for enabling ecosystem-based management to provide a collaborative approach to management of resources within ecologically bounded transnational areas. This will be done in an international context and consistent with customary international law as reflected in 1982 UN Convention on the Law of the Sea."* (U.S. Ocean Action Plan, 2004). NOAA is the lead agency in these efforts.

Large Marine Ecosystems (LMEs) are regions of ocean space of about 200,000 km^2 or greater that encompass coastal areas from river basins and estuaries out seaward to the break or slope of the continental shelf, or out to the seaward extent of a well-defined principal current. LMEs are defined not by political, but by ecological criteria, including bathymetry, hydrography, marine productivity, and trophically linked populations. Since 1984, the LME Program has developed ecosystem management tools, initiated projects that have been funded by partner organizations, and provided training for developing country participants, helping to raise their level of expertise, their scientific understanding and their capabilities to conduct resource and environmental assessments and improve resource management practices. The LME concept for ecosystem-based management and its 5-module approach (productivity, fish and fisheries, pollution and ecosystem health, socioeconomics, and governance) are being applied globally to analyze ecosystem-wide changes, and provide the scientific foundation for management actions that link scientific assessments, protection of the marine environment, sustainable development of coastal and marine resources, and poverty alleviation.

The NOAA LME Program is now partnering with the Global Environment Facility (GEF)/World Bank, five U.N. agencies (UNIDO, UNDP, FAO, IOC-UNESCO and UNEP), and two NGOs (IUCN and WWF) to promote the use of the LME approach to the assessment and management of marine resources in Africa, Asia, Latin America and eastern Europe. A total of 110 countries and an estimated network of 2,500 scientists, marine specialists and resource managers and partners are participating in 16 international LME Projects (Box 11), funded with grants and investment funds totaling $1.8 billion. The operational

Box 11: 16 GEF funded LME projects

- Agulhas Current LME
- Baltic Sea LME
- Bay of Bengal LME
- Benguela Current LME
- Black Sea LME
- Canary Current LME
- Caribbean Sea LME
- Guinea Current LME
- Gulf of Mexico LME
- Gulf of Thailand LME
- Humboldt Current LME
- Indonesian Sea LME
- Mediterranean Sea LME
- Somali Current LME
- South China Sea LME
- Yellow Sea LME.

strategies for the 4th replenishment of the GEF (2007-2010) will further augment international LME activities by $230 million. Supplemental financing of LME "Foundation" projects by the World Bank and regional development banks in the form of low-interest investment loans and no-interest revolving funds, is likely to increase support of LME projects to a level of $3 billion by 2010.

In the 16 GEF-supported LME projects, the 5-modular assessments are identifying ecosystem trends necessitating a precautionary approach to fisheries, improved forecasting of fishery fluctuations, conservation of biodiversity and, the reduction of excessive nitrogen loading and assessment of and adaptation to climate change. The projects use LMEs as the geographic focus for strategies to reduce coastal pollution, restore damaged habitats, and recover depleted fisheries. This effort will continue in partnership with the UN and other agencies through 2010.

In 2004, the NOAA LME Program partnered with the UNEP-Regional Seas Programme, when the 6th global meeting of the UNEP Regional Seas Conventions adopted a resolution to incorporate the LME 5-module approach to assessment and management of marine resources, and use LMEs as operational/management units for translating Regional Seas programs into concrete actions. In 2005, The LME Program partnered with the UNEP Global Progamme of Action for the Protection of the Marine Environment from Land-based Sources of Pollution (GPA), to assist developing nations in restoring and sustaining the goods and services of the world's LMEs, and to support an integrated approach to oceans management and a reduction of land based pollution. As an outcome of the second session of the Intergovernmental Review Meeting on the Implementation of the GPA in October 2006, the Beijing Declaration furthered the mainstreaming of the LME concept by outlining national, regional, and international actions needed to apply ecosystem approaches, value the social and economics costs and benefits of the goods and services that oceans and coasts can provide, and address coastal pollution by reducing and controlling nutrient over enrichment in LME coastal waters.

B. Arctic LME Activities

The Arctic LMEs are diverse and dynamic systems under stress from global warming and the melting of sea ice. Marine species are few, but each species has high numbers. Advances in the melting of Arctic ice have implications for zooplankton, fisheries, fish stocks, marine mammals, marine birds, which appear to be shifting northward, and socioeconomic conditions for Arctic people.

One of the major priorities of the Arctic Council Working Group on Protection of the Arctic Marine Environment (PAME) for 2006-2008 is the introduction of the LME approach to the assessment and management of Arctic ecosystems. The United States has been the lead on the ecosystem approach and has updated PAME on the status of the LME approach to assessment and management, in which place-based assessments of the changing states of Arctic LMEs can serve as the framework for ecosystem-based management practices. Planning for the introduction of the ecosystem-based approach was initiated with the LME Working Group and its representatives from the 8 participating countries. At this date, the countries have reviewed and accepted a working map of 17 Arctic LMEs that will be used to guide the PAME work plan. The PAME LME Working group has organized an e-mail exchange between key experts from each of the Arctic Council countries to consider suites of indicators of changing states of Arctic LMEs, as measured against baselines of (i) productivity/climate, (ii) fish and fisheries/marine birds and mammals, (iii) pollution and ecosystem health, (iv) socioeconomics, and (v) governance. This effort to reach consensus on generic suites of indicators for assessing the changing states of 17 Arctic LMEs will effectively guide decision-making in the Arctic Region. The LME Experts Group will work in close cooperation with other experts associated with the activities of other Arctic Council Working Groups including AMAP, CAFF and SDWG.

NOAA's Alaska Fisheries Science Center, the North Pacific Fishery Management Council (NPFMC), and the academic community have been paying a great deal of attention of ecosystem assessments and approaches to management. While research is ongoing, the NPFMC has adopted an ecosystem-based approach to the management of the EBS LME groundfish fishery through a 1.4-2.0 million metric ton Optimum Yield approach since 1982 that has maintained the health of the fisheries resources and stabilized the fisheries catch. The NPFMC has implemented a large scale closure of marine areas along the Aleutians to protect cold coral and essential fish habitats. The council is now working on developing an ecosystem management plan for the Aleutian Island sub-area of the EBS LME.

The NPFMC is also presently developing options for fishery management in the Arctic, north of Bering Strait. It has determined that a more deliberate and comprehensive management regime should be put in place for the Arctic region. This is partly in anticipation of potential fishery development in the region as climate conditions continue to warm. But this is also in response to some of the unique ecological conditions in the Arctic region, and the unique nature of the region's coastal communities, that merit more attention than has been given to this area previously. The NPFMC views the development of an Arctic Marine Resources FMP as an opportunity for implementing an ecosystem-based management policy that recognizes the unique issues in the Alaskan Arctic.

PAME has also discussed the opportunity to develop the LME approach for pilot assessment and management projects for the Arctic, in the West Bering Sea, the Barents Sea, and the Beaufort Sea. The West Bering Sea (WBS) LME supports fish, crustaceans, mollusks, marine birds and marine mammals. The catch of fish including pollock has undergone periods of growth and decline since 1975 for the fish in the Navarin sub-area of the WBSLME.

The Barents Sea LME, shared by the Russian Federation and Norway, is shallow, with a large shelf and an extensive polar front. It is a transition zone where relatively warm inflowing Atlantic water is cooled and transformed into Arctic as well as Polar water. The climate of this LME shows high spatial and temporal variability that depends mainly on the activity and temperature of the inflowing Atlantic water. There is considerable annual and inter-annual variations in ice cover, which extends over one- to two-thirds of the LME with maximum extension during winter. The Barents Sea LME is considered a moderately high productivity ecosystem, with biological activity determined mainly by seasonal changes in the temperature and light regimes, advection and ice cover. The major species fished are capelin, Atlantic cod and herring, with capelin and herring being major prey of cod. During the last decades, biomass yields of the major species have fluctuated significantly because of high fishing mortality and variation in the natural environment.

In addition, Canada is prepared to collaborate with the U.S. on a LME demonstration project in the Beaufort Sea LME (BSLME). The BSLME is a high-latitude, mostly ice-covered LME bordered by northern Alaska and Canada, with an Arctic climate and extreme environment driven by major seasonal and annual changes. New developments for the production of gas and oil are contemplated. It is clear from existing assessments that the resident populations on both the Canadian and U.S. coasts of the BSLME are undergoing major socioeconomic changes, caused by the significant increase in the rate of ice melt in the ecosystem. While the LME is considered a low productivity ecosystem, with high productivity only in the summer when the ice melts, an important question is how this productivity might change under an altered climatic regime. The effects of changing conditions in the BSLME need to be better understood and taken into consideration as the basis for adaptation actions for sustaining the living resources and biodiversity of the ecosystem, under a policy that can demonstrate utility in balancing economic development with an appropriate level of sustainability in the goods and services produced by the ecosystem.

V. Conclusion

It is fair to characterize the United States as "on the road" to implementation of ecosystem based ocean management. The U.S. Ocean Action Plan established the high level policy infrastructure necessary to achieve this goal. Decisions by this infrastructure and products prepared by its operating elements have moved the United States toward the ecosystem approach.

A major U.S. oceans science and management agency, NOAA, has adopted Ecosystem Based Management as one of its strategic goals. It

has elaborated its notion of EBM and created the organization mechanisms need to consider and create implementation programs.

Further, the U.S, with various partners, is pursuing a range of collaborative activities at the regional level. These activities involve international partners and cooperation among different levels of government. They include robust involvement of stakeholders.

Finally, pursuant to the decision reflected in the Ocean Action Plan, the U.S. has been a leader in implementing large marine ecosystem programs throughout the world.

While the U.S. has made major strides in developing major components of a strategy for ecosystem based ocean management, additional work is required before all these pieces come together. It would appear that the will and direction exist to achieve this goal in the coming years.

Annex A:

The Alaska Ecosystems

There are four LMEs off Alaska within the US EEZ that should be of interest to the Arctic Council – the Gulf of Alaska (GOA) LME, the East Bering Sea (EBS) LME , the Chukchi Sea (CS) LME and the Beaufort Sea (BS) LME. The EBS LME includes the Aleutian Islands Sub-Area and is the most productive LME in the US in terms of fisheries, followed by the GOA LME. Together, these two systems have produced 55% of US fisheries landings in recent years. The CS and BS LMEs, while not supporting large fisheries, are undergoing rapid changes as annual and multiyear ice coverage shrinks relative to the past 50 years.

These LMEs have experienced different climatic regimes and shifts in modern times. A report by King (2005) indicates that the environment of the North Pacific marine ecosystems has shifted; apparently a few times. It follows that the features of the living marine resources of the Alaskan LMEs have also changed over time. King (2005) cites several examples of decadal-scale changes in biological production and community composition that occurred around 1977 and in the 1990s. The scientific literature now generally recognizes that recent regime shifts occurred in 1925, 1947, 1977 and 1989. Hare and Mantua (2000) assembled and examined 100 environmental time series (31 climatic and 69 biological) for evidence of biological and physical responses to these regime shift signals. Levitus et al. (2000) reported that the Pacific Ocean has undergone a net warming since the 1950s. Changes in ocean temperature on a shorter time basis can be quite variable, and often mask long-term trends in ocean warming. Determining how these higher temperature variations will affect living marine resources (LMRs) on a short-term basis, and how they might mask the longer term effects of a gradual warming of the oceans are key management questions that require an ecosystem approach.

To support management of the ecosystems off Alaska, NOAA conducts research and collecting data that will eventually merge into better comprehensive assessments and management of the LMEs. This research includes oceanography and othe aspects of the physical environment, as well as the dynamics of LMRs. The LMRs of special and unique concern in the Alaska LMEs are the marine mammals, seabirds, and fishery resources. They all occur in high abundance and/or in high profile in a changing dynamaic environment.

On marine mammal research, the The US has been conducting periodic stock assessment surveys for pinnipeds and cetaceans in the EBS, BS, and CS LMEs. The results of these assessments provide details on population sizes and trends, stock identification, and potential anthropogenic impacts such as interactions with commercial fisheries, oil and gas development, and subsistence harvests. In addition to these studies, the US conducts a broad range of research on marine mammal ecology and behavior. In light of the potential effects of the loss of sea ice and climate change, this research is increasingly focused on better understanding the habitat requirements of the different marine mammal species. US government agencies also interact with domestic and international entities on issues pertaining to marine mammals in these LMEs. For example, the US-Russia Marine Mammal Working Group, under Area V of the US-Russia Agreement on Cooperation in the Field of Environmental Protection, convenes bi-annually to present recent research results and discuss issues of marine mammal science and conservation in the Bering and Chukchi Seas. Similarly, the US government has co-management agreements with several Alaska Native groups concerning the subsistence use of marine mammals.

For fisheries, research has been extensive on salmon, all the major groundfish resources, king and tanner crabs, shrimps, and all the ecologically related species, including lower trophic levels, down to phytoplankton blooms. Trawl surveys on the groundfish and crab resources in the shelf area of the EBS LME have been conducted annually since about 1972 and regular two-year phase surveys have taken place in the Aleutians and Gulf of Alaska regions. Longline surveys on Pacific Halibut have been conducetd by the International Pacific Halibut Commission that started back in the early 1900s. Longline surveys on sablefish (blackcod) have also been annual for more than 15 years.

The scientists of various NOAA agencies have also collaborated on FOCI-type studies (Fishery-Oceanography Coordinated Investigations) to study how ocean dynamics affect components of the ecosystems and determine survival of the LMRs. The also conduct special cruises to study marine mammal-fisheries-and seabird interactions. NOAA Fisheries also has an extensive observer program where trained biologists are placed onboard fishing vessels, processing vessels, and on-shore processing plats to collect data scientifically for the sciences. The extent of observer coverage is 100% for the large vessels and processing plants. At worst, the smaller operators are covered 30% of their operational time.

All the data that are being collected from marine mammals, fish, crabs, other LMRS and those FOCI-data collected by other US Government Agencies (Fish and Wildlife Service, Environmental Protection Agency, etc.); State agencies (like the Alaska Department of Fish and Game); academic institutions (like the University of Washington and University of Alaska) and special research-funding agencies (like the North Pacific Research Board and the SeaLife Center) are being examined for their broader applications and integration into in ecosystem assessments and management.

As the ocean environment is undergoing rapid changes, the North Pacific Research Board has encouraged use of integrated science to ecosystem approaches of research and funding research projects in consultation with Federal and State agencies, Universities, and the National Science Foundation. A Bering Sea Integrated Research Plan has been developed and funded. A similar exercise to develop a Gulf of Alaska Integrated Research Plan is under way. Some of the more innovative research plans that are coming online in the near future are "Loss of Sea Ice" and "Ocean Acidification". All the research projects are geared towards ecosystem approaches to assessments and management.

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North Pacific Fishery Management Council

The North Pacific Fishery Management Council (Council)[1] recognizes emerging concerns over climate warming and receding seasonal ice cover in Alaska's Arctic region, and the potential long term effects from these changes on the Arctic marine ecosystem. The Council has expressed concern over potential effects of these ecosystem changes on fish populations in the Arctic region, and has developed a strategy to prepare for possible future change in the Arctic region. The Council has determined that a fishery management regime for Alaska's Arctic marine waters is necessary.

The Council proposes to develop an Arctic Fishery Management Plan (FMP) that would (1) close the Arctic to commercial fishing until information improves so that fishing can be conducted sustainably and with due concern to other ecosystem components; (2) determine the fishery management authorities in the Arctic and provide the Council with a vehicle for addressing future management issues; and (3) implement its ecosystem based management policy that recognizes the unique issues in the Alaskan Arctic. This precautionary action is necessary to prevent commercial fisheries from developing in the Arctic without the required management framework and scientific information on the fish stocks, their characteristics, and the implications of fishing for the stocks and related components of the ecosystem.
The Arctic Management Area is all marine waters in the exclusive economic zone (EEZ) of the Chukchi and Beaufort Seas from 3 nautical miles offshore the coast of Alaska or its baseline to 200 nautical miles offshore, north of Bering Strait (from Cape Prince of Wales to Cape Dezhneva) and westward to the U.S./Russia Convention Line of 1867 and eastward to the U.S. Canada maritime boundary.

1 The fishery management council system was established by Congress in 1976 for the purpose of managing fisheries in a newly recognized exclusive economic zone (EEZ) between 3 and 200 miles offshore of the United States of America coastline. The eight regional fishery management councils are decision-making bodies and develop and recommend specific management measures in the form of fishery management plans, subject to approval and implementation by NOAA Fisheries.

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Conclusions

Introduction

With population growth and technological advances, the demand for the ecological services of the oceans is growing. This has brought increasing pressure on natural resources and the marine environment. Living marine resources are in many instances overexploited. Pollution pressures are high in some regions. And various uses of the oceans may be difficult to reconcile. At the same time, climate change constitute and important driver for change in the marine environment.[1]

The changing nature of oceans can be witnessed also in the Arctic. Although Arctic marine ecosystems in general are healthy, the increasing pressures on them raise shared concerns and opportunities for Arctic countries. The Arctic countries have in the 2004 Arctic Marine Strategic Plan pointed to the ecosystem-based approach to oceans management as a critical measure in confronting these challenges.

Numerous international agreements commit states to the introduction of ecosystems-based oceans management. In particular, the 2001 World Summit on Sustainable Development in its Johannesburg Joint Plan of Action specified that:

"Oceans, seas, islands and coastal areas form an integrated and essential component of the Earth's ecosystem and are critical for global food security and for sustaining economic prosperity and the well-being of many national economies … (and) … Encourage the application by 2010 of the ecosystem approach…" (para 30, JPOI).

This has since been followed up upon by many countries, in developing and implementing plans for integrated oceans management, including ecosystems-based management. All Arctic countries have or have undertaken important work in this regard, and several of them have implemented or are in the process of implementing ecosystems-based oceans management in one form or another.

Ecosystems-based oceans management fundamentally comes in two forms: either as an overarching plan including all aspects of ocean use, or more narrowly defined, sector based approaches to ecosystems-based oceans management, pertaining to for example fisheries. These approaches are not mutually exclusive, and in some countries they coexist at various levels of governance. Both approaches are found in the Arctic.

The project

The objective of the Best Practices in Ecosystem-based Oceans Management in the Arctic (BePOMAr) Project is to present the concepts and practices the Arctic countries have developed for the application of an ecosystem-based approach to oceans management. By reviewing how countries actually put such concepts and practices to use, lessons can be drawn on how to effectively do ecosystems-based oceans management.

Two sets of questions address the substance and process of putting ecosystems-based oceans management to work, respectively:

- Which practices and approaches have proved useful in moving towards effective protection and sustainable use of the Arctic marine environment?
- What are the main obstacles, and what are the important success elements in moving towards ecosystems-based oceans management?

The elements to be considered include how countries define ecosystems-based oceans management, the types of objectives that are formulated, the choice of policy instruments and organization of the work, for example in terms of how stakeholders are consulted and the geographical context for ecosystems-based oceans management, including existing transboundary agreements relevant to the management of Arctic marine ecosystems.

An important aspect of the practices considered is that they address use as well as conservation and protection of marine ecosystems. The sustainable use of the natural resources in the marine environment is a major issue in this regard.

The question of obstacles and success elements has been considered by asking the Arctic countries to describe their experiences in applying an ecosystems-based approach to oceans management. Important elements here include the *process aspects* of interagency cooperation and the organization of that, the organization and use of science, and stakeholder involvement, as well as the actual *content* of ecosystems-based oceans management, such as institutions for ecosystems-based oceans management, legislation and policy tools, geographical approaches, including LMEs, and biodiversity considerations.

The project is built around 7 case studies of how countries develop and implement ecosystems-based oceans management in the Arctic: Russia, Finland, Norway, Iceland, Greenland, Canada and the USA. An additional case study presents an indigenous perspective on these issues.

These case studies represent a very diverse set of practices for ecosystems-based oceans management. For one thing, they vary in geographical scope. The countries also are very diverse with respect to administrative traditions and cultures. Also, the types of ecosystems included in this study range from boreal in the Atlantic to Arctic. Moreover, the challenges countries face with regard to ecosystems-based oceans management vary considerably, with some primarily being concerned with fisheries, while other consider how to reconcile the concerns of fisheries, petroleum and the protection of the marine environment.

All Arctic countries face the reality of their marine ecosystems being to some extent shared with other countries (map). The application of ecosystem-based approaches to oceans management may therefore raise transboundary issues. A large number of bilateral and regional agreements address such transboundary issues, mostly on a sectoral basis as the case is in relation to fisheries. In relation to the central Arctic Ocean, there is only one international agreement specific to that region, the 1973 International Polar Bear Treaty.[2]

The fundamental principles and rules for the management of Arctic marine ecosystems are set forth in the Law of the Sea Convention, including provisions regarding the high seas beyond national jurisdiction.

The case studies in perspective

There are numerous definitions of the Arctic. The Arctic ocean proper, to the North of the continents, is about 14 million km2. Little economic activity take place here. The bulk of the commercial economic activity in the Arctic region takes place in the bordering seas, like the Bering and the Barents Sea, i the waters around Iceland and Greenland, and in the Baltic.

Some ecosystems straddle the jurisdiction of several countries. This give rise to a number of transboundary issues relating to for example fisheries and pollution. The states in the Arctic region have established a number of bilateral and multilateral cooperative agreements in response to such transboundary problems.

Observed Best Practices in Ecosystem-based Oceans Management in the Arctic Countries

Background and objective

The need for oceans management based on an ecosystem approach is widely recognized by the international community, as reflected in calls for the implementation of the ecosystem approach by 2010 in the 2002 Johannesburg Plan of Implementation from the World Summit on Sustainable Development (WSSD), in recommendations from the UN General Assembly, in the work under the Convention on Biological Diversity, and in the 2001 Reykjavik Declaration on Responsible Fisheries in the Marine Ecosystem. These international commitments have proved particularly important in the Arctic region, where this project represents a collective attempt at demonstrating progress towards the WSSD goals in the region.

1 ACIA 2005: Arctic Climate Impact Assessment. Cambridge University Press.

2 http://pbsg.npolar.no/ConvAgree/agreement.htm

Many Arctic communities and settlements are based on the sustainable use of natural resources, and see themselves as integrated parts of these ecosystems. The importance of the non-renewable resources is growing, and offshore petroleum developments are expanding to new areas of the Arctic. Likewise, tourism is growing in importance, and with it cruiseship traffic. Other economic developments include expansion of mining, bioprospecting, aquaculture, and marine transportation. At the same time, climate change, increased pollution and other human-induced pressures brings unprecedented rates of change in marine ecosystems.

The aggregate effects of these multiple pressures on the oceans call for an ecosystem-based and integrated approach to oceans management. This is critical to the protection and sustainable use of marine ecosystems and the natural resources there. To aid in this process, the Arctic Marine Strategic Plan, which describes the ecosystem approach and calls for its application, was adopted by the Arctic Council in November 2004. Ecosystem-based management is the key principle of the Arctic Marine Strategic Plan.

Many countries are now in the process of reviewing and developing their oceans management policies in order to base their management and use of the oceans on ecosystem considerations. In the Arctic, for instance, most countries are working to implement ecosystem-based management of their oceans.

The Best Practices in Ecosystem-based Oceans Management project, carried out by the Arctic Council working groups on Sustainable Development and Protection of the Arctic Marine Environment, has observed a number of Best Practices in this regard, which governments may want to consider. These practices have proved useful and may be relevant also to other Arctic countries as well as in the world beyond, in order to provide for sustainable development and protection of the marine environment.

Core elements

Although definitions may differ, some core elements are essential to ecosystems based oceans management:

- The geographical scope of ecosystems defined by ecological criteria.
- The development of scientific understanding of systems and of the relationship between human actions and changes in other system components.
- The application of the best available scientific and other knowledge to understand ecosystem interactions and manage human activities accordingly.
- An integrated and multidisciplinary approach to management that takes into account the entire ecosystem, including humans.
- Area-based management and use of scientific and other information on ecosystem changes to continually adapt management of human activities.
- The assessment of cumulative impacts of different sectors on the eco-system, instead of single species, sectoral approaches.
- A comprehensive framework with explicit conservation standards, targets and indicators in order to facilitate responses to changes in the eco-system
- Transboundary arrangements for resolution and handling of transboundary ecosystems and issues.

Conclusions

In reviewing the practices countries have established in developing and implementing ecosystem-based oceans management, the following have been found useful: 1) flexible application, 2) integrated and science based decision-making, 3) commitment to ecosystem-based oceans management, 4) area-based approaches and transboundary perspectives 5) stakeholder participation , and 6) adaptive management.

1) Flexible application of effective ecosystem-based oceans management

Differences in circumstances and contexts have to be taken into consideration as ecosystem-based oceans management is context sensitive. There is not one single method for ecosystem-based management. A number of different practices and understandings of the concept appear to work.

Ecosystem-based management is a work in progress and should be considered a process rather than an end state.

Rule-based relationships between countries in oceans affairs, based on applicable international law and agreements, have to be promoted. Recognition of humans as an ecosystem component, and increased consideration of social effects when food security and poverty alleviation are issues of concern.

Management must be based on best available science. Open lines of communication between managers, resource users, and the general public are necessary to foster mutual understanding and recognition of shared interests.

Biodiversity conservation strengthens the structure and functions of ecosystems, thus ensuring the long term delivery of ecosystem services.

2) Decision-making must be integrated and science based

Increased communication and exchanges among both states and sectors are also key components of successful ecosystem-based management. A great deal of scientific knowledge already exists. However, much of this information needs to be better synthesized and communicated to a variety of audiences. Cooperation in science and exchange of relevant information within and between countries is important for understanding the cumulative impacts to the marine environment. Another challenge is to address what information exists and what information still needs to be gathered. Knowledge gaps can be closed through development/identification of key ecosystem indicators and comprehensive modelling, mapping, monitoring, and analysis. Various forms of scientific, traditional, and management knowledge need to be integrated to improve ecosystem-based management. Potential advantages of integrating various forms of knowledge include decision-making that is better informed, more flexible, and incorporates traditional ecological knowledge.

A multi-sector approach lies at the core of the ecosystem approach as it contributes to a common understanding of challenges in oceans management and thereby an increased trust between authorities with different sector responsibilities/interests. Ecosystem-based management calls for coordination and shared responsibility between all levels of government and cooperation across sectors, both with respect to monitoring, mapping and research. The challenge of monitoring, however, is both a scientific challenge and a policy issue. Monitoring programs can provide the ongoing basis for management, but require a long-term commitment of resources. Secondly, a multi-sector approach depends on providing opportunity for stakeholder comments on how a specific sector is to be managed or how to assess the impact of that sector in relation to the ecosystem. This is a difficult process, requiring care and time.

3) National commitment is required for effective management

National commitment to conservation and sustainable use of ocean resources is necessary. A “roadmap”, management plan or national action plan for addressing priorities in oceans management is developed in many of the Artic countries.

An integrated organizational structure (framework) to support the coordination of a holistic approach to the implementation of EBM at the national level through inter-agency cooperation seems to be effective. In this respect, harmonization of domestic laws governing use of ocean resources with EBM principles, as well as with regional and international management efforts may be appropriate. This requires legislation and enforceable policy tools to provide government strategic directions and overall framework for ecosystem-based management implementation.

4) Area-based approaches and transboundary perspectives are necessary

Area-based management approaches are central to ecosystem-based management. The identification of management units within ecosystems should be based on ecological criteria. Management

measures should reflect the status of areas and take into account the human element.

Ecosystem-based management requires specific geographical units at various scales.

Issues of scale can be addressed viewing ecosystems as nested systems.

The identification and protection (including through protected areas and networks) of key areas, species, and features that play a significant role within the marine ecosystem help management set priorities and ensure ecosystem structure and function are maintained.

Increased international cooperation in shared ecosystems could be addressed through existing regional management bodies and, as necessary, new collaborative efforts focused on individual ecosystems. Effective area-based approaches include mechanisms for addressing effects of land-based activities and atmospheric deposition on ocean ecosystems.

5) Stakeholder and Arctic resident participation is a key element
Stakeholder and Arctic resident consultation are important to build understanding and foster development of knowledge.

Stakeholder participation can be encouraged by providing for public participation in a manner that enables stakeholders and members of the public who lack the capacity to prepare for/attend numerous meetings to make their voices heard in a meaningful fashion.

Stakeholders can be engaged to develop and strengthen cooperative processes to sustain ecosystem structure and function.

Effective stakeholder participation can encourage and achieve compliance with necessary conservation measures through education and enforcement.

6) Adaptive management is critical
Effective management requires adaptive management strategies that reflect changing circumstances. This is especially important in view of the accellerating effects of climate change on marine ecosystems. Implementation of ecosystem-based management should be approached incrementally.

Conservation objctives and targets, benchmarks and action tresholds should be set for the measurement of achievement of ecosystem health. Flexible mechanisms should be used for implementing ecosystem-based management.

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