



DET KONGELIGE
MILJØVERNDEPARTEMENT

The Royal Norwegian Ministry of the Environment

Report No. 8 to the Storting

(2005–2006)

Integrated Management of the Marine
Environment of the Barents Sea and the
Sea Areas off the Lofoten Islands

Map of the Barents Sea

The Barents Sea is named after Willem Barents (1550–97), who made three expeditions to the far north. The map on the cover is based on his drawings and notes, and was the first map to show Svalbard (marked as “Het Nieuw land”, or the new land). The route followed by the third expedition, during which Barents himself died on Novaya Zemlya, is marked with a stippled line. Some of the seamen took the drawings back to Holland with them before the expedition was forced to winter on Novaya Zemlya. The map was important for the development of the cartography of the Arctic.

The map was engraved by Baptista van Doetichum and published by J.H. van Linschoten. The copy reproduced on the front cover is in private Norwegian ownership and was loaned by Kunstantikvariat PAMA AS.

Contents

1	Summary	7	3.3	The underwater cultural heritage	34
2	Introduction	13	3.4	Resources that support value creation.....	35
2.1	Background.....	13	3.4.1	Living marine resources.....	35
2.2	Purpose.....	15	3.4.2	Petroleum resources.....	38
2.3	Organisation of the work.....	15	3.4.3	The natural environment as a basis for value creation	40
2.4	Geographical delimitation and time frame	17	3.4.4	Other industries	41
2.5	Thematic delimitation	18	3.5	Socio-economic conditions	41
2.5.1	Introduction	18	3.5.1	Population and settlement.....	41
2.5.2	Issues of international law	18	3.5.2	Employment.....	41
2.5.3	Security policy issues.....	18	3.5.3	The economic importance of various industries.....	43
2.5.4	Business policy issues	19			
2.5.5	Other issues	19	4	Main elements of the current management regime	46
2.6	Work on integrated, ecosystem-based management plans in other countries	19	4.1	Introduction	46
2.6.1	Sweden	19	4.2	Law of the Sea.....	47
2.6.2	Denmark.....	19	4.3	The fisheries.....	47
2.6.3	Iceland	20	4.4	Petroleum activities.....	49
2.6.4	United Kingdom	20	4.4.1	General framework	49
2.6.5	The Netherlands.....	21	4.4.2	Regulatory framework for risk management ⁵⁰	
2.6.6	Germany.....	21	4.5	Maritime transport.....	51
2.6.7	The EU.....	21	4.5.1	The international framework	51
2.6.8	USA.....	22	4.5.2	Norwegian management	53
2.6.9	Canada.....	22	4.6	Onshore activities of particular importance for the Barents Sea–Lofoten area	56
2.6.10	Australia.....	22	4.7	Marine protected areas and areas with special environmental status	57
2.6.11	Russia.....	23	4.8	Management of endangered and vulnerable species.....	58
2.6.12	Summary	23	5	Pressures and impacts on the environment	60
3	Description of the area covered by the management plan	24	5.1	Introduction	60
3.1	The ecosystems of the area.....	24	5.2	Pressures and impacts associated with the fisheries industry.....	60
3.1.1	Introduction	24	5.2.1	Introduction	60
3.1.2	The Barents Sea ecosystem	25	5.2.2	Impacts on commercial fish stocks	60
3.1.3	Other parts of the area covered by the management plan	27	5.2.3	Impacts on other parts of the ecosystem.....	62
3.2	Particularly valuable and vulnerable areas	27	5.2.4	Bycatches of seabirds and marine mammals.....	63
3.2.1	Introduction	27	5.2.5	Fisheries and the underwater cultural heritage	64
3.2.2	The area from the Lofoten Islands to the Tromsøflaket, including the edge of the continental shelf.....	29	5.3	Pressures and impacts associated with the oil and gas industry	64
3.2.3	The Tromsøflaket bank area	30	5.3.1	Introduction	64
3.2.4	50-km zone outside the baseline from the Tromsøflaket to the border with Russia	31	5.3.2	Oil and other chemicals.....	65
3.2.5	The marginal ice zone.....	32			
3.2.6	The polar front.....	32			
3.2.7	The waters around Svalbard, including Bjørnøya	33			

5.3.3	Impacts on the seabed and the underwater cultural heritage.....	66	6.2.4	Fishing in the vicinity of subsea structures	90
5.4	Pressures and impacts associated with maritime transport	66	6.3	Marine transport and fisheries	90
5.4.1	Introduction	66	6.3.1	Collisions.....	90
5.4.2	Operational discharges to the sea	68	6.3.2	Vessel noise	91
5.4.3	Introduction of alien species	68	6.4	Maritime transport and petroleum activities.....	91
5.5	External pressures	69	6.4.1	Introduction	91
5.5.1	Introduction	69	6.4.2	Collisions.....	91
5.5.2	Rising atmospheric greenhouse gas concentrations and climate change	70	6.4.3	Anchoring over pipelines	92
5.5.3	Long-range transboundary pollution.....	72	6.5	Summary	92
5.5.4	Pollution originating in neighbouring areas	73	7	Goals, current status and trends...	93
5.5.5	Impacts of external pressures – summary.....	75	7.1	Introduction	93
5.6	Overall pressures and impacts.....	75	7.2	General objectives.....	93
5.6.1	Introduction	75	7.3	Goals, status and trends as regards pollution	94
5.6.2	Overall pressure and impacts on primary and secondary production.....	78	7.3.1	General remarks.....	94
5.6.3	Overall pressure and impacts on benthic communities	78	7.3.2	Hazardous substances and radioactive substances	94
5.6.4	Overall pressure and impacts on commercial fish stocks	79	7.3.3	Operational discharges.....	95
5.6.5	Overall pressure and impacts on seabirds.....	79	7.3.4	Litter and environmental damage resulting from waste	96
5.6.6	Overall pressure and impacts on marine mammals.....	79	7.4	Goals, status and trends with regard to safe seafood.....	96
5.6.7	Overall pollution levels	79	7.5	Goals, status and trends with regard to acute pollution	97
5.6.8	Overall impacts on biodiversity other than from pollution.....	80	7.5.1	Introduction	97
5.6.9	Summary	80	7.5.2	Maritime transport.....	97
5.7	The risk of acute oil pollution.....	80	7.5.3	Petroleum activities.....	98
5.7.1	Introduction	80	7.5.4	Overall evaluation.....	98
5.7.2	Risk, risk analysis and risk management.....	81	7.6	Goals, status and trends with regard to biodiversity.....	98
5.7.3	Impacts of acute oil pollution and the environmental risk concept	81	7.6.1	General objectives.....	98
5.7.4	Risks associated with maritime transport	82	7.6.2	Management of particularly valuable and vulnerable areas and habitats	99
5.7.5	Risk associated with petroleum activities.....	84	7.6.3	Species management	101
5.7.6	Overall risk.....	85	7.6.4	Conservation of marine habitats.....	104
6	Co-existence between industries...	88	8	Current knowledge and need for knowledge	105
6.1	Introduction	88	8.1	Introduction	105
6.2	The oil and gas industry and the fisheries industry	88	8.2	Ecosystem interactions.....	106
6.2.1	Introduction	88	8.3	Individual species.....	109
6.2.2	Acquisition of seismic data.....	89	8.3.1	Fish	109
6.2.3	Occupation of areas by the oil and gas and fisheries industries.....	89	8.3.2	Marine mammals	109
			8.3.3	Seabirds.....	109
			8.3.4	Corals and other benthic fauna.....	110
			8.3.5	Alien species.....	111
			8.4	Pollution	111
			8.4.1	Introduction	111
			8.4.2	Levels and inputs.....	111
			8.4.3	Impacts of pollution.....	112
			8.5	Waste	113

8.6	Climate and weather conditions.....	113	10.5	Ecosystem-based harvesting of living marine resources.....	130
8.7	Environmental risk associated with acute oil pollution	114	10.6	Illegal, unreported and unregulated fishing (IUU fishing)	130
8.8	Other issues	115	10.7	Unintentional pressures on the benthic fauna	131
8.9	Summary	115	10.8	Unintentional bycatches of seabirds.....	131
9	A new approach: integrated, ecosystem-based management	117	10.9	Introduction of alien species	132
9.1	Introduction	117	10.10	Endangered and vulnerable species and habitats	133
9.2	A sounder foundation for the management regime	117	11	Economic and administrative consequences	134
9.3	Closer integration of interest groups.....	119	11.1	Introduction	134
9.4	Updating the management plan	119	11.2	Assessment of measures for integrated ecosystem-based management	134
9.5	An integrated system for monitoring the state of the ecosystem	119	11.2.1	Costs	134
9.5.1	Introduction	120	11.2.2	Benefits	135
9.5.2	Elements of the monitoring system .	120	11.2.3	Administrative consequences	135
9.5.3	Monitoring of selected indicators in the Barents Sea–Lofoten area	121	11.3	Measures for preventing and reducing pollution.....	135
9.5.4	Monitoring of pollutants	121	11.3.1	Costs	135
9.5.5	Implementation.....	121	11.3.2	Benefits	135
9.6	Management based on the characteristics of different areas	123	11.4	Other measures	136
9.7	Better surveys.....	123	11.4.1	Costs	136
9.8	Expanding research activity	123	11.4.2	Benefits	136
9.9	Assessing the impact of elevated CO ₂ levels.....	124	11.4.3	Administrative consequences	136
9.10	Exchange of information and experience.....	124	11.5	Regional and local consequences	136
9.11	Enhancing international cooperation, especially with Russia	124	Appendix		
10	Measures to prevent and reduce pollution and to safeguard biodiversity	126	1	Abbreviations.....	137
10.1	Introduction	126	2	Studies and reports drawn up as a basis for the management plan and available at http://odin.dep.no/md/norsk/ tema/svalbard/barents/bn.html	138
10.2	Preventing acute oil pollution.....	126	3	Elements of the monitoring system for environmental quality	141
10.3	Reducing long-range transboundary pollution.....	129			
10.4	Other measures to prevent and reduce pollution.....	129			



DET KONGELIGE
MILJØVERNDEPARTEMENT

The Royal Norwegian Ministry of the Environment

Report No. 8 to the Storting

(2005–2006)

Integrated Management of the Marine Environment of the Barents Sea and the Sea Areas off the Lofoten Islands

*Recommendation of 31 March 2006 by the Ministry of the Environment,
approved in the Council of State the same day.
(With the paper from the Stoltenberg II Government)*

1 Summary

Marine ecosystems to be safeguarded for future generations as a basis for long-term value creation

The ecosystems of the Barents Sea and the sea areas off the Lofoten Islands are of very high environmental value and are rich in living natural resources that are the basis for a considerable level of economic activity. There are major stocks of cod, herring and capelin in the area, and large cold-water coral reefs and seabird colonies of international importance. By international standards, the state of these ecosystems is generally good today, and the area covered by the management plan can be characterised as clean and rich in resources. The Government considers it very important to safeguard the basic structure and functioning of the ecosystems of this area in the long term, so that they continue to be clean, rich and productive.

Changes in industrial structure are making it even more important to develop a robust cross-sectoral management regime. The area has major potential for value creation in the future. Traditionally, the primary users of the northern seas, including the Barents Sea, have been the fishing

and maritime transport industries. However, this situation is changing radically. There is growing activity in new fields such as oil and gas extraction, transport of oil – mainly from Russia – along the coast, cruise traffic along the coast and around Svalbard, and marine bioprospecting. Such activities must be regulated and coordinated with more traditional activities, and a balance must be struck between the various interests involved. The common denominator for all activities in or on the sea is that they interact in some way with the marine environment.

The purpose of this management plan is to provide a framework for the sustainable use of natural resources and goods derived from the Barents Sea and the sea areas off the Lofoten Islands (subsequently referred to as the Barents Sea–Lofoten area) and at the same time maintain the structure, functioning and productivity of the ecosystems of the area. The plan is intended to clarify the overall framework for both existing and new activities in these waters. The Government considers it very important to encourage broad-based and varied industrial development in North Norway. It is therefore important to facilitate the

co-existence of different industries, particularly the fisheries industry, maritime transport and petroleum industry. The management plan highlights issues where further work is required to ensure that these industries continue to co-exist satisfactorily. The plan is also intended to be instrumental in ensuring that business interests, local, regional and central authorities, environmental organisations and other interest groups all have a common understanding of the goals for management of the Barents Sea–Lofoten area.

The management plan focuses on the environmental framework for sustainable use of this sea area. Spin-off effects on business and industry onshore in North Norway and on value creation in the region are therefore not treated here. The Government will initiate separate processes to deal with these issues at a later date.

Special caution needed in particularly valuable and vulnerable areas

There are certain parts of the area covered by the management plan where the environment and natural resources are considered to be particularly valuable and vulnerable. These are areas that on the basis of scientific assessments have been identified as being of great importance for biodiversity and for biological production in the entire Barents Sea–Lofoten area, and where adverse impacts might persist for many years. Important criteria used in identifying these areas were that they support high biological production, high concentrations of species, or endangered or vulnerable habitats. Further important criteria were their function as key areas for endangered or vulnerable species or species for which Norway has a special responsibility, or as habitats for internationally or nationally important populations of certain species all year round or at specific times of year. Vulnerability was assessed with respect to specific environmental pressures such as oil pollution, fluctuations in food supply and physical damage. Vulnerability varies from one time of year to another.

The areas identified as particularly valuable and vulnerable are the sea area between the Lofoten Islands and the Tromsøflaket bank area and the area identified as Eggakanten on the map (see figure 3.5 or 9.3), a zone off Finnmark county stretching 50 km outwards from the baseline, the marginal ice zone, the polar front and the coastal zone of Bjørnøya and the rest of Svalbard. These areas include the key spawning and egg and lar-

val drift areas for the most important commercial fish stocks in the Northeast Atlantic, such as Northeast Arctic cod and herring. Eggs and larvae, which are the critical stages in fish life cycles, are transported with the coastal current and are found in large concentrations at certain times of year. Several of the areas are also important as breeding, moulting or wintering areas for seabird populations of international importance, such as the lesser black-backed gull (subspecies *Larus fuscus fuscus*), Steller's eider and Atlantic puffin. In addition, the areas identified include valuable and vulnerable habitats where the benthic fauna includes such species as cold-water corals (the largest known cold-water coral reef is off Røst in the Lofoten Islands) and sponge communities. The Government emphasises that activity in these areas requires special caution, but also that precautionary measures must be adapted to the characteristic features of each area, such as why it is vulnerable and how vulnerable it is.

Good scientific basis, but significant gaps in our knowledge

The Government has attached great importance to obtaining a sound scientific basis for the management plan. Information was compiled on environmental conditions, commercial activities in the Barents Sea–Lofoten area, and social conditions in North Norway to provide a common factual basis for impact assessments. Impact assessments have been carried out for activities, primarily fisheries, petroleum activities and maritime transport, that may affect the state of the environment, the natural resource base or the possibility of engaging in other commercial activities in the same area. In addition, the impacts of external pressures such as long-range transboundary pollution, emissions from onshore activities, climate change and industrial activity in Russia were reviewed. An expert group consisting of representatives of the directorates involved was responsible for compiling the input from each sector so that it was possible to consider the various pressures in context. To ensure broad participation in the preparation of the management plan, transparent procedures were followed and various interested parties were drawn into the work. These included local authorities, Sami interest groups, environmental organisations, business and industry, and research institutions. These groups provided substantial input to the scientific basis for the plan.

These thorough scientific efforts have shown

that we already have a considerable body of knowledge about the sea area in question. This includes knowledge of the marine environment and living marine resources in general, and of the most important commercial fish stocks in particular. Nevertheless, there are gaps in our knowledge of a number of aspects of marine ecosystems. This is particularly true of the benthic fauna (for example the distribution of coral reefs and sponge communities), the distribution of seabirds, and the impacts of long-range transboundary pollution, climate change and the overall level of pressure on different parts of ecosystems. We also need to know more about the distribution of fish species, where and how the benthic fauna may be damaged, and about bycatches of seabirds.

In response to the gaps that have been identified in our knowledge, the Government intends to introduce a better coordinated monitoring system for systematic assessment of ecosystem quality. This will use indicators, reference values and action thresholds to provide a basis for more systematic evaluation of trends in ecosystems in the area. Closer monitoring of pollution levels is an important basis for initiating measures to combat pollution, and will also be useful in documenting the quality of Norwegian seafood. In addition, the Government will strengthen research on the Barents Sea–Lofoten area by setting strategic priorities for research programmes under the auspices of the Research Council of Norway in the next few years. Surveys of the benthic fauna and seabirds, together with learning about the impacts of pollution, will also be of key importance as the Government focuses on knowledge development. Building up knowledge in this way will maintain Norway's strong position in discussions of environmental and resource issues in the High North in the future, and will provide important input to work within the framework of multilateral environmental agreements.

There is also an urgent need for more information on illegal, unreported and unregulated fishing (IUU fishing) in the area, and more knowledge is needed as a basis for risk assessments. The Government will encourage knowledge development in these fields as well.

Ambitious goals for the future

In this plan, the Government has set ambitious goals for management of the Barents Sea–Lofoten area. These goals are intended to ensure that the

state of the environment is maintained where it is good and is improved where problems have been identified. In several cases, the goals are more ambitious than similar national targets in Norway's general environmental policy because this entire sea is considered to be of special importance. This is why for example petroleum activities in the area are subject to particularly high emission standards, among the strictest in the world. These requirements will continue to apply. One of the goals is to ensure that activities in particularly valuable and vulnerable areas are conducted in a way that does not threaten ecological functions or biodiversity in these areas. Populations of endangered and vulnerable species and species for which Norway has a special responsibility are to be maintained or restored to viable levels as soon as possible. Unintentional negative impacts on such species as a result of activities in the Barents Sea–Lofoten area are to be reduced as much as possible by 2010.

New measures will be needed in a number of areas to achieve these goals, and follow-up of the management plan will be organised with close reference to the goals. In its regular assessments of the need for further measures, the Government will give considerable weight to the results obtained by the monitoring system for environmental quality to be established according to this white paper. The goals for value creation are intended to ensure that the interests of industrial development are taken into account together with the ambitious environmental goals.

Need to reduce and prevent pollution

Although the state of the ecosystems in the area considered here is generally good, the Government emphasises that there are nevertheless considerable challenges to be dealt with, especially as regards long-range transboundary pollution. Another central issue will be dealing with the risk of acute oil pollution. Given the very strict existing standards, which require zero discharges under normal operating conditions, operational discharges from the petroleum industry are not expected to have any significant impact on the marine environment.

Trends in the risk of acute oil pollution will depend on a number of factors, including the scale and geographical location of any spills from maritime transport and petroleum activities, and the willingness of actors in these industries to comply with the legislation, including require-

ments for the development of preventive technologies, expertise and methods. In the period up to 2020, the key tasks as regards pollution will continue to be related to long-range transboundary pollution and the risk of acute oil pollution. A forum on environmental risk management will be established and will focus mainly on the risk of acute oil pollution in the area covered by the management plan. The purpose is to improve understanding of risk trends in the area so that risk can be managed in the best possible way within each sector and cross-sectorally. Beyond 2020, it is expected that anthropogenic climate change will be the most important environmental pressure on all key parts of the ecosystems. The Government considers it important to gain a better understanding of the impacts of climate change in the Barents Sea–Lofoten area, and will therefore take the initiative for an impact assessment. It will be closely linked to existing research and monitoring programmes, for example under the Arctic Council.

Reinforce international cooperation on chemicals

Bioaccumulation of environmentally hazardous substances in Arctic organisms is a serious problem. The Government will seek to reinforce international cooperation on chemicals by systematically building up knowledge of the impacts of hazardous substances and through new initiatives in international fora such as the Stockholm Convention on Persistent Organic Pollutants.

Environmental risk associated with acute pollution from maritime transport

A number of preventive measures in the fields of maritime safety and oil spill response have already been implemented with respect to maritime transport in the Barents Sea–Lofoten area. These must be seen in the context of a general tendency to continue to raise environmental standards for maritime transport to ensure that it is an environmentally sound means of transport. This is why the Government has taken the initiative for new mandatory routing and traffic separation schemes for maritime transport about 30 nautical miles from the coast. Such schemes will be important in preventing any appreciable rise in the risk level in the period up to 2020. The Government will submit a proposal on the adoption of mandatory routing and traffic separation schemes to the International Maritime Organization (IMO) at the earliest possible date.

In addition, the Government will continue and reinforce other preventive measures and the emergency response system for acute pollution in the area to which the management plan applies.

Cautious approach to the expansion of petroleum activities

In this white paper, the Government makes it clear that the existing regulatory framework will allow petroleum activities to take place in large parts of the southern Barents Sea. On the basis of an evaluation of the areas that have been identified as particularly valuable and vulnerable, an assessment of the risk of acute oil pollution, and an evaluation of interactions with the fisheries industry, the Government has decided to establish a framework for petroleum activities in these areas. This framework will be re-evaluated on the basis of the information available each time the management plan is updated and information from the regular reports that are to be drawn up from 2010 onwards (see Chapter 9.2). In addition to results from research and surveys, important elements in the evaluation will be experience gained from new activities in the Barents Sea–Lofoten area, including impacts of unintentional releases of pollutants and data obtained from the environmental monitoring system that is to be established (see Chapter 9.5). The framework for petroleum activities, including a specification of areas where no petroleum activities are to be started up at present, is further presented in Chapter 10.2.

Reinforcing efforts to safeguard biodiversity

When living marine organisms are harvested, part of the annual production is removed from the ecosystems. This creates a substantial environmental pressure, but one that is managed since it is based on management strategies that follow the principle of sustainable harvesting of marine production. The scientific advice underlying the total allowable catches (TACs) determined for each stock is based on the principle of ecosystem-based management of resources. However, in practice the emphasis is still on management of single stocks. Further development of an ecosystem-based management regime is therefore required. The Government will take steps to increase the proportion of commercially exploited stocks for which management strategies including management targets exist, and that are surveyed, monitored and harvested in accordance

with these. Furthermore, the Government considers it important to seek the establishment of precautionary reference points for all stocks that are exploited commercially, particularly stocks that are being rebuilt to sustainable levels. Control measures to ensure that harvesting takes place in accordance with the TACs set will be reinforced.

There is considerable IUU fishing in the Barents Sea, which is a threat to sound, sustainable management of the fish stocks there. The Government will therefore initiate closer monitoring of the fish resources in the area and seek to bring IUU fishing activities to a halt. The Government will also work towards arrangements that will make it impossible for fish caught during IUU fishing in the Barents Sea to be sold or landed in any part of the world. Furthermore, it is important that fish stocks with a spawning biomass that is currently below the precautionary level are rebuilt to sustainable levels so that a long-term yield can be ensured.

Depending on conditions on the seabed, trawling with heavy bottom gear can cause damage and result in changes in benthic communities. The MAREANO programme to develop a marine areal database for Norwegian waters is an important initiative that will increase our knowledge of ecologically important benthic communities such as coral reefs and sponges. This will provide a better basis for evaluating the scale and importance of anthropogenic pressures on the environment. Efforts to ensure satisfactory protection of coral reefs in the Barents Sea–Lofoten area will be reinforced, for example by the establishment of a cross-sectoral national action plan for coral reefs.

Seabirds are particularly vulnerable to pressures caused by human activity, and it is important to improve our understanding of the overall level of pressure as a basis for a knowledge-based management regime. Unintentional bycatches of seabirds and effects on their food supply are two important elements. In addition, the Government will give priority to improving knowledge of the risks associated with the introduction of alien species.

A pioneering approach involving closer international cooperation, particularly with Russia

The Government considers this management plan to be a practical application of efforts to introduce a more integrated, ecosystem-based management regime for Norwegian seas. The management plan is a pioneering piece of work. Norway's efforts have attracted international attention,

since this is one of the first regional management plans for an entire sea area. Work is now in progress in the EU, within the framework of circumpolar cooperation under the Arctic Council, in the OSPAR Commission for the Protection of the Marine Environment of the North-East Atlantic, through the North Sea cooperation and bilaterally to draw up similar plans for other areas, and Norway is playing an active part in these processes. The management plan described here applies to Norwegian waters and not to the entire Barents Sea. Internationally, the Barents Sea has been identified as a Large Marine Ecosystem (LME). The Government will therefore seek close cooperation with Russia to ensure an integrated management regime for the entire Barents Sea. This white paper includes proposals for strengthening cooperation between Norway and Russia, particularly through the new Norwegian-Russian working group on the marine environment under the Joint Norwegian-Russian Commission on Environmental Protection. To ensure that the satisfactory state of the Barents Sea environment is maintained, it will be necessary to have an agreed assessment of the state of the environment and high environmental standards for all activities in the entire area. The Government also intends to start the preparation of similar management plans for the Norwegian Sea and the North Sea, using experience gained during the preparation of this management plan as a starting point.

Systematic implementation, follow-up and updating of the management plan

The Government considers it important to ensure that the management plan is implemented and followed up systematically and flexibly on the basis of new knowledge, changes in activity levels, trends in the state of the environment and other developments. The Norwegian Polar Institute will therefore, in consultation with the authorities involved, compile reports on the scientific work that is to be done. The first of these reports is due in 2010. This will not entail any changes in spheres of authority or responsibility, but will provide a better basis for a more integrated management regime. An important basis for the five-yearly reports will be provided by the more structured monitoring programme that will be the responsibility of the Advisory Group on Monitoring of the Barents Sea, which will be headed by the Institute of Marine Research, and the Forum on Environmental Risk Management headed by

the Norwegian Coastal Administration. The Ministry of the Environment will be responsible for coordinating government control of the work and administrative follow-up of the reports, while the individual ministries will be responsible for implementing the measures that are found to be necessary. The management plan is intended to be dynamic, and the Government will therefore regularly assess the need to update the plan and adapt it to changing conditions, for example by introducing new measures. On the basis of the overall

needs identified during these assessments, a process will be started well before 2020 with a view to completing an updated version of the whole management plan in 2020 with a time frame up to 2040. The Government will ensure that the interest groups affected are given an opportunity to play an active role in this process.

The measures outlined in the management plan will be considered by the Government in the ordinary budgetary processes, in the same way as other measures in other priority areas.

2 Introduction

2.1 Background

The Barents Sea–Lofoten area is currently a clean, rich marine area of great significance for Norway. It is important to safeguard its rich natural resources and environment for the future. This is a nursery area for fish stocks that provide the basis for rich fisheries and provide food supplies for internationally important seabird colonies and a number of marine mammal populations. In addition, the area has a rich benthic fauna including coral reefs and sponge communities.

Moreover, the Barents Sea–Lofoten area is crossed by important transport routes, and is believed to contain large petroleum resources which can provide the basis for increased petroleum activity. In recent years there has been considerable growth in tourism in the area. The traditional fisheries in the Barents Sea–Lofoten area play an important role in the culture of the whole of North Norway. The sea and the fisheries are a vital basis for settlement along the coast of this region, and this is reflected in the way of life and identity of the population.

More and more use is being made of coastal and marine areas throughout the world, and this is also true of the Barents Sea–Lofoten area. Norway's management of this area is based on extensive international and national legislation. The increase in the activity level and in the number of users is making good coordination essential if we are to ensure that the ecosystem can continue to provide a basis for long-term value creation and that different industries can co-exist. However, at present we often know too little about the relation between the impacts of different activities in the area and the overall pressure on the ecosystem. Management of commercial activities, pollution control, harvesting of resources and spatial planning have tended to take place in relative isolation, without much assessment of their consequences for the ecosystem as a whole.

During its debate on the white paper on the marine environment (Report No. 12 (2001–2002) to the Storting, *Protecting the Riches of the Sea*), the Storting endorsed the need for integrated manage-

ment of Norwegian maritime areas based on the ecosystem approach. This is also in line with international developments in this field, for example in regional cooperation in the northeast Atlantic within the framework of OSPAR, in the Arctic Council, through the North Sea Conferences and in the European Union. 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 of human activities (the Malawi Principles), which Norway has adopted. Under the auspices of the Food and Agriculture Organization of the United Nations (FAO), a Code of Conduct for Responsible Fisheries was drawn up in 1995. It includes guidelines for ecosystem-based management of fisheries resources. The International Council for the Exploration of the Sea (ICES) uses an ecosystem-based approach in its advice on how much should be harvested of each stock.

This makes it clear that effective mechanisms for cross-sectoral coordination of Norway's management of the Barents Sea–Lofoten area will be an important element of the management regime, together with systematic monitoring of the state of



Figure 2.1 In economic terms, cod is by far the most important species of fish in the Barents Sea

Source: Institute of Marine Research (Photo: Bjørnar Isaksen)

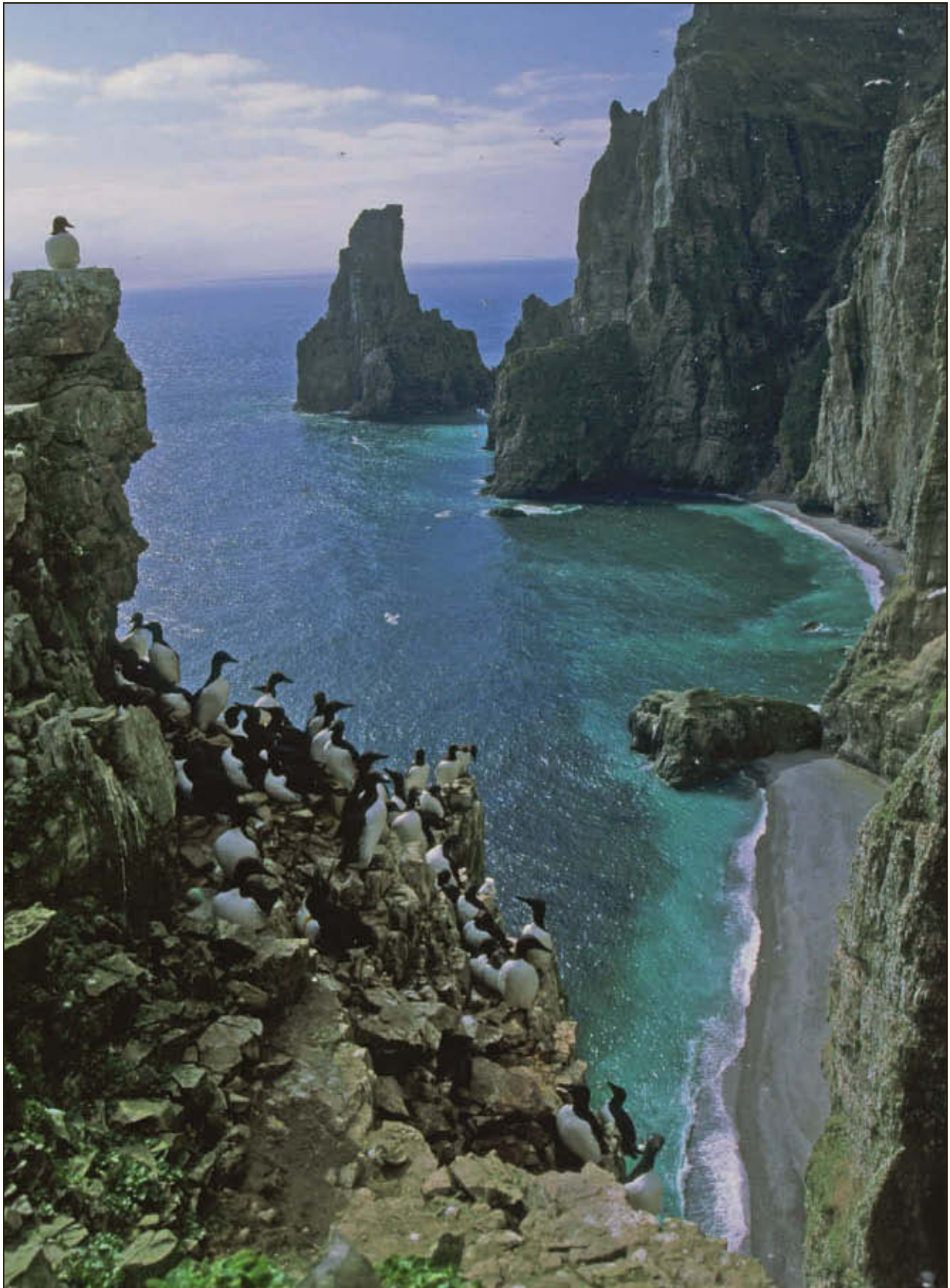


Figure 2.2 Colony of Brünnich's guillemot on Bjørnøya.

Source: Norwegian Polar Institute (Photo: Hallvard Strøm)

the environment. Coordinated, ecosystem-based management of the Barents Sea–Lofoten area is a continuous process which will require interaction between the competent authorities, the scientific community and the stakeholders.

During its debate on the white paper on the marine environment, the Storting agreed that the first integrated management plan should be drawn up for the Barents Sea–Lofoten area. This area was chosen because it is a rich, clean area of sea where considerable new activity is anticipated, and it is therefore important to develop an integrated management regime. The management plan for the Barents Sea–Lofoten area is a groundbreaking effort, putting the concept of an integrated, ecosystem-based management regime into practice for the first time. It will form the basis for integrated management plans for other Norwegian sea areas. Work on this plan has attracted international attention.

2.2 Purpose

The purpose of this management plan is to provide a framework for the sustainable use of natural resources and goods derived from the Barents Sea–Lofoten area and at the same time maintain the structure, functioning and productivity of the ecosystems of the area. The management plan is thus a tool which will be used both to facilitate value creation and to maintain the high environmental value of the area. This requires a clarification of the overall framework for activities in these waters in order to pave the way for the co-existence of different industries, particularly the fisheries industry, petroleum industry and maritime transport. The management plan is also intended to be instrumental in ensuring that business interests, local, regional and central authorities, environmental organisations and other interest groups all have a common understanding of the goals for the management of the Barents Sea–Lofoten area.

2.3 Organisation of the work

Work on the management plan started in 2002 after the adoption of the white paper on the marine environment, and was organised through an interministerial Steering Committee chaired by the Ministry of the Environment. Other members of the Steering Committee were the Ministry of Labour 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.

During the period 2002–2003, the Steering Committee compiled information on environmental conditions, commercial activities in the Barents Sea–Lofoten area and social conditions in North Norway to provide a common factual basis for impact assessments.

This was used as a basis for impact assessments for activities that may have consequences for the state of the environment, the natural resource base and opportunities for other commercial activities in the Barents Sea–Lofoten area, which were carried out in 2003 and 2004. The most important of these were petroleum activities (impact assessment of year-round petroleum activities in the Lofoten–Barents area), fisheries and maritime transport. An impact assessment was also made of external pressures such as transboundary pollution, discharges from land-based activities, climate change, alien species and activities in Russia.

To ensure broad participation, transparent procedures were followed and various interested parties and experts were involved in the work. The study programmes were distributed for comment to stakeholders and the results of the sectoral studies were discussed at consultation meetings in North Norway. Written responses were received and compiled in special consultation memorandums.

In 2004 the Steering Committee established an expert group whose task was to compile the scientific basis for an integrated management plan for the Barents Sea–Lofoten area. The group was led by the Norwegian Polar Institute and the Directorate of Fisheries. Other members of the group were the Institute of Marine Research, the Norwegian Petroleum Directorate, the Norwegian Coastal Administration, the Norwegian Pollution Control Authority, the Directorate for Nature Management, the Norwegian Maritime Directorate and the Norwegian Radiation Protection Authority. Where necessary, the group also enlisted the help of the Directorate for Cultural Heritage. The work of the group was based on the sectoral impact assessments that had been drawn up. Reports were also produced on the overall pressure from different activities, gaps in our knowledge, and vulnerable areas and conflicts of interest.

In November 2003, as part of the preparatory work on the management plan, the Ministry of

Fisheries and Coastal Affairs and the Ministry of the Environment gave the Institute of Marine Research and the Norwegian Polar Institute the task of compiling the scientific basis for the development of environmental quality objectives for the Barents Sea. This task was later extended to include proposals for environmental quality objectives. The report was published in 2005.

In May 2005, the Ministry of the Environment arranged a major conference on the management plan in Tromsø where all the scientific work was discussed in workshops and plenary sessions. Almost 200 persons attended the conference. There was also an opportunity to submit written input and views after the conference. A report from the conference has been published, including input submitted afterwards. After the conference a separate meeting was held with Sami interest groups and the Sami Parliament to consider the responses that had been received.

In the light of the basic documents and impact assessments and the comments they had received, the Steering Committee commissioned further

studies during autumn 2005 on the risk of acute oil pollution in the Barents Sea–Lofoten area. All the studies and reports have been made available on the Internet.

In response to a request by the Storting, a special group was established under the direction of the Ministry of Petroleum to evaluate co-existence between the fisheries and petroleum industries within the framework of sustainable development. The group was made up of representatives of the Ministry of Petroleum and Energy, the Ministry of Fisheries and Coastal Affairs, the Ministry of the Environment, the Ministry of Labour and Social Inclusion, the Institute of Marine Research, the Directorate for Nature Management, the Norwegian Pollution Control Authority, the Directorate of Fisheries, the Petroleum Safety Authority Norway, the Norwegian Petroleum Directorate, the Norwegian Fishermen's Association and the Norwegian Oil Industry Association. The work of the group was coordinated with the work on this management plan.



Figure 2.3 The Steering Committee and the organization of work on the scientific basis for an integrated management plan for the Barents Sea–Lofoten area

Source: Norwegian Pollution Control Authority

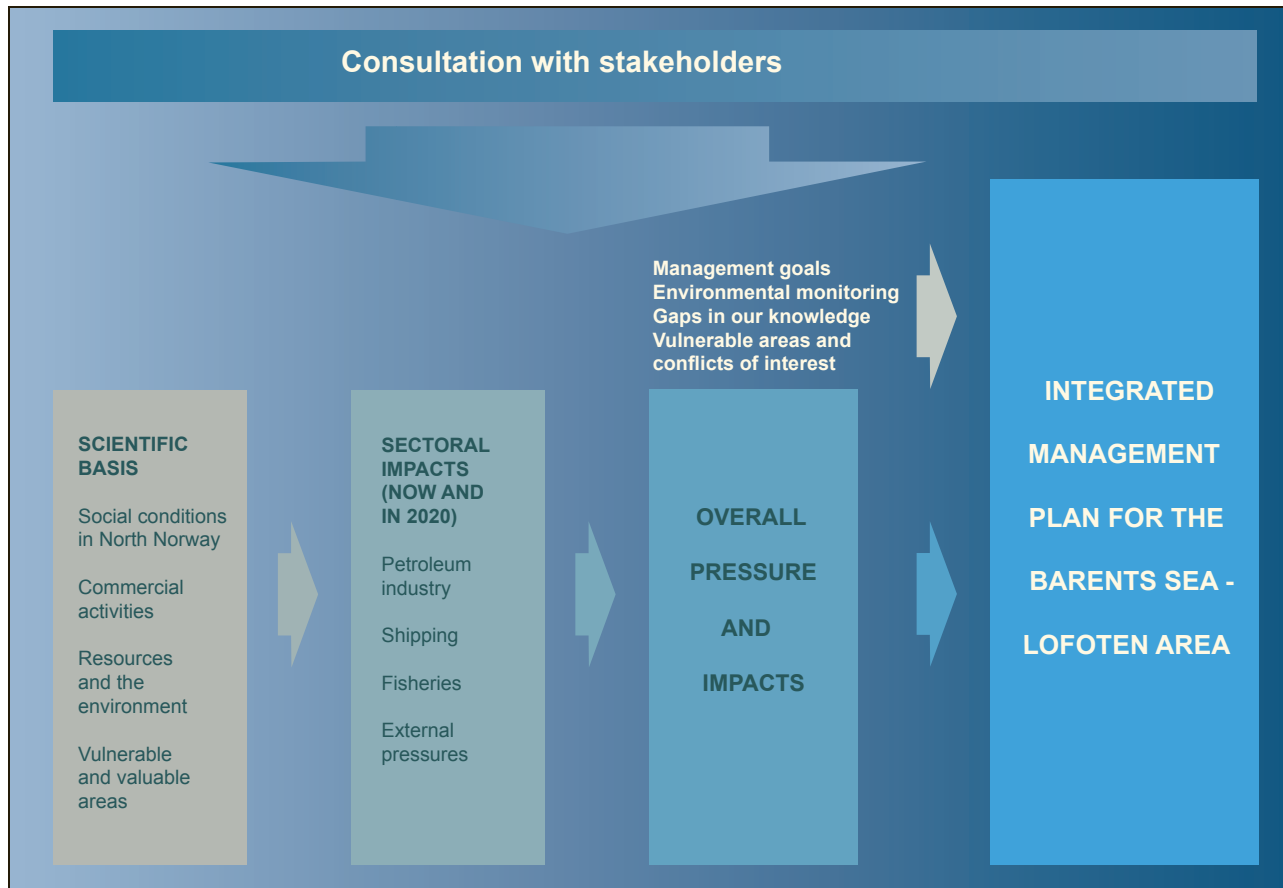


Figure 2.4 The consultation process leading to the integrated management plan for the Barents Sea–Lofoten area

Source: Norwegian Pollution Control Authority

A list of all the background documents that were produced can be found in Annex 2.

In addition to the scientific studies that were initiated directly by the Steering Committee for this management plan, a considerable amount of work of significance for the Barents Sea–Lofoten area has been commissioned by government and private bodies. This includes a project on the spin-off effects of petroleum activities in North Norway carried out under the direction of the Ministry of Local Government and Regional Development.

2.4 Geographical delimitation and time frame

The area covered by this management plan measures almost 1 400 000 km², or four times the size of Norway's land area.

The delimitation of the area is based on ecological and administrative considerations. The area is delimited by the Norwegian Sea in the south-west, by the Arctic Ocean in the north and by the Rus-

sian part of the Barents Sea in the east. One of the reasons for including the sea areas off the Lofoten Islands is the close ecological relationship between fish stocks here and in the Barents Sea.

Activities in the coastal zone on the landward side of the baseline that do not affect the sea areas outside the baseline have not been included, as coastal zone management involves problems of a different nature and to discuss these here would not serve the purpose of this management plan. However, impacts on the coastal zone caused by activities in the Barents Sea–Lofoten area, for example acute oil pollution, have been included.

There are important issues relating to the management of kelp forests in the coastal areas. However, these are not dealt with in the following, as kelp forests are affected by pressures on shallow coastal areas, which are not clearly related to activities in the Barents Sea–Lofoten area. Management of the kelp forests should therefore be considered in the context of management of the coastal areas inside the baseline. Work is being done to improve our understanding of the depletion of the kelp for-

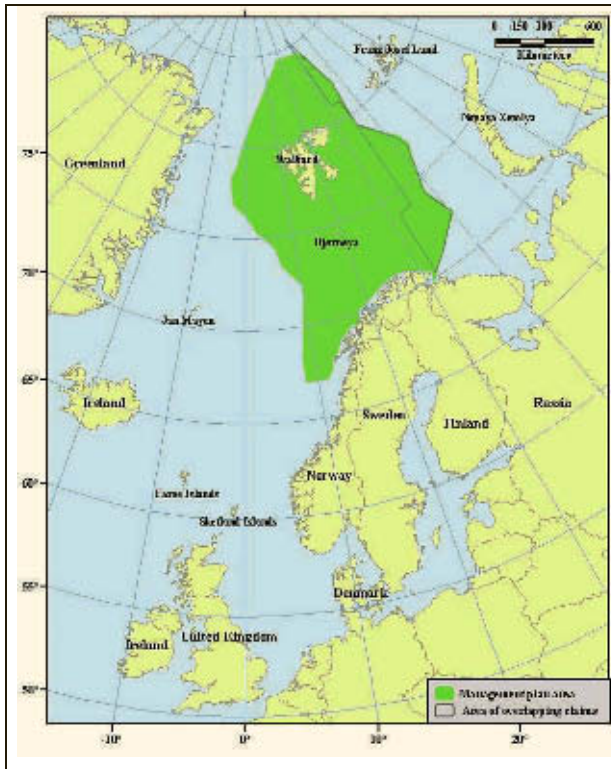


Figure 2.5 Geographical delimitation of the management plan area

Source: Norwegian Coastal Administration

ests along the Norwegian coast, and the relevant sectoral authorities intend to draw up an action plan to reverse this trend as soon as the required knowledge base is available.

Moreover, issues relating to the management North Atlantic salmon are not included, as this species spends important stages of its life cycle in fresh water and its management may more appropriately be considered in other contexts.

The area of overlapping claims east of the main management plan area, which is the subject of delimitation consultations between Norway and Russia, has been included in the background documents and in the assessments of challenges and goals in this plan. An important element of the Government's follow-up of the plan will be to promote further cooperation with Russia.

The background studies and assessments for this plan are based on scenarios for the period up to 2020. A process to update the whole management plan for the period after 2020 is planned. There will also be regular updates in the period up to 2020, see Chapter 9.4.

2.5 Thematic delimitation

2.5.1 Introduction

This management plan has a broad scope, covering all types of interactions between the different commercial interests and all types of environmental pressures from the different sectors on the entire ecosystem. However, it is not possible for the management plan to cover every issue relating to the Barents Sea–Lofoten area, and it is therefore necessary to exclude certain themes and policy areas. These include issues of international law, security policy and business policy. Nevertheless, these themes and policy areas are taken into account as far as possible in assessing the need for action.

2.5.2 Issues of international law

Norway and Russia give priority to a timely conclusion of an agreement on a delimitation line for the continental shelf and the 200-mile zones in the Barents Sea. Considerable progress has been made in the consultations, which started in 1970 with regard to the continental shelf and since 1984 have also included the zones. The two parties agree to continue the discussions on the basis of a comprehensive approach that takes into account all relevant elements, including fisheries, petroleum activities and defence interests. Such a boundary line will not affect the freedoms of the high seas, which are essential, for example, to ensure the freedom of navigation for naval operations. The line will however make it clear which state's legislation and jurisdiction may apply in the maritime areas concerned for certain specific purposes, in particular in relation to exploring or exploiting resources. This is essential for ensuring sufficiently predictable conditions under which commercial and other actors can operate. These issues are dealt with in detail in a white paper on the High North (Report No. 30 (2004–2005) to the Storting, *Opportunities and Challenges in the North*) and will not be discussed further here.

2.5.3 Security policy issues

During the Cold War, Norway was vulnerable because of its geographical location. Norway's strategic importance, and particularly that of North Norway and the northern sea areas, meant that the country's position and views were of great interest to its allies. The Soviet Union's dissolution and the

end of the Cold War put an end to the greatest threat to Norway's security.

The reduced level of tension has gradually led to a reduction in the Russian military presence on the Kola Peninsula, although it is still considerable. The headquarters of the strategically important Northern fleet is there, and there is still a large concentration of nuclear weapons in North-western Russia. The large quantities of radioactive material in the many and often inadequately secured nuclear facilities pose a challenge to the efforts to prevent the proliferation of material that could be used in terrorist operations. Russia's High North policy shows that the country still considers this region to be strategically significant. However, civilian activities are gradually gaining in importance, and there is every indication that Russian business interests, especially in the petroleum sector, will become increasingly influential in the years to come.

Security policy issues are dealt with in detail in the white paper on the High North and are not discussed further here. There is also an annual review of security policy trends and Norway's main priorities in the government budget.

2.5.4 Business policy issues

It is stated in the white paper on the marine environment (Report No. 12 (2001–2002) to the Storting, *Protecting the Riches of the Sea*) that one of the purposes of management plans for maritime areas is to establish framework conditions which make it possible to find a balance between the interests of the fisheries, maritime transport and petroleum industries within the framework of sustainable development. The purpose of this plan, as set out in section 2.2 above, is specifically to

“provide a framework for the sustainable use of natural resources and goods derived from the Barents Sea–Lofoten area and at the same time maintain the structure, functioning and productivity of the ecosystems of the area”.

Thus, the plan is intended to clarify the overall environmental framework for commercial activity in this area.

Within this framework, the plan will be supplemented by both sectoral and more general business policy assessments, relating for example to employment and competitive strength, structural conditions in the various industries, the tax regime, and spin-off effects. These issues will be considered by various sectoral ministries, the

Ministry of Local Government and Regional Development and the Ministry of Finance, and are not discussed further here. The Government considers it important to examine these issues, see also Box 3.3, Spin-off effects on land. They are also examined in the two most recent white papers on regional policy and in the High North strategy that is being developed.

2.5.5 Other issues

It is not a specific aim of this management plan to safeguard human life and health. This issue will be followed up on the basis of the existing safety legislation. Work is now in progress on a white paper on health, environment and safety activities in the oil industry.

The plan does not deal specifically with links between settlement patterns and activities in the Barents Sea–Lofoten area and issues relating to exploitation of the resources in the area by different population groups, including the interests of indigenous peoples. These issues will be examined through separate processes in the context of this management plan. The plan will provide an important framework for commercial activity, and will thus also influence settlement patterns and the opportunities indigenous peoples have to engage in commercial activities. The economic and administrative consequences of the proposals in this white paper are discussed in Chapter 11.

2.6 Work on integrated, ecosystem-based management plans in other countries

2.6.1 Sweden

In 1999 Sweden adopted a number of national environmental quality objectives, setting various interim targets for each of them. One of these objectives concerns marine and coastal areas. Progress reports are issued each year giving an assessment of whether the targets will be achieved within the time frames set for them. Sweden is working actively towards the development of an integrated marine environmental policy within the framework of HELCOM and OSPAR.

2.6.2 Denmark

Denmark has developed a set of indicators of ecological status in the coastal zones. It is working actively towards the development of an integrated



Figure 2.6 Large Marine Ecosystems (LME)

Source: National Oceanic and Atmospheric Administration (NOAA)

marine environmental policy within the framework of HELCOM and OSPAR.

2.6.3 Iceland

Iceland published a report entitled *The Ocean – Iceland's Policy* in 2004. Drawn up jointly by the Icelandic Ministries for the Environment, Fisheries and Foreign Affairs, this report gives a comprehensive overview of Iceland's marine environment policy. The report reviews different environmental pressures and identifies a particular need to follow up work on transboundary pollution, the risk of acute oil pollution, better coordination of different interests and knowledge development. The report does not refer specifically to ecosystem-based management or regional management plans. Iceland is working actively within the fram-

ework of OSPAR towards the development of an integrated marine environmental policy.

2.6.4 United Kingdom

In 2002, the UK published its first marine stewardship report, *Safeguarding our Seas: A Strategy for the Conservation and Sustainable Development of our Marine Environment*. A working group was established under the Department of Environment, Food and Rural Affairs (Defra) to assist the government in following up the strategy. It has been concluded during this process that the current management system has developed in a largely piecemeal fashion, and the government is now working to improve coordination between sectors and implement an ecosystem approach to management of the marine environment. Defra has organised a

two-year pilot project, the Irish Sea Pilot, to test the potential for an ecosystem approach to managing the marine environment at a regional sea scale. The report makes a number of recommendations for further work, but there are no specific plans for the systematic preparation of regional management plans in the UK.

In 2004, the British government presented a proposal for a new Marine Bill that will simplify and modernise existing legislation and focus on integrated management. The report *Charting Progress: An Integrated Assessment of the State of UK Seas* was published in 2005. The UK is working actively towards an integrated marine environmental policy within the framework of OSPAR.

2.6.5 The Netherlands

The Netherlands has developed a system of environmental quality objectives for the Dutch sector of the North Sea and bases its marine management regime on the ecosystem approach. In 2002, the National Institute for Coastal and Marine Management established a programme called Toestand van de Zee (the state of the sea), which produces annual state of the environment reports for Dutch sea areas and on the need for action. In 2005, the Netherlands issued a management plan for the Dutch sector of the North Sea (Integrated Management Plan for the North Sea 2015) with a particular focus on spatial planning and conflicts of interest. The Netherlands is working actively towards an integrated marine environmental policy within the framework of OSPAR.

2.6.6 Germany

Reports on the state of the environment in the German sector of the North Sea and the Baltic Sea are compiled at national level through a monitoring programme (Bund/Länder-Messprogramms für die Meeresumwelt von Nord- und Ostsee (BLMP)). This has a programme committee with representatives from all the relevant national and regional authorities in the fields of environment, transport, fisheries, research, etc. Data collected under this programme is accessible in the Marine Environmental Database, or MUDAB database. Germany is working actively towards an integrated marine environmental policy within the framework of HELCOM and OSPAR.

2.6.7 The EU

The EU's Sixth Environment Action Programme adopted in July 2002 requires the European Commission to develop seven thematic strategies, one of which is a marine strategy. As a first step, in October 2002, the European Commission submitted a Communication to the Council and the European Parliament: Towards a strategy to protect and conserve the marine environment, (COM (2002) 539 final).

In 2003 four working groups were set up under the informal cooperation between the EU Water Directors for the purpose of preparing a basis for the strategy:

- Working group on Strategic Goals and Objectives (SGO)
- Working group on Ecosystem Approach to Management of Human Activities (EAM)
- Working group on Hazardous Substances (HS)
- Working group on European Marine Monitoring and Assessment (EMMA)

Norway has been represented at the twice yearly meetings of the Water Directors and in all the working groups.

On 24 October 2005 the European Commission presented a proposal for a marine strategy directive which was submitted to the European Parliament and the Council for adoption in accordance with the codecision procedure laid down in Article 251 of the EC Treaty. Through their forthcoming presidencies of the Council, Finland and Germany will play a central part in the procedures for adoption of this directive in autumn 2006 and spring 2007. The directive is intended to constitute the environmental pillar of the future maritime policy of the EU, which is now being developed.

Like the EU Water Framework Directive which applies to waters on the landward side of the baseline, the proposal for a marine strategy directive is based on the ecosystem approach. It is a framework directive, dealing mainly with procedural and general matters. It contains no specific environmental requirements regarding economic activities, but does set out requirements for member states' management systems for their marine waters.

The key elements of the directive are:

- Its objective is to achieve "good environmental status" in European marine waters by 2021.
- It includes a procedure for establishing environmental targets, indicators and standards for

“good environmental status” by a special committee (comitology procedure).

- Members are required to develop regional marine strategies for the different marine regions during the period 2009–2016.
- The marine regions may be divided into sub-regions in accordance with the list in the directive.
- Each strategy must include an assessment of environmental status, analysis of pressures and impacts, environmental targets and indicators, and a monitoring programme. By 2016 at the latest, each strategy must contain a programme of measures, to be implemented by 2018 at the latest.
- The directive does not address measures regulating fisheries or radioactive material, but refers to the EU’s Common Fisheries Policy and the EURATOM Treaty. However, pressures and impacts on marine waters related to the fisheries and the use of radioactive material come within the scope of the requirements to assess environmental status, analyse pressures and impacts, and establish environmental targets.
- It includes a procedure to be followed when “good environmental status” cannot be achieved through national measures.
- It lays down that, where appropriate, the Commission will adopt standardised methods for monitoring and assessment of the state of the environment.
- It provides for coordination of efforts at regional level within the framework of existing structures (OSPAR, HELCOM (Helsinki Commission) etc.).
- It requires notification and approval through the European Commission of the strategies and various elements of the strategies.
- It includes a procedure for updating strategies.

Norway will consider the proposal for a directive in the normal way with reference to the EEA Agreement.

2.6.8 USA

The US Commission on Ocean Policy, created under the terms of the Oceans Act of 2000, issued a comprehensive report in September 2004 on marine management in the USA (*An Ocean Blueprint for the 21st Century*). The report contains recommendations for a new coordinated and comprehensive ecosystem-based management of American marine regions. One of the recommendations

is to divide the marine areas into ecoregions, with individual plans for management and review of the state of the environment (regional ecosystem assessments). High priority is given to stakeholder involvement.

In response to the Commission’s report, the Bush administration approved the US Ocean Action Plan in December 2004 and in 2005 established a Committee on Ocean Policy to review the recommendations of the Commission in the course of an 18-month period.

Another committee, the Ecosystem Principles Advisory Committee, advocated adopting an ecosystem approach to fishery management in 1999. This principle has also been incorporated in various sectoral acts, such as the Magnuson-Stevens Fishery Conservation and Management Act which was revised in 1996.

2.6.9 Canada

The Canadian Oceans Act was passed in 1997. A key element of this Act is an integrated, ecosystem-based approach to management of the Canadian oceans. It was followed in 2002 by Canada’s Oceans Strategy and related plans for a number of measures to be implemented in the course of a four-year period ending in 2006. In this connection, the Canadian Department of Fisheries and Oceans (DFO) set up a national coordinating body to facilitate the development of best practices for integrated management and to oversee projects and the development of ecoregions and ecological quality objectives for these regions. One of the main objectives is to promote the development of a State of the Oceans reporting system. As a further follow-up, the Canadian authorities announced a programme of measures (Canada’s Oceans Action Plan) for an initial phase from 2005 to 2007. A sum of CAD 28 million has been earmarked for improved sectoral integration of environmental concerns and implementation, including the development of regional, integrated management plans for the different Canadian marine areas, in the time ahead. High priority is given to stakeholder involvement.

2.6.10 Australia

Australia’s Oceans Policy, launched in 1998, requires the development of regional management plans for Australian marine areas. These plans are to be based on integrated ecosystem-based management. The first of these plans, the South-East

Regional Marine Plan, was adopted in 2004 and a regional plan for the northern marine region is under development. Australia is thus one of the countries which are leading the field in the development of an integrated management model for regional seas. The South-East Regional Marine Plan, which is now available, contains a range of objectives and measures. One of the measures is to carry out an overall assessment of the pressures on the environment, similar to the work carried out to compile the scientific basis for this management plan.

Australia has been publishing national state of the environment reports since 1996. One of the environmental themes for these reports is coasts and oceans, for which a set of 61 indicators has been developed. The national reports are supplemented by regional and local state of the environment reports.

2.6.11 Russia

In Russia, protection of the marine environment and management of marine resources are regulated by law. Russia's national marine policy is set out in the "Marine Doctrine of the Russian Federation", which has been approved by the President and entered into force in 2001. It sets out Russian policy regarding marine activities and further develops the regulation of matters dealt with in other areas of legislation, such as the "National Security Concept of the Russian Federation", the "Foreign Policy Concept of the Russian Federation", the "Military Doctrine of the Russian Federation", the "Concept of Navigation Policy of the Russian Federation", the "Basis of Military and Naval Policy of the Russian Federation until 2010".

Petroleum projects in Russia must be developed in accordance with its Strategy for Research and Exploitation of Oil and Gas Resources on the Continental Shelf, and an integrated action plan for implementation of this strategy. The most important guidelines for Russia's federal policy for fisheries management are laid down in a policy document entitled the "Concept for Development of the Fishery Industry of the Russian Federation until the year 2020".

In 2005, a Norwegian-Russian working group on the marine environment was established as part of the bilateral marine protection cooperation between Norway and Russia. The task of the working group is to contribute to closer cooperation on ecosystem-based management of the Barents Sea. A central element here will be cooperation on the

scientific basis for ecosystem-based management and exchange of practical experience. This work is already underway. Russian experts have been involved in the preparation of parts of the scientific basis for this plan. A joint Norwegian-Russian seminar on pressures on the Barents Sea ecosystem held in February-March 2006 provided an opportunity to present the work on the Norwegian plan to the Russian authorities and to discuss the possibility of a similar approach on the Russian side. The response from the Russian delegation was positive.

Norway and Russia can look back on many years of fruitful cooperation in the fisheries sector. Joint marine research programmes started in the 1950s and cooperation in other fields has followed. Cooperation on fisheries was formalised in two bilateral agreements in 1975 and 1976. The Joint Norwegian-Russian Fisheries Commission was established under the 1975 agreement, and bilateral cooperation in the fisheries sector takes place mainly within the framework of the Commission. Norwegian and Russian authorities have an ongoing dialogue on management rules and other matters, and the Commission itself meets once a year.

In 2003, the Norwegian and Russian authorities established Russian-Norwegian cooperation on maritime safety and oil spill prevention and response. One objective of this cooperation is to obtain a better overview of the vessels leaving Russian ports and their cargoes; another is to achieve a reciprocal exchange of information with a view to ensuring the highest possible level of maritime safety in the Barents Sea.

2.6.12 Summary

The concept of ecosystem-based management of marine waters is still under development. Norway, Canada and Australia are probably the countries which have made most progress in developing regional management plans as part of an integrated, ecosystem-based management regime for their sea areas. Norway is however in a special position, since responsibility for this management plan rests with the highest political level. Work is now in progress in several other like-minded countries and in the European Union, and it seems likely that a network of management plans for different ecoregions will be developed in the course of the next twenty years. Important elements of this work are the involvement of all interested parties and those who will be affected by the plans, and the establishment of transparent procedures.

3 Description of the area covered by the management plan

3.1 The ecosystems of the area

3.1.1 Introduction

There are close links between the different elements of the ecosystems in the Barents Sea–Lofoten area. Seabirds transfer nutrients from marine to terrestrial ecosystems. Fish live on the plankton production in the upper water layers, and transfer nutrients between marine ecosystems as they migrate from the open sea to coastal waters. Benthic animals also rely partly on production in the upper water layers. Article 2 of the UN Convention on Biological Diversity defines an ecosystem as “a dynamic complex of plant, animal and

micro-organism communities and their non-living environment interacting as a functional unit.” According to this definition, 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, which in a simplified classification scheme can be divided into three ecosystems:
 - the area south of the Tromsøflaket,
 - the area around Svalbard, and
 - parts of the deep-sea areas of the Norwegian Sea.

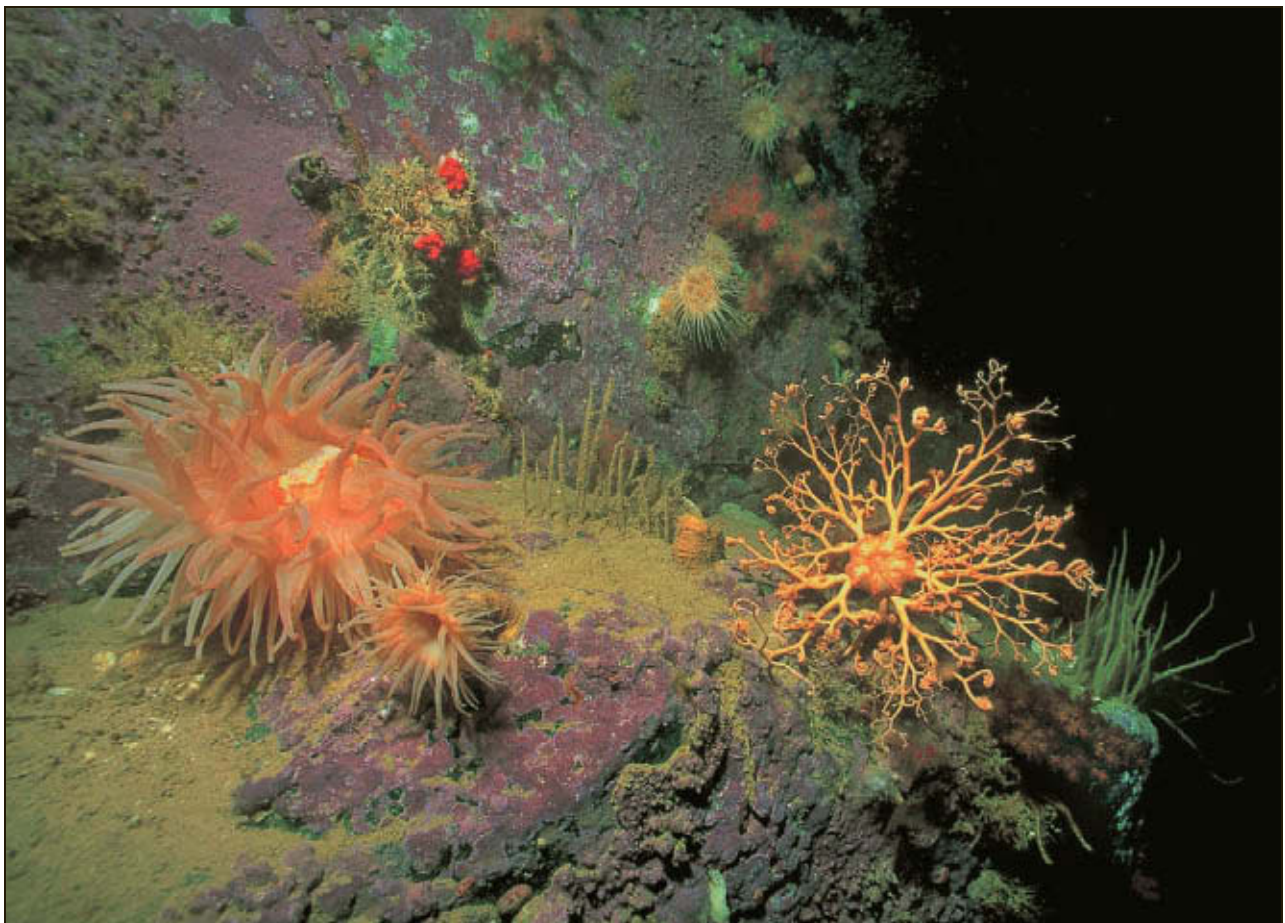


Figure 3.1 From the seabed along the coast of Svalbard (Hinlopen Strait), showing a large sea anemone, a basket star (which may have up to 5000 arms) and some small red corals in the background.

Source: Photo: Erling Svensen

There are large natural fluctuations in environmental conditions throughout this area, for example in the inflow of Atlantic water and in weather conditions. In addition, activities such as fisheries, petroleum activities and maritime transport create anthropogenic pressures. External pressures such as long-range transboundary pollution and global change also affect the state of the environment. Other important factors are the risk of acute oil pollution and the spread of alien species.

The water temperature has risen in the Barents Sea–Lofoten area in recent years, and is now at about the same level as in the 1930s. This may be a result of a stronger inflow of Atlantic water, but an additional factor is that in some of the most recent years, water flowing into the area has been warmer than normal. A temperature rise may result in changes in species distribution and species composition in the area; in fact, changes in the distribution of blue whiting have already been recorded. This species has never before been recorded in such large numbers so far north and east in the Barents Sea. It is too early to draw any conclusions about the impacts this may have on other established fish stocks in the Barents Sea.

3.1.2 The Barents Sea ecosystem

The Barents Sea is defined internationally as a Large Marine Ecosystem (LME) (see figure 2.6), which means that although the management plan only applies to Norwegian waters, it is most logical in this white paper to describe the Barents Sea ecosystem as a whole.

The Barents Sea is a relatively shallow sea, with an average depth of 230 m, and the southeastern part is shallowest. 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 km², corresponding to only about 7 per cent of the sea areas in the Arctic, but the greater part of all Arctic marine resources of commercial interest are found here. This is partly because a substantial proportion of the fish stocks of the Northeast Atlantic spend part of their life cycle in the Barents Sea.

The inflow of warm Atlantic water supports high biological productivity and also keeps large parts of the Barents Sea ice-free all year round. Because the water is shallow, vertical mixing normally takes place right down to the bottom in win-

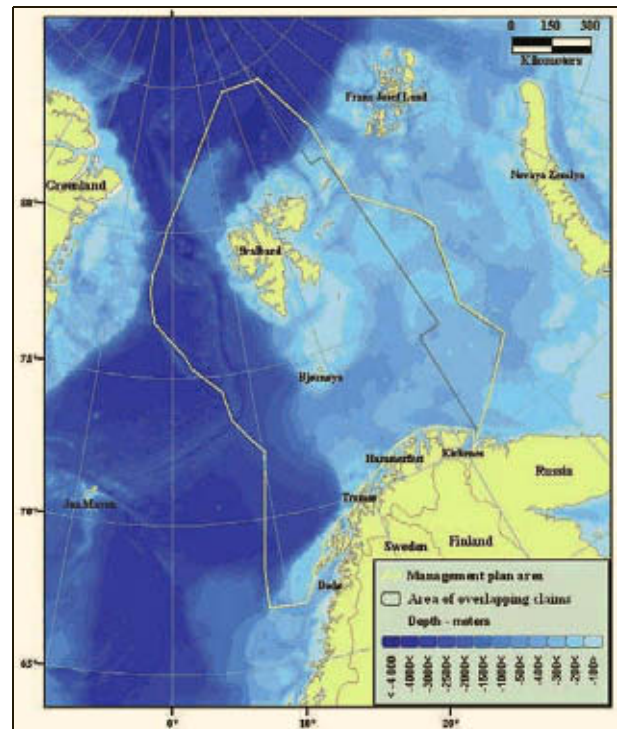


Figure 3.2 Water depths in the area covered by the management plan

Source: Norwegian Coastal Administration

ter, carrying nutrients up to the productive surface waters, where they sustain biological production in spring. However, because recent winters have been mild, vertical mixing has seldom reached deeper than 200 m. Variations in environmental conditions such as temperature, wind and ocean currents result in large seasonal and inter-annual fluctuations in the production of phyto- and zooplankton and thus in the food supplies available for fish, seabirds and marine mammals. Recruitment to these populations therefore also varies between years. The food chains in the Barents Sea are relatively short, containing few but robust species that are well-adapted to the unstable climate. There are large populations of individual species, and they may have wide distribution ranges. Even though individual species are robust, the impact of negative environmental pressures may be intensified because food chains are so short.

Not all fish species found here spend their whole life cycle in the Barents Sea. Some, such as herring and cod, spend parts of the year or part of their life cycle here. For others, like 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

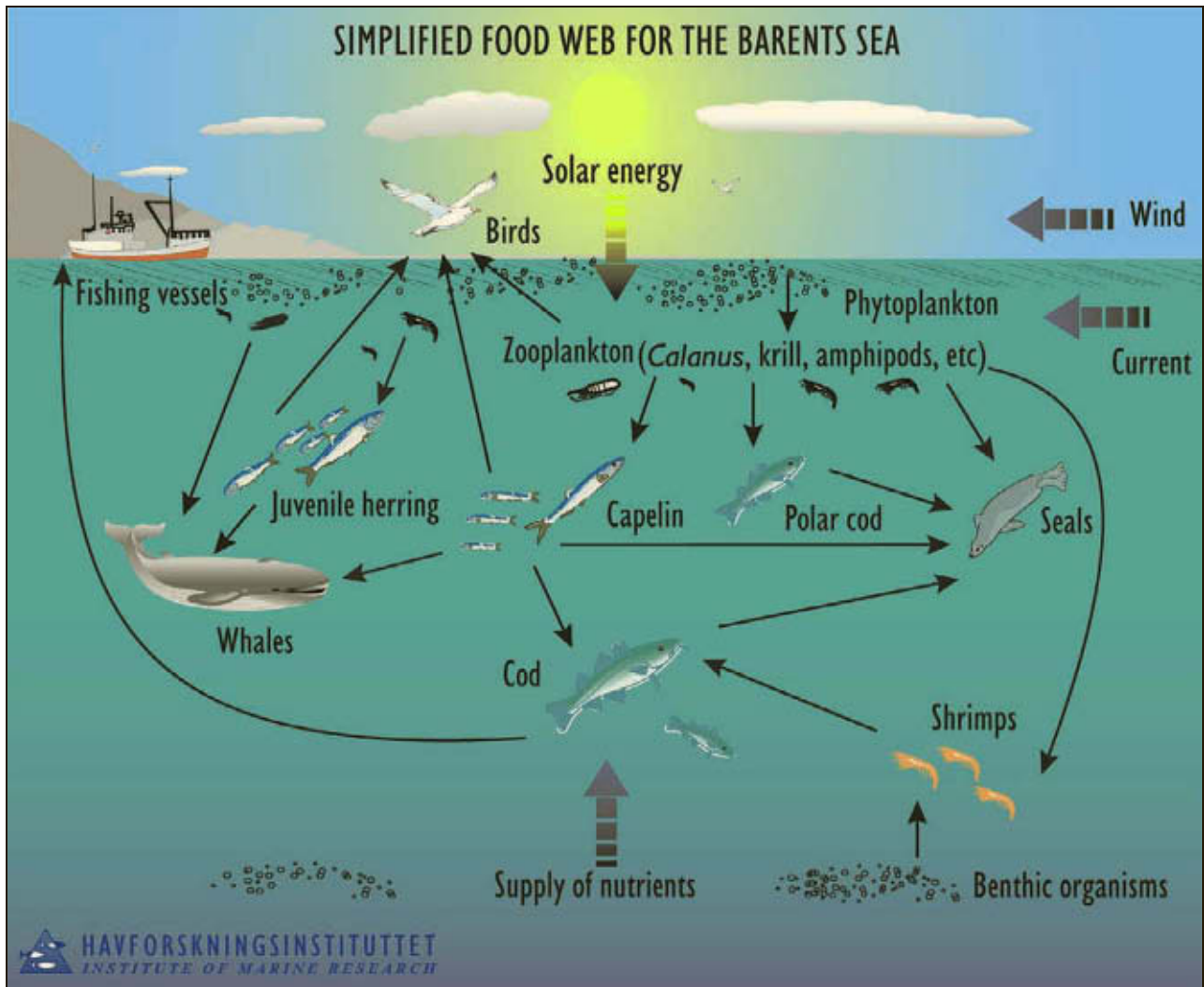


Figure 3.3 Simplified food web for the Barents Sea

Source: Institute of Marine Research

Barents Sea rises. This allows fish such as herring and cod and other marine organisms whose distribution is limited by low temperatures to expand their ranges. Cooling of the Barents Sea, on the other hand, is favourable for capelin. Figure 5.1 shows variations in the capelin stock, which are partly related to temperature fluctuations.

The marginal ice zone can be considered as a separate ecosystem that retreats gradually northwards in spring and summer. This creates particularly favourable 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. The Norwegian part of the Barents Sea and the waters south to the Lofoten Islands support an estimated 5.4 million breeding pairs of seabirds. Most of these migrate southwards from the Barents Sea in winter. A number of marine mammals forage in the Barents Sea and calve further south in temperate waters (minke whale, humpback whale, fin whale), while others spend their whole lives in the Arctic (beluga whale, narwhal). The large populations of harp seal and minke whale eat 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 tonnes, with an annual production of 25–30 million tonnes. About 2700 species have been recorded. Although the Barents Sea is an important fishing ground, relatively little is

known about the distribution of benthic animals. However, information from fishermen indicates that sponges and corals may dominate the seabed in certain areas.

3.1.3 Other parts of the area covered by the management plan

The most characteristic feature of the ecosystem in the area from Røst (at the southern tip of the Lofoten Islands) to the Tromsøflaket bank area is that the geological continental shelf is narrower than it is further south and north. The Norwegian coastal current is strongly influenced by the topography of the seabed, and is therefore narrow and strong in this area. The narrow continental shelf includes shallow banks and deeper areas, which also affect the movement of the water masses and generate eddies above the shallower banks, where biological resources are concentrated. In addition, the warm Atlantic current is closer to the coast in this area, giving coastal areas a considerably milder climate than would be expected on the basis of their latitude alone.

The Tromsøflaket is a shallow bank area at the entrance to the Barents Sea proper. It is bounded in the north by the Bjørnøyrenna Channel and in the west and south-west by the edge of the continental shelf, which here drops steeply to the deep waters of the Norwegian Sea. The current sys-

tems are strongly influenced by the topography of the seabed, which creates eddies, so that the water masses have a relatively long residence time over the Tromsøflaket.

The areas around Svalbard can in theory be divided up into a number of ecosystems, but are here considered as a single area that differs from the other parts of the management plan area. The continental shelf is relatively narrow along the west coast of Svalbard, but otherwise there are large shallow bank areas. The warm Atlantic water flowing northwards along the Norwegian coast splits into two branches when it reaches the Tromsøflaket, one of which flows into the Barents Sea and the other north-westwards towards Svalbard, see figure 3.4.

The deep-sea parts of the management plan area (see figure 3.2) belong to the ecosystem of the Norwegian Sea and Greenland Sea, which is quite different from the other ecosystems in the Barents Sea–Lofoten area. Since activities in the Barents Sea, south of the Tromsøflaket and around Svalbard will have little effect on this ecosystem, it has not been included in the more detailed description below.

3.2 Particularly valuable and vulnerable areas

3.2.1 Introduction

Within the sea area and ecosystems described above, there are certain areas where the environment and natural resources are considered to be particularly valuable and vulnerable. These are areas that on the basis of scientific assessments have been identified as being of great importance for biodiversity and for biological production in the entire Barents Sea–Lofoten area, and where adverse impacts might persist for many years. Vulnerability (see the definition in box 3.1) was assessed with respect to fisheries, shipping and petroleum activities, and also with respect to external pressures such as environmentally hazardous substances, radioactivity and alien species. The following are important criteria used in assessing whether an area is vulnerable to environmental pressures:

- whether it supports high production and high concentrations 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

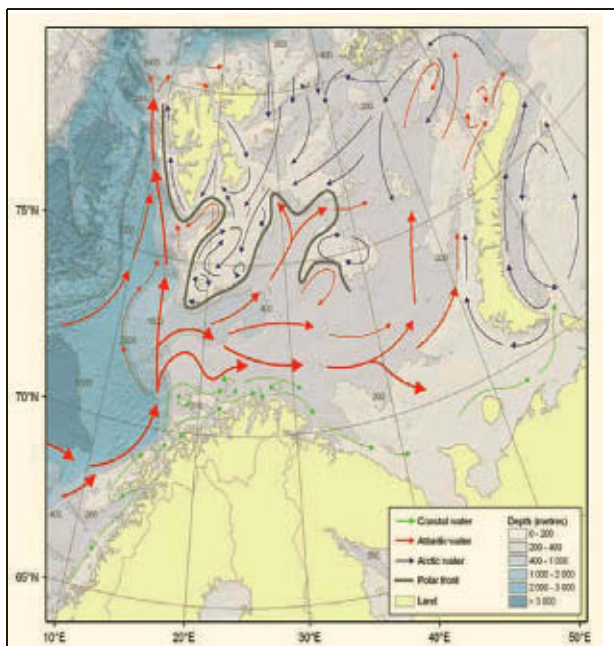


Figure 3.4 Ocean currents and depths in the Barents Sea

Source: Institute of Marine Research

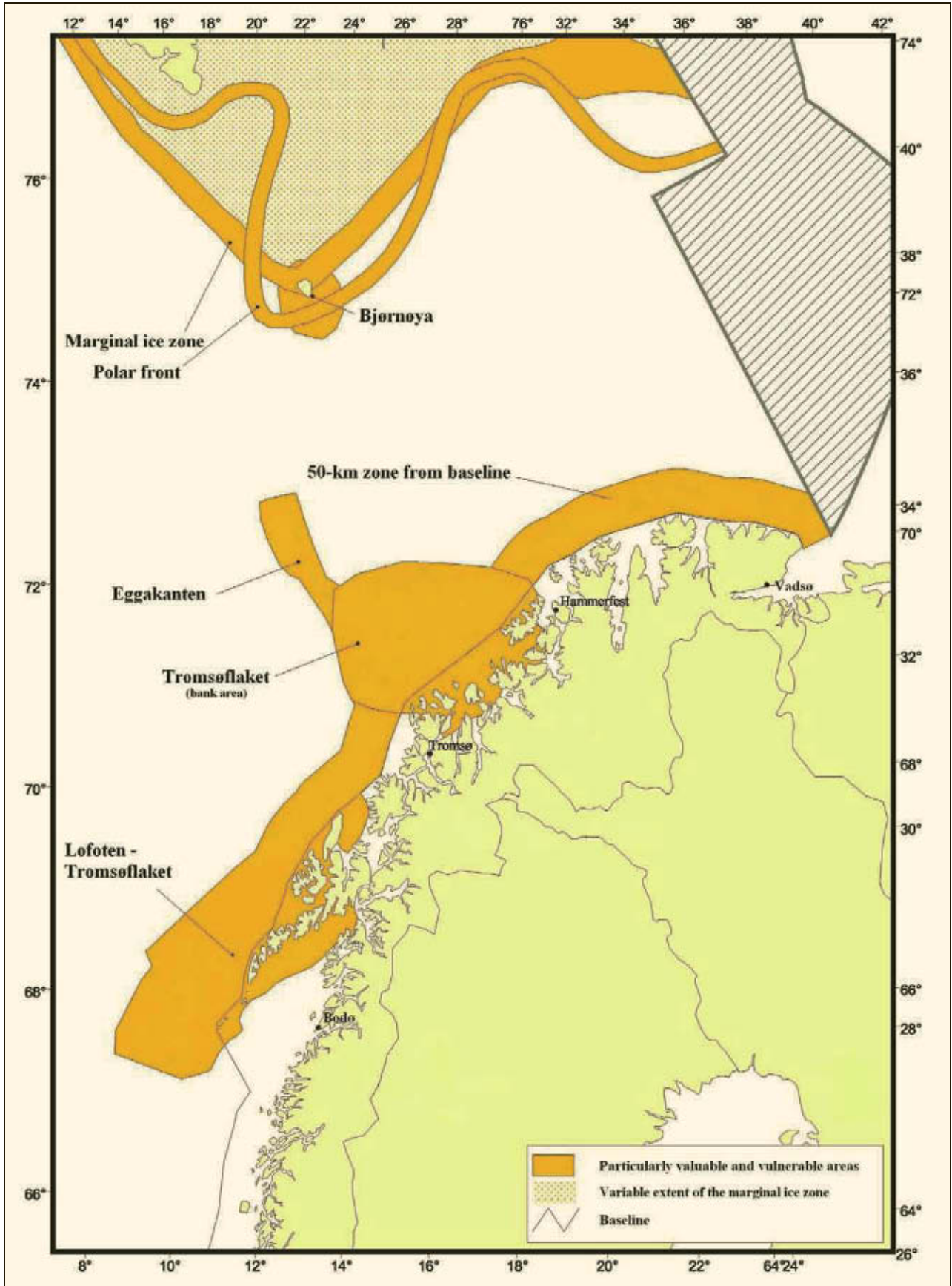


Figure 3.5 Particularly valuable and vulnerable areas in the area covered by the management plan

Source: Ministry of the Environment

Box 3.1 Vulnerability

Vulnerability can be defined as a measure of how liable a species or habitat is to be negatively affected by external, often anthropogenic pressures.

The starting point for an assessment of the vulnerability of an area is generally which species and habitats are found there naturally, and the productivity of these species. Factors such as seasonal variations, distribution pattern, age/stage of the life cycle, behaviour and biological characteristics are important for assessing the vulnerability of individual species. Vulnerability is assessed on the basis of the likely impacts of different pressures on the development and survival of a species or population. Some species are particularly vulnerable at times of the year when most of the population is concentrated in a limited area (for example seabirds during the breeding season). The vulnerability of habitats depends on factors such as the substrate type (sand or rock, sessile or motile species, whether the habitat type is rare, etc). Certain areas dominated by fragile, habitat-forming species such as corals and sponges may be particularly vulnerable. Areas where biological production is high may be particularly vulnerable at certain times of year (for example when the early stages of fish, eggs and larvae, are present). Vulnerability can be measured at individual, population, community and ecosystem level. For management purposes, impacts at population, community and ecosystem level are most important.

endangered or vulnerable species (see box 4.5 for definitions),

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

There is temporal and spatial variation in the vulnerability of specific areas, resources and species to different environmental pressures. For example, a species that is particularly vulnerable to acute oil pollution is not necessarily vulnerable to bycatch or to long-range transboundary pollutants. This is discussed in more detail for each of the areas described below.

It is not possible to delimit the particularly valuable and vulnerable areas precisely, but figure 3.5 indicates the approximate extent of the most important of these areas.

3.2.2 The area from the Lofoten Islands to the Tromsøflaket, including the edge of the continental shelf

Nutrient-rich Atlantic water flows into the area along the edge of the geological continental shelf, and supports high phytoplankton production. This in turn provides food for grazing species and predators higher up the food chain, including zooplankton, fish, seabirds and marine mammals. A number of the species found in the area are key species in the Barents Sea ecosystem.

The geological continental shelf is relatively narrow in the area from the Lofoten Islands to the southern edge of the Tromsøflaket. The Norwegian coastal current is strongly influenced by the topography of the seabed, and is therefore narrow and strong in this area. As a result, organisms at all levels of the marine food chains are more concentrated within a limited area than elsewhere along the coast. An example is the spatial and temporal concentration of eggs and larvae of various species, including the most important commercial fish species in the Northeast Atlantic. As a result, fish at the most sensitive stages of their life cycle are more vulnerable to external pressures than in areas where biological production is not so concentrated, but spread across a larger area. Mature fish also migrate back to their spawning areas in this current system.

In addition, the rich supplies of easily available food make this an important breeding, moulting and wintering area for seabirds. Seabirds forage up to 100 kilometres beyond the baseline. Many of the islands along this stretch of coastline provide important nesting sites for seabirds such as Atlantic puffin, razorbill, common guillemot, black-legged kittiwake and European shag. Puffin numbers on Røst, at the southern end of the Lofoten Islands, have dropped to only 27 per cent of the 1979 level, and there has also been a serious decline in the common guillemot population in recent decades. The reasons for the decline in these populations are described in Chapter 7.6.3.3. The Lofoten and Vesterålen Islands are a particularly important wintering area for species such as common eider, king eider, yellow-billed diver, black guillemot and great cormorant. The area also supports large populations of herring

gull, great black-backed gull, Eurasian oyster-catcher and common gull. In addition, this is one of the areas that is important for the lesser black-backed gull (subspecies *Larus fuscus fuscus*). This subspecies has shown a dramatic decline and has almost disappeared from Norway.

Marine mammals such as the grey seal, common seal, common porpoise and killer whale occur all along the coast. Grey seals are only gregarious during the whelping and moulting seasons, whereas common seals are found in colonies throughout the year. Porpoises live in small groups and are also relatively stationary, but the distribution of killer whales varies more through the year. In winter they are found in coastal waters, while in summer they are more scattered in the Norwegian Sea and Barents Sea.

The strong current along the edge of the continental shelf makes this a highly suitable habitat for sponges (for example *Phakelia*), anthozoans (for example dead man's fingers) and large coral reefs. Røstrevet is a coral reef on the edge of the continental shelf 110 km west of Røst in the Lofoten Islands. This is the largest known reef of the stony coral *Lophelia pertusa*, and is therefore particularly valuable. Coral reefs are large biological structures that support high biological diversity. Despite the fact that there have been few studies of animals associated with these reefs, more than 600 species have already been identified. The commonest fish species on coral reefs are tusk, ling and redfish. There are generally more fish on the reefs than in adjacent areas. Given the high species diversity of coral reef communities, there may also be unknown genetic resources associated with them.

The deep-water trench Bleiksdjupet cuts across the continental shelf towards the northern end of Andøya. This carries deep-water species into the area from the Norwegian Sea, and results in particularly high species diversity.

The Lofoten Islands are on the Tentative List submitted by Norway to UNESCO for possible inclusion on the World Heritage List, partly on the basis of the 1000-year long unbroken tradition of the spawning-season cod fishery in the islands (see Chapter 4.7).

In connection with the work on a national marine protection plan, an advisory committee has proposed the establishment of several protected areas in the Lofoten-Tromsøflaket area, see Chapter 4.7.

The characteristic features of the area from the Lofoten Islands northwards to the Tromsø-

flaket make it vulnerable with respect to variations in food supplies, acute oil pollution and physical damage. See Chapter 5 for further discussion of environmental pressures.

This area is highly valuable throughout the year for different species. Any negative environmental pressures in the area, at any time of year, are liable to have major impacts that may last for several years.

This is considered to be one of the most important areas along the Norwegian coast in terms of environment and natural resources. It is a particularly valuable and vulnerable area, and houses a number of species that are vulnerable at different times of year.

3.2.3 The Tromsøflaket bank area

The Tromsøflaket is a large bank area with high biological diversity at the entrance to the Barents Sea proper. It is bounded in the north by the Bjørnøyrenna Channel and in the west and southwest by the edge of the continental shelf, which here drops steeply to the deep waters of the Norwegian Sea. The current systems are strongly influenced by the topography of the seabed, which creates eddies, so that the water masses have a relatively long residence time over the Tromsøflaket. This gives longer retention times for fish larvae and other organisms drifting more or less passively with the water masses, and also for non-living material, which means that they are exposed to negative pressures for longer periods. Larvae of commercially important fish species such as cod, herring and haddock are among those that may be affected. In years when the capelin spawning stock has a more westerly distribution, the Tromsøflaket can be an important area for their larvae. Capelin is a key species in the ecosystem.

The high concentration of biomass on the Tromsøflaket also supports large numbers of birds, and this is an important breeding and wintering area for seabirds. Some of Norway's largest and most important seabird colonies are found on the nearby coastline, including large populations of auks and a relict population of the threatened lesser black-backed gull (subspecies *Larus fuscus fuscus*), which are dependent on the rich food supplies.

There are large and important sponge communities on the Tromsøflaket, and there are probably coral reefs at the edge of the deeper areas. Species diversity is known to be high in sponge



Figure 3.6 The stony coral *Lophelia pertusa* is the only reef-building coral in the Northeast Atlantic. New coral reefs are still being found along the Norwegian coast, where they mainly occur at depths between 200 and 600 metres.

Source: Photo: Erling Svensen

communities, and they are therefore believed to be of great ecological importance for fish and many other organisms.

The characteristic features of the Tromsøflaket make it vulnerable to physical damage to the seabed and also to variations in food supplies and acute oil pollution. See Chapter 5 for further discussion of environmental pressures.

This area is highly valuable throughout the year for different species. Any negative environmental pressures in the area, at any time of year, are liable to have major impacts that may last for several years.

The area is important in terms of biodiversity and is very important for fish such as cod, herring and capelin. It is therefore considered to be particularly valuable, and houses a number of species that are vulnerable to negative pressures at different times of year.

3.2.4 50-km zone outside the baseline from the Tromsøflaket to the border with Russia

The waters near the coast provide a productive environment with high biodiversity. There are large fish stocks, and extensive fisheries along the coast for much of the year.

The rich biological resources are of particular benefit to seabirds, which are found in large concentrations in the area. Seabirds forage up to 100 kilometres beyond the baseline. The inner part of the Varangerfjord (Finnmark county) is an important wintering area for Steller's eider, common eider, king eider and long-tailed duck. The Steller's eider is the rarest diving duck in the world, and 5–10 per cent of the world population winters in the fjord, which is also a moulting area for Norwegian and Russian populations of common eider, king eider and other sea ducks.

Marine mammals such as the grey seal, common seal, common porpoise and killer whale also

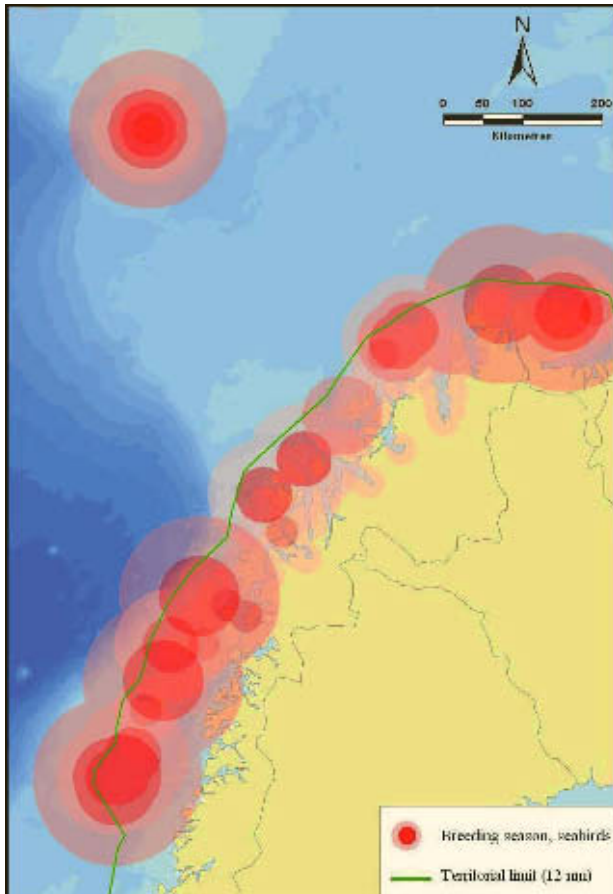


Figure 3.7 Areas that are particularly valuable for seabirds from the Lofoten Islands to the border with Russia

Source: Expert group report on vulnerable areas and conflicts of interest (April 2005)

occur along the whole coastline. See section 3.2.2 for more details.

The Institute of Marine Research has recently found coral reefs in near-shore areas in Loppahet, in the western part of Finnmark county. Further surveys will be needed to find out whether there are coral reefs further east along the coast of Finnmark.

The characteristic features of the waters near the coast make them particularly vulnerable with respect to variations in food supplies and to acute oil pollution. See Chapter 5 for further discussion of environmental pressures.

This area is highly valuable throughout the year for different species. Any negative environmental pressures in this area, at any time of year, are liable to have major impacts that may last for several years. The area is particularly valuable and houses a number of species that are vulnerable to negative pressures at different times of year.

3.2.5 The marginal ice zone

The marginal ice zone is an extremely productive ecosystem within the Barents Sea. The ice melts and retreats during the summer, creating particularly favourable conditions for phytoplankton, and high production (primary production). This supports zooplankton, which in turn is grazed by other species further up the food chain. The phytoplankton bloom is intense, but partly because the water is so cold, only limited quantities of zooplankton are present to feed on it. Much of the phytoplankton production therefore sinks to the bottom, where it can be utilised by benthic animals. Capelin and polar cod are the main fish species that feed on production in the marginal ice zone. When the capelin return to the coast of Finnmark to spawn in spring, they transport part of the biological production from the marginal ice zone to coastal waters. Production in the marginal ice zone also attracts large numbers of seabirds and marine mammals. In addition, many seals haul out and whelp on the sea ice. The whole production system follows the ice northwards during the spring and summer. The combination of high biodiversity and high production makes this area particularly valuable.

The varied fauna associated with the algal bloom in the marginal ice zone, in particular the large concentrations of seabirds found there, makes this ecosystem vulnerable to acute oil pollution, hazardous substances and climate change. Phyto- and zooplankton production is concentrated in surface waters in a zone that is 20–50 km wide and where the temperature is low. This means that the concentrations of grazing species can be very high, and that seabirds in particular are vulnerable to acute oil pollution at certain times of year. Some hazardous substances also bioaccumulate very effectively in the short food chains in this ecosystem, so that seabirds and marine mammals at the top of the food chains are particularly vulnerable to their effects. In the longer term, large-scale climate change may change the ecosystem of the marginal ice zone and its distribution.

3.2.6 The polar front

The polar front is the zone where warm Atlantic water meets cold, less saline Arctic water. It winds across the whole of the Barents Sea to the Norwegian Sea and further westwards. It shows some seasonal movement, but the position of the

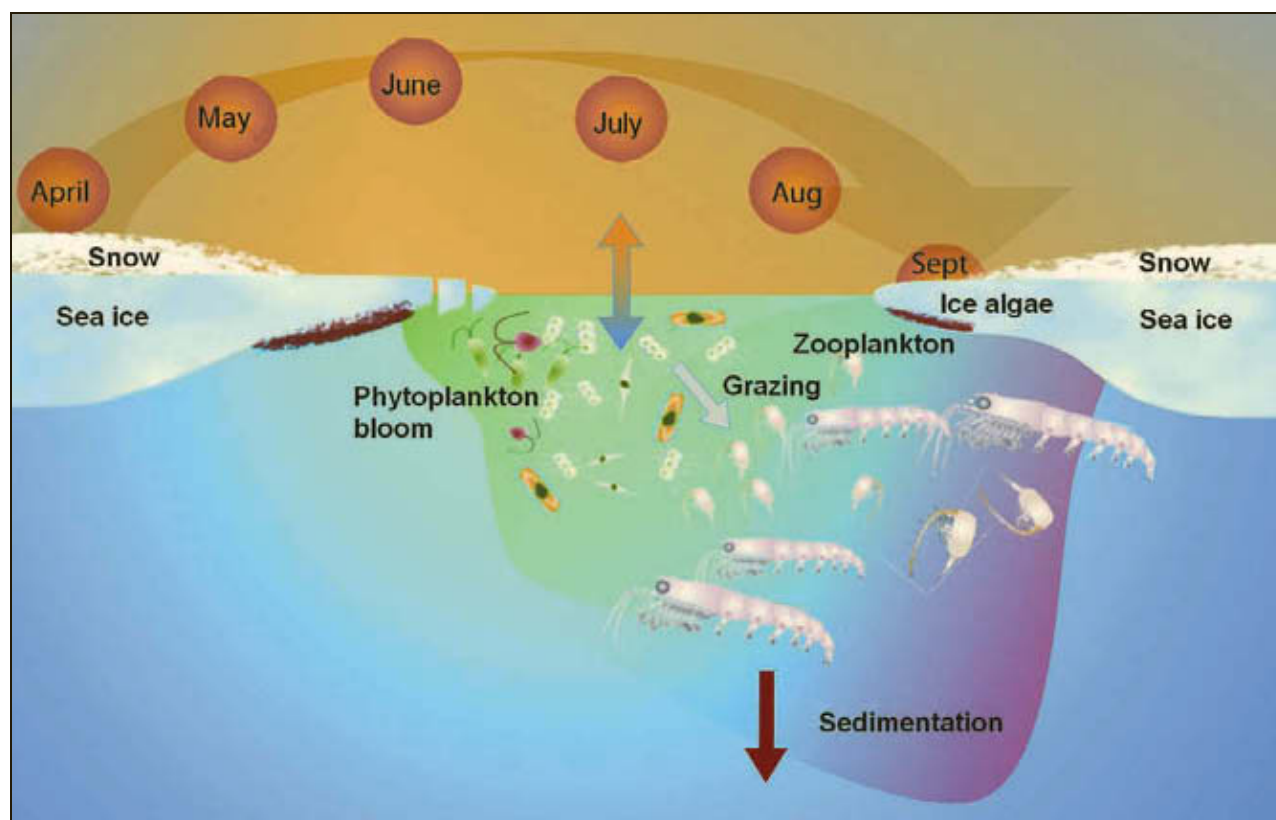


Figure 3.8 Phyto- and zooplankton production is concentrated in the surface waters in the 20–50 km wide marginal ice zone. The whole production system follows the ice northwards in spring and summer

Source: Paul F. Wassmann, Norwegian College of Fishery Science, University of Tromsø

western part is determined by the seabed topography. Variations in the position of polar front from one year to another are related to differences in the balance between Atlantic and Arctic water. The polar front is valuable both because it is a limited area with a high concentration of biological production and because it supports high biodiversity. Nutrients are released in or transported to the upper part of the water column, where they form the basis for high primary production (phytoplankton production). This supports high production of zooplankton such as krill and copepods, which in turn are food for other organisms higher up the food chain, including fish, seabirds and marine mammals. There is a particularly rich benthic fauna that feeds on the large quantities of nutrients that sink to the bottom. The polar front also provides a large proportion of the food supplies for the large seabird populations in the area Hopen–Storfjorden (Svalbard)–Bjørnøya, and is a very important foraging area throughout the year. Auks moult out at sea, and the polar front is believed to be an important moulting area.

The ecosystem of the polar front, particularly the seabirds, is vulnerable to variations in food supply, acute oil pollution, and climate change. Species that winter in the area may also be affected by these pressures. Climate change may result in changes in the distribution of species.

Organisms at all levels of the food chain are concentrated along the narrow polar front. As a result, any negative environmental factors that affect the polar front may have an impact on a substantial proportion of the populations of various species.

3.2.7 The waters around Svalbard, including Bjørnøya

The archipelago of Svalbard consists of many islands of all sizes, the largest being Spitsbergen, Nordaustlandet, Edgeøya, Barentsøya and Prins Karls Forland. Svalbard also includes Bjørnøya and Hopen south and south-east of the main group of islands. The territorial limit off Svalbard has been extended to 12 nautical miles, and 84 per cent of the territorial waters around Svalbard are now protected.

The rich bird and animal life of Svalbard is largely concentrated along the coast and associated with the marine environment and drift ice. Most animal life and a good large proportion of the plant life of Svalbard is directly or indirectly dependent on nutrients from the sea. Several million seabirds breed in Svalbard, particularly in the southern and western parts of the archipelago, which face the productive parts of the Barents Sea. The drift ice is an important habitat for species such as polar bear, walrus, bearded seal and ringed seal. In addition, the west coast of Spitsbergen is home to the world's most northerly population of common seal. This is a small, isolated population concentrated in a limited area, and is therefore very vulnerable to external pressures. Edgeøya and the Tusenøyane islets in the southern part of the archipelago are important areas for walrus and the vulnerable Svalbard population of brent goose. There are many walrus haul-out sites around Svalbard. Egdeøya is an important area for walrus in summer, while the areas south-east of the Tusenøyane and around Hopen are particularly important in winter.

Bjørnøya lies within a loop of the polar front. Around the island, there are large shallow-water areas with a characteristic benthic fauna that has relatively few species but a high biomass, and a well-developed kelp forest. Bjørnøya is a key area for seabirds in the Barents Sea, and is home to some of Europe's largest breeding colonies of Brünnich's and common guillemots. It is also the only place in Norway where yellow-billed divers are known to breed. In addition, the island has large populations of fulmar, kittiwake and glaucous gull, and the largest colony of great skua in the Barents Sea region. In addition to seabirds, several bird species that breed in the wetland areas feed at sea. Just before and after the breeding season in particular, species such as divers spend long periods at sea close to Bjørnøya. The island is also very important as a staging and moulting area for the Svalbard population of barnacle geese during the autumn migration. During the moult, all the eider species, geese and auks gather in large moulting flocks and are therefore vulnerable. Auks are flightless for 45–50 days during the moult.

Several of the species found in this area are of national or international importance and are categorised as red-list species, species for which Norway has special responsibility, key species in the ecosystem or indicator species. This applies, for example, to the Brünnich's guillemot, common

guillemot and kittiwake. Bjørnøya is therefore of both national and international importance in conservation terms, and a nature reserve has been established covering the whole island and its territorial waters.

The waters around Svalbard, including Bjørnøya, are vulnerable with respect to variations in food supply, acute oil pollution, hazardous substances and climate change.

3.3 The underwater cultural heritage

The underwater cultural heritage includes all traces of human activity that are now in or under water, for example remains from shipwrecks and aircraft crashes, and sites that are now submerged. The cultural heritage is non-renewable: in essence, adverse impacts on the cultural heritage are irreversible, so that any damage results in a permanent loss of value. The impacts of environmental pressures on the cultural heritage depend on the type and scale of pressure, and on the type of cultural heritage affected, its state of preservation and the nature of the surrounding environment.

The Norwegian cultural heritage authorities have only very limited information on the underwater cultural heritage of the Barents Sea. Although the cultural heritage on land has been systematically surveyed and registered, this has not been done for the underwater heritage. Nevertheless, historical and environmental indicators can be used to say something about the likelihood of finds in particular areas. A special feature of the Barents Sea is the concentration of a large number of wrecks from the Murmansk convoys of the Second World War. Ship-related finds are generally from wrecks, but there are cases where cargo or other material was lost but the ship itself did not sink. Ships usually sink in deep water as a result of bad weather conditions, ice damage or acts of war. If a ship is not driven ashore, it often sinks more or less intact, and is deposited, together with its contents, in a small area of the seabed. A find of this kind, in which the main structures and other objects are all from the same period and are found at a clearly defined site, can provide much more information than the more fragmented finds that are typical of wrecks along the coast. There may be submerged Stone Age sites along the coast of Finnmark, and cultural objects from earlier land-based activities in the coastal waters of Svalbard.

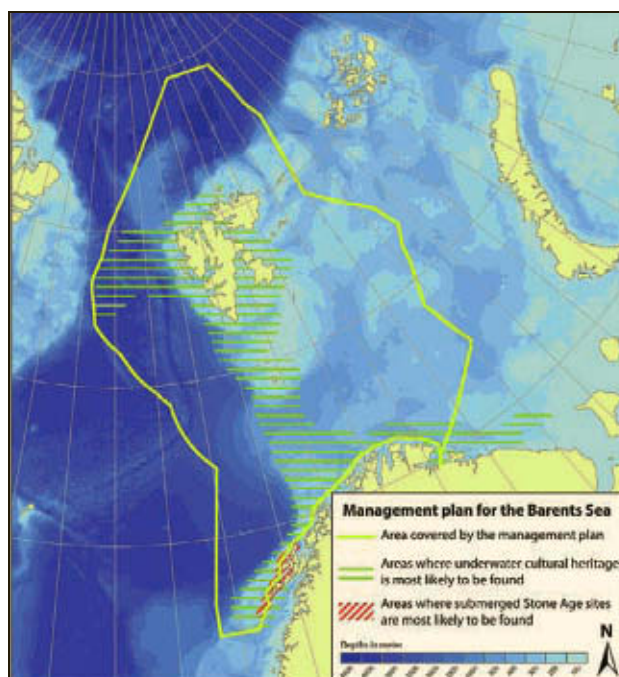


Figure 3.9 Areas where valuable underwater cultural heritage and submerged Stone Age sites are most likely to be found

Source: Expert group report on vulnerable areas and conflicts of interest (April 2005)

A database has been constructed that can be used to predict the likelihood of finding underwater objects and sites around Svalbard on the basis of indicators (information from the literature, old maps and archives). The database is maintained by the Governor of Svalbard and the Directorate for Cultural Heritage. The maritime and archaeological museums maintain archives and registers of underwater finds in the geographical areas of mainland Norway for which they are responsible. In 1993–94, priority areas for work on the underwater cultural heritage of the mainland coast were mapped, and information provided by the maritime museums and the marine archaeology departments of Tromsø Museum and the Museum of Natural History and Archaeology in Trondheim was used to identify areas where underwater cultural heritage was likely to be found, and where there was a high probability of conflict between cultural heritage considerations and planned developments or land-use plans. This map is intended as a working tool for the cultural heritage authorities, and is therefore revised regularly. The work on the establishment of a network of marine protected areas takes account of cultural heritage considerations, see Chapter 4.7, but does not involve any further registration of the cultural heritage.

3.4 Resources that support value creation

3.4.1 Living marine resources

3.4.1.1 Fisheries resources

Cod and capelin have always been important commercial species in the Barents Sea. The stock of Northeast Arctic cod is heavily dependent on capelin as food. Other important species in this area are herring, haddock, saithe, redfish and Greenland halibut. Substantial quantities of juvenile herring also occur in the Barents Sea in years when large year classes are recruited to the stock. In addition, there are large shrimp stocks. The most important spawning grounds for cod, herring and saithe are outside the Barents Sea. Redfish and Greenland halibut are to a large extent found along the continental slope. The extent of their distribution in the Norwegian Sea is uncertain. In recent years, blue whiting have penetrated more deeply into the Barents Sea from further south. In autumn 2005, the Institute of Marine Research estimated on the basis of its surveys that the total biomass of blue whiting in the western part of the Barents Sea was about 1.4 million tonnes.

The Directorate of Fisheries collects satellite tracking data from fishing vessels over 24 metres in length, which can be used to illustrate the level of activity in different areas. Figure 3.10 shows data for a whole year. The deepest red shading shows the areas where there was most activity at one or more times of year. In addition, there is a substantial coastal fishery using smaller vessels. Vessels fish in different areas depending on the type of fishing gear they use.

Cod

At the beginning of 2005, the total stock of Northeast Arctic cod was estimated to be about 1.6 million tonnes, and the spawning stock about 700 000 tonnes. Both these figures were about the same as in 2004. The spawning stock is above the precautionary level, but the catch is still too high. Illegal, unreported and unregulated fishing (IUU fishing) makes the stock estimates very uncertain. In 2002 and 2004, the total harvest in IUU fishing was estimated at 90 000 tonnes, and the estimate for 2003 was 115 000 tonnes. The estimate for 2005 is not yet available. In 2002, the Joint Norwegian-Russian Fisheries Commission agreed on new rules for calculating the annual

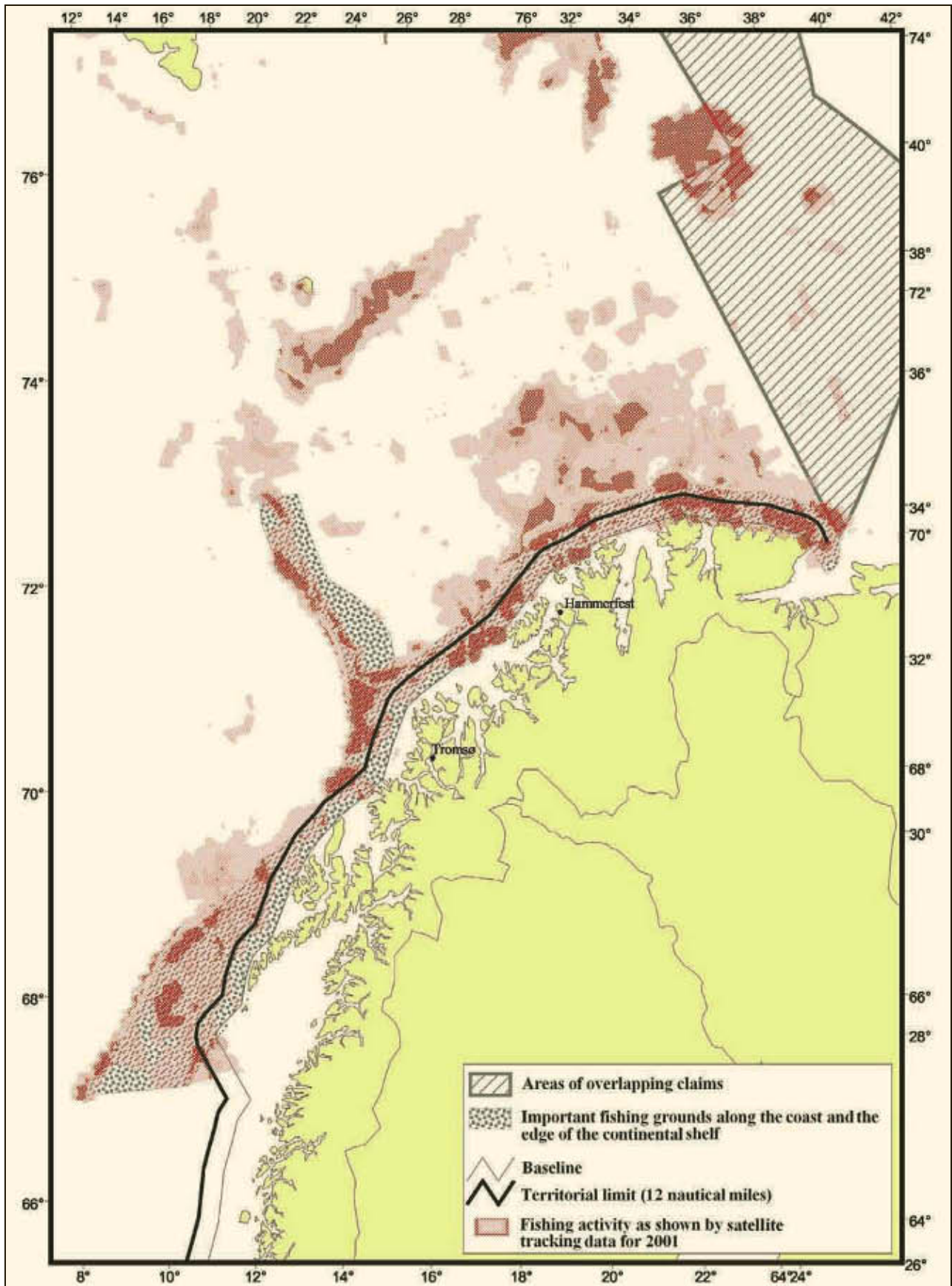


Figure 3.10 The most important fishing grounds and fishing activity as indicated by satellite tracking data from vessels over 24 metres in length

Source: Petroleum Directorate

total allowable catches (TACs) for cod. These have now been evaluated by the International Council for the Exploration of the Sea (ICES), which found that a management plan based on these rules would be in agreement with the precautionary approach. The TAC for 2005 was set at 485 000 tonnes in accordance with these rules. On the same basis, ICES has recommended that the total harvest in 2006 should not exceed 471 000 tonnes. The Joint Norwegian-Russian Fisheries Commission agreed to set the TAC at this level.

Haddock

At the beginning of 2005, the total stock of North-east Arctic haddock was estimated to be about 370 000 tonnes, and the spawning stock about 140 000 tonnes. Recruitment to the stock is satisfactory, and it is expected to remain at a high level in the next few years. The spawning stock is now well above the precautionary level, but fishing mortality in 2004 was estimated to be around the precautionary limit. At its 2002 meeting, the Joint Norwegian-Russian Fisheries Commission also agreed on rules for calculating the annual TACs for haddock. These have not yet been evaluated by ICES, but preliminary analyses carried out by the Institute of Marine Research indicate that they should probably be modified to be in agreement with the precautionary approach. The TAC for 2005 was set at 117 000 tonnes in accordance with these rules. ICES recommended a TAC of less than 106 000 tonnes. For 2006, ICES has recommended that the total harvest in 2006 should not exceed 112 000 tonnes. At its 2005 meeting, the Joint Norwegian-Russian Fisheries Commission agreed on a TAC of 120 000 tonnes.

Capelin

In September 2005, the Institute of Marine Research estimated the capelin stock in the Barents Sea to be about 240 000 tonnes, of which the maturing component accounted for about 160 000 tonnes. The stock is still considered to have reduced reproductive capacity. ICES concluded that even with no fishery, it was highly probable that the stock at the time of spawning (April 2006) would be below the critical reference point (200 000 tonnes). It therefore recommended that no capelin should be fished in the Barents Sea in 2006, and in accordance with this advice, the Joint Norwegian-Russian Fisheries Commission set a zero TAC for 2006.

Greenland halibut

The stock of Greenland halibut has been growing slowly in recent years, but is still low compared with historical figures. Fishing mortality has been slightly below the long-term average for the past two years, but IUU fishing results in a high level of uncertainty in the figures for this species as well. Recruitment has been stable but low since 1990. The growth of the stock is so slow and the estimates so uncertain that ICES has recommended keeping the harvest below 13 000 tonnes, which is the average for the past few years. ICES has also advised that additional management measures should be introduced to control catches.

Redfish

Catches of both redfish species were extremely low in 2003 and 2004 (about 2500 tonnes of *Sebastes mentella* and 7000 tonnes of *S. marinus*). Stocks of both species are low, and the *S. mentella* stock is in particularly poor condition. Numbers of juvenile *S. marinus* are alarmingly low, and there has not been a single strong year class of *S. mentella* in the last 14 years. The slow growth and maturation of these species will limit how quickly it is possible to rebuild the stocks. ICES has recommended that the direct fishery for redfish should be stopped in 2006, and that strict restrictions should be introduced on bycatches of both mature and immature redfish in other fisheries.

Shrimps

The shrimp stock in the Barents Sea and Svalbard area has declined from 2003 to 2004 and is now at a low level. Weak recruitment to the stock was expected in 2005, keeping the stock at a low level. No management objectives have been adopted for this stock, and a TAC is only set for the catch in the Russian economic zone. ICES has recommended that the total catch should be restricted to around 37 000 tonnes until an increase in the stock size is observed. In accordance with this, Norway has reduced the number of fishing days in the shrimp fishery in the Barents Sea for 2006.

3.4.1.2 Marine mammals

Norway harvests the stocks of minke whale, harp seal and hooded seal that feed in the management plan area. The total minke whale quota for 2006

was set at 1052 animals. The Northeast Atlantic minke whale stock, which includes the animals caught in the Barents Sea, is estimated to number 80 500 animals. There are two stocks of harp seal, both of which feed in the area covered by the management plan. The stock in the East Ice numbers 1.8 million animals aged one year and older, while the corresponding figure for the stock in the West Ice is 350 000. The current harvest level will ensure continued growth in both stocks.

3.4.1.3 Other living marine resources

The red king crab is an alien species that was introduced to the eastern Barents Sea in the 1960s and has now spread through coastal waters from the Kanin Peninsula in Russia westwards to about Hammerfest. Since 1994, there has been a crab fishery in both Norway and Russia, and the TACs for 2006 are 300 000 and 3 million crabs respectively. Red king crabs grow slowly and are sexually mature at about five years old. They are believed to live for more than 20 years. They spawn each year, and a female can lay up to 500 000 eggs, which hatch in spring and have a pelagic phase that lasts about two months. Fishing for red king crab is currently unrestricted west of 26 °E. East of this limit the crabs are managed as a joint Norwegian-Russian stock.

The Iceland scallop is an Arctic species that is found along the coast of North Norway, off Jan Mayen and in substantial quantities throughout the Svalbard fisheries protection zone. In the period 1985–92, 29 newly-built and converted vessels took part in a large-scale scallop fishery off Jan Mayen and Svalbard. The largest catch was taken in 1987, when 4 000 tonnes of scallop muscle was landed. The popularity of the fishery resulted in considerable overfishing. The dredging also had a substantial impact on other benthic organisms, and it is uncertain how long it will take

before these areas are restored to their original state. Iceland scallops grow slowly, particularly in the areas north of Svalbard, and it will therefore take many years before the scallop stock recovers. The most important fishing grounds for Iceland scallop were surveyed in 1996, and the Institute of Marine Research will carry out another survey in 2006.

3.4.2 Petroleum resources

3.4.2.1 Introduction

The continental shelf in the Barents Sea and off the Lofoten Islands consists of two different geological areas, or provinces. The shelf in the Barents Sea is further divided into a number of smaller geological areas, or exploration provinces, with very different geological histories and great geological variations. A considerable proportion of the petroleum resources in the area are still undiscovered.

At least 35 per cent of the total undiscovered resources on the Norwegian continental shelf are expected to lie in the waters off Lofoten and in the Barents Sea.

The estimate of undiscovered petroleum resources in the Barents Sea–Lofoten area is more uncertain than that for other areas on the continental shelf where there has been more activity. The estimate is therefore expressed with a range of uncertainty from low (P90) to high (P10), in addition to an expected value. As shown in Table 3.1, an increase in the high estimate of resources (P10) could result in a substantial increase in the resource base. The area is expected to yield larger finds of gas than of oil. Total undiscovered resources in the area are estimated at 1215 million Sm³ o.e. (oil equivalents): 485 million Sm³ liquid and 730 billion Sm³ gas (not including the area of overlapping claims).

Table 3.1 Petroleum resources in Norwegian sea areas expressed as Sm³ o.e. (oil equivalents)

Area	Liquid		Gas		Total	
	Expected value	High estimate	Expected value	High estimate	Expected value	High estimate
Barents Sea	400	790	590	1120	990	1700
Norwegian Sea	410	620	810	1050	1220	1770
North Sea	690	850	500	600	1190	1390
Total	1500	1960	1900	2660	3400	4300

Box 3.2 Play analysis

The volume of undiscovered petroleum resources is estimated by a method called play analysis. A play is a geographically delimited area where geological conditions are reasonably uniform, so that the probability of finding oil or gas can be assessed for the area as a whole. A play is confirmed when petroleum is discovered in volumes that are producible with current technology; the play is described as unconfirmed before petroleum is discovered. There is always a certain degree of uncertainty attached to estimates of undiscovered resources, but this is smallest in areas that have been adequately surveyed and explored and highest in areas where knowledge of the geological conditions is relatively limited.

Table 3.1 shows risk-adjusted figures for resources in plays that have been confirmed by discoveries. There are a number of plays in the Barents Sea where no exploratory drilling has yet been conducted. If we assume that all the identified plays are confirmed, the estimated volumes of undiscovered resources will be those shown by the tallest bars in Figure 3.11. Thus the figure illustrates the high scenario for the resources in the Barents Sea.

So far, there has been little or no exploration of most of the exploration provinces on the Barents continental shelf, but a few (the Hammerfest Basin, the Tromsø Basin and parts of Loppfødga) have been explored to some extent. The continental shelf off the Lofoten Islands is geologically quite different, and here too, there has been little exploration. On this part of the shelf most interesting area is a classic play with rocks from the early and middle Jurassic. The geological shelf in this area is narrow and the exploration province is therefore limited in size, but it has great potential.

3.4.2.2 The continental shelf off the Lofoten Islands

Parts of Nordland VI were opened for exploration in 1994 in connection with the impact assessment for the mid-Norwegian shelf, and in 1999 one exploration well was drilled.

Seismic data coverage in the area varies widely: it is relatively good in the eastern parts,

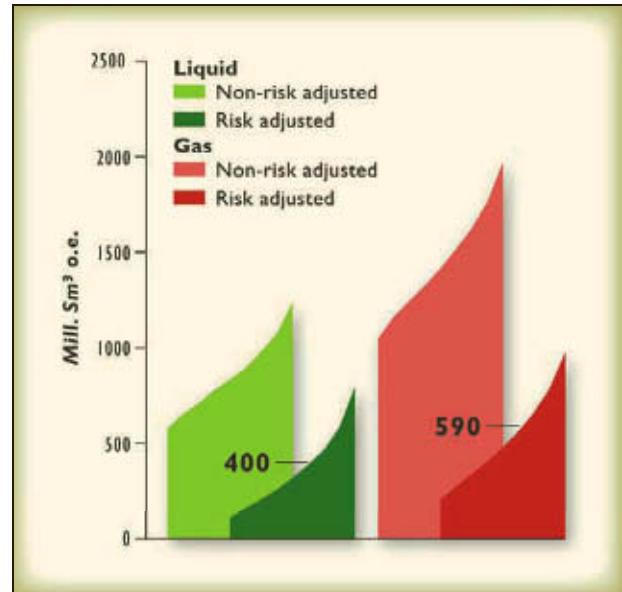


Figure 3.11 Estimates of total undiscovered liquid and gas resources in the Barents Sea

Source: Norwegian Petroleum Directorate

but low in the northwestern parts of Nordland VI. The quality of the data also varies a great deal. A number of prospects and possible prospects have been identified, and the potential in these areas is estimated to be considerable. In most of these areas the source rocks lie so deep that hydrocarbons are most likely to be found in the form of gas. However, the smaller and shallower basins are expected to hold source rock that could result in oil discoveries.

Figure 3.12 shows the areas off the Lofoten and Vesterålen Islands that are currently considered to have the greatest potential for petroleum resources. The map shows plays at the Jurassic and Cretaceous levels. Discoveries are possible in all the areas where plays have been identified, but on the basis of existing seismic data coverage and data quality, there is a greater density of prospects and possible prospects in some areas than in others. This situation could change when new and better seismic data are available.

Exploration activities have been in progress in the Barents Sea for a long time, but no production has yet been started. Parts of Tromsøflaket were opened for petroleum activity in 1979, and the first production licences were granted in 1980. The area around Tromsøflaket was extended in 1985, and the Barents Sea South was formally opened for exploration in 1989 after the first comprehensive impact assessment on the Norwegian continental shelf had been carried out pursuant to the

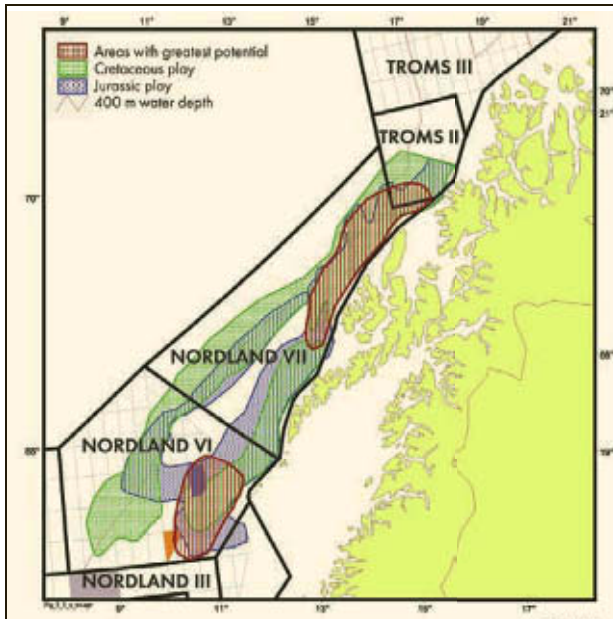


Figure 3.12 Areas off the Lofoten and Vesterålen Islands that are currently considered to have the greatest potential for petroleum resources

Source: Norwegian Petroleum Directorate

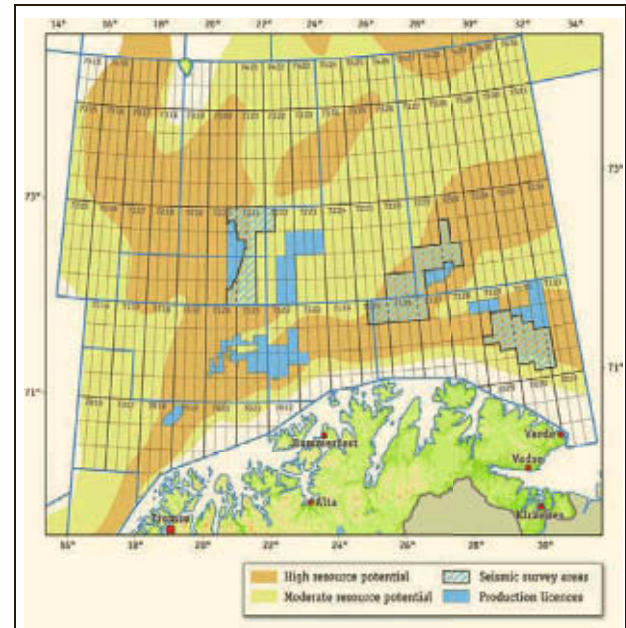


Figure 3.13 Areas in the Barents Sea considered to have the greatest potential for petroleum resources

Source: Norwegian Petroleum Directorate

Petroleum Act. By the first quarter of 2006 a total of 41 production licences had been granted and 64 wells had been drilled. A number of small and medium-sized discoveries have been made, mainly of gas. So far it has only been decided to develop one field, the Snøhvit gas field, which lies off Finnmark and consists of the Snøhvit, Albatross and Askeladd discoveries; production is expected to start in 2007.

Oil has also been discovered in the Barents Sea. Recently, oil was proven in deeper formations on the Goliat field, which has resulted in a considerable upwards adjustment of the resource estimate for the discovery. Discoveries were made in several geological formations at deeper levels than previously. As a result, a new play was proven in this part of the Hammerfest Basin.

Figure 3.13 shows the areas in the Barents Sea that are assumed to have the greatest potential for petroleum resources. There are no adequate surveys of prospects or possible prospects in the areas from the baseline out to 35 km, which means that the prospectability of these areas cannot be assessed. However, the possibility of discoveries being made in rocks of the Devonian, Carboniferous and Permian periods cannot be excluded, since there are important plays at these levels in the area.

3.4.3 The natural environment as a basis for value creation

In 2005 the group of experts appointed by the UN to conduct the Millennium Ecosystem Assessment published the results of its first four-year study, which investigated the state of global ecosystems and their impact on human well-being. In their report they point to the essential role played by ecosystem services in the welfare of humanity. This means that knowledge of the workings of ecosystems and the importance of natural assets is essential for the sustainable management of natural resources.

Tourism in Norway's three northernmost counties relies on natural assets that cannot be quantified in the same way as the resources utilised by other industries. Norway is famous for Hurtigruten (the Norwegian coastal steamer service), the Lofoten Islands and Svalbard, for the midnight sun, the magnificent scenery and the traditional culture of the fishing villages along the coast. A further attraction is the clean, rich waters off the coast, which are a source of value added for the industries of the region. Tourists are attracted by the opportunities for fishing, sampling the fresh seafood and observing marine mammals and seabird colonies. Thus the tourist industry depends heavily on the environmental



Figure 3.14 From the Lofoten Islands

Source: Institute of Marine Research (photo: Hans H. Stockhausen)

values of these waters. The employment and economic benefits brought by the tourist industry are described in more detail in sections 3.5.2 and 3.5.3.5.

3.4.4 Other industries

In addition to their direct economic benefits, the fisheries and petroleum industries have spin-off effects for the whole region. This applies especially to suppliers, but also to other sectors like transport, hotels and restaurants. The effects will vary considerably at the local and regional level, and will be studied more closely in a separate project under the auspices of the Ministry of Local Government and Regional Development (see Box 3.3). The value of the management plan area for maritime transport is described in more detail in section 3.5.3.4.

3.5 Socio-economic conditions

3.5.1 Population and settlement

The three northernmost counties of Norway recorded steady population growth in the period 1950–1982, but from 1982 to 2002 the population declined by 1.3 per cent, while the population of the country as a whole increased by 10 per cent. Over the last few years the trend has been stable, and the current population of the three northernmost counties is about 460 000. The population trend in North Norway is mainly influenced by the relation between inward and outward migration, which again is dependent on economic upturns and downturns. The relation between births and deaths is less important, although the

fertility rate in this region has declined more than in other parts of the country.

North Norway also has considerably fewer inhabitants in the 20–29 age-group than it had in 1980, and the proportion has decreased by 3 percentage points more than in the rest of the country. This means that the labour force is aging. At the same time there is a strong trend towards centralisation; densely populated areas are undergoing substantial population growth, while the population of large geographical areas with scattered settlements is declining and aging.

According to Statistics Norway's population projections, the trends towards centralisation and aging will intensify further towards 2020 unless there are radical changes in the framework conditions for the region. The population decline and tendency towards aging are more pronounced in Finnmark than in Troms or Nordland.

3.5.2 Employment

The employment figures for the region have not changed very much since 1980, and the total number of employed is currently about 225 000. Almost half of those in employment in North Norway work in the public sector.

However, during this period there has been a considerable shift in employment across industries, away from the primary industries (fisheries and agriculture), where the number of employed

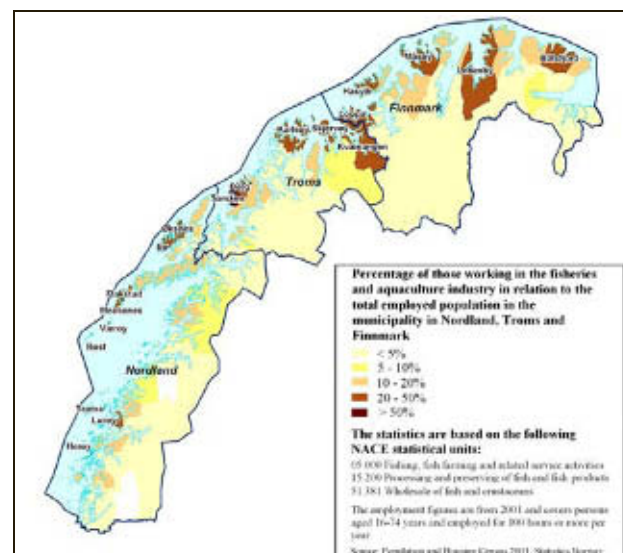


Figure 3.15 Percentages of those working in the fisheries and aquaculture industry in relation to the total employed population in the municipality in Nordland, Troms and Finnmark

Source: Directorate of Fisheries

has been almost halved. Only about 7 per cent of employed persons now work in the primary industries, although this is still twice the percentage of those working in these industries in the rest of the country. About 6000 people, 2.5 per cent of the employed, had fisheries as their main occupation in 2004. In addition about 1700 were employed in the aquaculture industry and 4000 in the fish-processing industry, including at salmon-slaughtering plants. Many of the fisheries- and aquaculture-related jobs, especially in Finnmark and Troms, are located in areas that are defined as vulnerable to further outward migration, and are thus dependent on fisheries.

The fisheries also generate a significant number of jobs in other industries, and almost 20 000 people have employment related to the fisheries and aquaculture sector in the three northernmost counties.

As regards employment in the service industries (retail, hotels and restaurants), there has been a sizable increase in North Norway during the period 1980–2004, as in the rest of the country, due to the general growth in prosperity. In 2004 about 16 per cent of those employed worked in the service industries, and tourism alone accounted for about 12 000 person-years. Roughly

10 per cent of employed persons work in the tourist industry in North Norway, which makes this industry relatively more important to this part of the country than to the country as a whole, where the figure is 8 per cent.

Local employment in the petroleum industry is linked to the Snøhvit field, which is under development. This is expected over the long term to provide 400–500 new jobs in Hammerfest, 160 of them at the LNG (liquefied natural gas) plant. Development of the field and exploratory drilling in the area will also provide temporary jobs. In the impact assessment of year-round petroleum activities in the Lofoten–Barents Sea area, three scenarios were established for future petroleum activities. These activities are predicted to generate between 1000 and 4000 person-years in North Norway, depending on the scenario. Petroleum activities will also generate jobs in other industries. The effects cannot be predicted with any great certainty, and will vary considerably at the local level. The Ministry of Local Government and Regional Development is conducting a project to study the effects of such activities.

Maritime transport, especially of goods for distribution, is of great importance for the coastal communities of Troms and Finnmark. About 3300

Box 3.3 Spin-off effects on land

The Government considers it important to ensure that activities in the Barents Sea have spin-off effects on land. An important element of its High North policy and its business policy is ensuring that North Norway benefits from the values generated by natural resources in the form of jobs, competence and activities.

There are a number of studies and scenarios concerning the development of North Norway:

- A study of the positive and negative effects of the development of the Snøhvit field has been conducted by the Norwegian Institute for Urban and Regional Research (NIBR) in Alta.
- ECON has developed a set of scenarios.
- Barlindhaug AS has produced a report entitled “Petroleumsvirksomhet i Barentshavet, utbyggingsperspektiver og ringvirkninger” (“Petroleum activities in the Barents Sea: development perspectives and spin-off effects”)
- A project concerning spin-off effects that includes studies by experts in the field is

being carried out under the auspices of the Barents Secretariat.

- A project is being conducted by Storvik & co for Norsk Hydro to build competence among contractors, which includes a survey of Norwegian and Russian contractors.
- Innovation Norway has intensified its work on the practical follow-up on High North issues.
- Priority is being given to High North studies by the Research Council of Norway.

The Ministry of Local Government and Regional Affairs intends to start a project to assess the spin-off effects on land of the activities in the Barents Sea. It will cover important industries like fisheries and tourism as well as petroleum-related industries. The project will include a review of previous studies and projects in this field.

persons in the three northernmost counties were employed in jobs related to shipping in 2003.

Fisheries and agriculture, often in combination with other industries, are central elements of Sami culture, and about 13 per cent of employed persons with a Sami background are estimated to have a primary industry as their main occupation. As in the rest of North Norway, this percentage has decreased substantially in the last 30 years, and considerable efforts are being made to provide jobs in other industries, especially in aquaculture and in the service industries, for example tourism. Reindeer husbandry is a small industry by national standards but has great importance, economically, culturally and in terms of employment, for the Sami and for local communities, and unlike the other primary industries, reindeer husbandry is steadily increasing. Most of the reindeer and reindeer herders are to be found in North Norway. Since reindeer husbandry forms an important part of the material basis of Sami culture, the state is obliged under the Norwegian Constitution and the rules of international law relating to minorities and indigenous peoples to safeguard the economic basis for this industry. Reindeer husbandry needs extensive areas, both because of the marginal nature of some of the pasture and because reindeer need to be able to use different areas at different times of year and to move between them. The present white paper does not cover land issues (see section 2.4).

As in the rest of North Norway, a very large percentage of the Sami population is employed in the public sector. Future downsizing of the defence establishment will have considerable consequences for the number of employees in the public sector.

Generally speaking the employment figures for the tourist industry are expected to increase up to 2020, and those for the primary industries to decrease further.

3.5.3 The economic importance of various industries

3.5.3.1 Introduction

There are other indicators besides employment figures that reflect the relative importance of different industries for the economy of the region. These include the value added in the national accounts, i.e. the production value minus the material input, the export value, and the turnover in the industry concerned. However, it is difficult to provide a precise indication of the economic importance of a particular industry, and for an

overview of the value added, reference is made to the national accounts by county that are drawn up annually by Statistics Norway. The aim here is to present some key figures for the industries in the northern areas together with the most important development trends.

3.5.3.2 Fisheries and aquaculture

The long-term value of the fish stocks is very high.

In 2004 the contribution to GDP of the core activities in the fisheries and aquaculture industry (fishing, fish farming, fish processing and wholesaling) was NOK 15.7 billion, with a turnover of NOK 49.6 billion. The spin-off effects of the industry contributed NOK 14.5 billion to GDP, with a turnover of NOK 36.2 billion. This means that the total contribution to GDP was NOK 30 billion, with a turnover of NOK 86 billion. The sums are more or less equally divided between the direct effects for subcontractors and the indirect effects for the business sector in general.

The landed value of the fisheries (the sum the fisherman receives for the catch) in the three northernmost counties was about NOK 4.3 billion in 2005. In 1990 the landed value was about NOK 2 billion at 1990 prices. The landed value has thus remained constant in spite of the steep decline in employment.

The value of fish farming in the three northernmost counties was about NOK 3.9 billion in 2004. The turnover in this industry is very cyclically sensitive.

The total value added for fishing, whaling and sealing, fish farming and fish processing for the three northernmost counties in 2002 was about NOK 4.8 billion: about NOK 2.4 billion for Nordland, NOK 1.2 billion for Troms and NOK 1.2 billion for Finnmark.

3.5.3.3 Petroleum activities

Petroleum activities are important both for economic growth and as a means of financing the Norwegian welfare society. The petroleum industry is Norway's largest industry. In 2004 it accounted for 21 per cent of total value added and almost 50 per cent of the value of exports. The net cash flow from petroleum activities was NOK 383 billion in 2005. In addition to providing the state with large revenues, petroleum activities in other parts of the country have been shown to result in extensive value creation at the local level.

The Petroleum Directorate has estimated that the total resources in the Barents Sea–Lofoten area amount to about 1 billion Sm³ o.e. At a price of NOK 300 a barrel o.e., this represents about NOK 1900 billion. The figures may be considerably higher or lower depending on the resource base and trends in the price of oil and gas.

In connection with the above-mentioned impact assessment of year-round petroleum activities in the area, various scenarios were developed for future trends in the level of activities. In the scenario “medium level of activity”, at prices assumed in the national budget for 2006, the gross earnings will be NOK 700 billion. The scenario covers a period of 40 years, and the average annual gross earnings during this period are expected to be NOK 17.5 billion. This does not include the development of or production from new discoveries with a start-up after 2020. Thus in terms of gross earnings, petroleum activities could have enormous importance for North Norway. Petroleum activities on the Norwegian continental shelf have generated particularly sound profits in excess of the normal compensation of labour and return on fixed assets. The profits can be tapped through taxation and thus benefit society as a whole. In addition to the direct value of petroleum activities, spin-off effects can be expected in the region, especially for suppliers, but also more generally, for example for the hotel and restaurant industry. The effects will vary considerably at the local and regional levels, and will be studied more closely in a separate project under the auspices of the Ministry of Local Government and Regional Development (see Box 3.3).

3.5.3.4 Maritime transport

Maritime transport is particularly important for coastal communities in Nordland, Troms and Finnmark counties, and is responsible for the largest proportion of goods distributed in the region. Some areas of North Norway are completely dependent on maritime transport of goods and passengers for the normal functioning of activities. This is treated in more detail in the 2003–2004 white paper on a national transport plan.

There are four main shipping lanes in the Barents Sea–Lofoten area (see Figure 3.16):

1. One is the coastal shipping lane. This is used by for example Hurtigruten, fishing vessels sailing along the coast, and local, regional and

national goods and passenger traffic. During the cruise season most of the cruise ships follow this lane. The lane is also used by a considerable number of ships in international goods traffic.

2. Another shipping lane runs along the area between the baseline and the territorial limit. This is mainly used by cargo vessels. The smallest vessels, with a length of less than 100 metres, sail closest to the coast, and often put into public or private port terminals in the area. Most of the cargo vessels measuring more than 100 metres come from northwestern Russia, and their main cargo is timber, followed by general cargo and dry bulk cargo.
3. Tankers sailing to and from north-western Russia sail about 12 nautical miles from the coast, i.e. along or just outside the territorial limit. There is mandatory routeing within the Norwegian territorial limit along the Vardø–Nordkapp stretch. These routes lie as close as possible to the territorial limit and ensure that there is a mandatory minimum distance from the coast for categories of vessels that represent a high pollution risk. The mandatory routeing does not prevent ships from sailing further from the coast, outside the territorial limit.
4. Maritime traffic to and from Svalbard consists predominantly of fishing vessels, which very seldom put into land at Svalbard. Mining activities on Svalbard also generate ship traffic, and a large proportion of cruise ships sailing in the coastal shipping lane visit Svalbard on their way north. They usually start the voyage at either Tromsø or the North Cape, and follow a route that ends at the other of these two destinations. For example, a cruise ship sailing from Tromsø would return to the North Cape and from there sail southwards along the coastal shipping lane. On their voyage to or from Svalbard these ships usually sail close to Bjørnøya.

The transport of iron ore from Kiruna, Sweden, which is first by rail to Narvik and thence by ship along the coast, accounts for a considerable share of the ship traffic through the region, and the cargos are large. The routes taken by these vessels touch the area of the management plan at its southernmost point.

The volume of petroleum products transported by sea in the High North is expected to increase considerably. In 2004, 12 million tonnes were shipped from northwestern Russia in 290

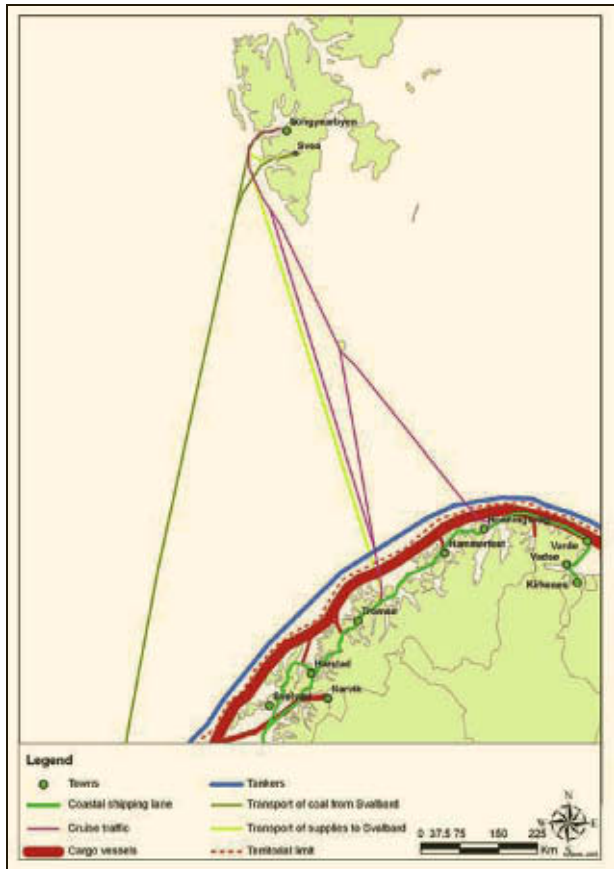


Figure 3.16 Map of the shipping lanes in the area of the management plan excluding those used by the fishing fleet

Source: Norwegian Coastal Administration

tankers. This transport is expected to increase to 36 million tonnes by 2015. If the plans for a pipeline from Siberia to Murmansk materialise, petroleum transport from Murmansk is expected to reach 150 million tonnes annually after 2015. Today oil tankers transporting oil from Russia have a cargo capacity of 15 000 to 100 000 tonnes, but up to 2015 the number of tankers with a cargo capacity of 300 000 tonnes is expected to increase considerably.

Norway is represented in most of the large markets for tankers, bulk carriers, and chemical and LNG tankers. Norwegian companies are also leaders in a number of offshore markets, and the

country has the largest offshore industry in the world after the US. This is the result of the natural resources and harsh weather conditions on Norway's continental shelf combined with the experience and competence gained by its maritime industries. Qualified designers, suppliers of high-quality equipment, experienced and knowledgeable seamen, and smoothly functioning financial markets have also made a major contribution to Norway's leading position. This competence will be invaluable in the development of activities in the Barents Sea, especially given the general tendency to continue raising environmental standards for maritime transport to ensure that it is environmentally sound.

The value represented by maritime transport in the area is difficult to estimate because of the international nature of the industry and the insufficiency of data. In addition to the earnings from fisheries and national goods transport, from which the whole country benefits, there are the revenues from international cruise traffic. It can be said that the total income from maritime transport is considerable, but that a large part of this income cannot be directly attributed to activities in the three northernmost counties.

3.5.3.5 Tourism

The total tourism-related turnover in Nordland, Troms and Finnmark, including transport, was NOK 11.8 billion in 2004. In 2002 the hotel and restaurant industry alone had a turnover of about NOK 3.8 billion. The relative importance of the turnover from tourism has grown during the last 20 years, but the industry is cyclically sensitive, with periods of decline caused by international conditions such as those after the 11 September attacks in 2001. The turnover is expected to increase substantially up to 2020 owing among other things to the growth in popularity of adventure holidays. The tourist industry is larger in Nordland than in Troms or Finnmark.

The hotel and restaurant industry in the three northernmost counties had value added amounting to about NOK 2 billion in 2002.

4 Main elements of the current management regime

4.1 Introduction

Norway manages the Barents Sea–Lofoten area within the framework of international law, including the international conventions to which Norway is a party.

The Ministry of the Environment has the main responsibility for national goals, management systems and performance monitoring in the field of environmental policy. The Ministry is also responsible for cross-sectoral environment policy instruments and plays a key role in coordinating the efforts of the ministries responsible for the different sectors. At national level, sectoral authorities such as the Ministry of Fisheries and Coastal Affairs and the Ministry of Petroleum and Energy have an independent responsibility to integrate environmental considerations into their management activities, for example by making use of sectoral policy instruments.

The Ministry of Fisheries and Coastal Affairs is responsible for the management of living marine resources and for Government policy as regards the fisheries industry, the aquaculture industry, seafood safety, fish health and welfare, maritime safety, maritime transport and the emergency response system for acute pollution. The harvesting of marine resources depends on the overall functioning of the ecosystems and thus requires extensive knowledge of the marine environment. The Ministry of Fisheries and Coastal Affairs therefore has the overall responsibility for R&D and monitoring of marine ecosystems. The Institute for Marine Research is the leading agency for knowledge generation in this field, which is also important for environmental issues beyond the Ministry's areas of responsibility.

The Ministry of Petroleum and Energy is responsible for the management of Norway's petroleum resources.

The responsibilities of the Ministry of Trade and Industry include maritime safety and legislation relating to ships and crews. The Ministry is also responsible for Norwegian activities within the framework of the International Maritime Organization (IMO).

The Ministry of the Environment is responsible for the management of biodiversity, the regulation of polluting activities and private and municipal emergency response systems. The Ministry is also responsible for environmental issues linked to the shipping industry.

In the petroleum sector, the Ministry of Labour and Social Inclusion has the overall responsibility for preventing accidents that may lead to pollution and for the emergency response system for fighting pollution at source. Thus, responsibility for the management of the Barents Sea–Lofoten area is split between a number of ministries and subordinate agencies.

Common national goals and a clear division of responsibility between different authorities are needed in order to put the principle of sectoral responsibilities into practice. And in order to implement an integrated, cross-sectoral policy, coordination and overall assessment by the public administration must first be established.

It is not possible to give a detailed review of all the elements of the current management regime for the Barents Sea–Lofoten area in this general plan. Activities and natural resource management in the area are governed by a wide range of international agreements, national regulations, guidelines, plans, programmes and economic policy instruments. A large body of international law is in place to safeguard biodiversity and prevent pollution. Furthermore, the concept of the "ecosystem approach" has been developed and incorporated into a number of international agreements in the course of the past ten years, and plays a central role in the implementation of the Convention on Biological Diversity. Under this Convention, general criteria have also been developed for the implementation of an ecosystem-based management regime (the Malawi principles), which Norway has adopted.

Some parts of the current management regime are based on general policy instruments, while others have been adapted especially for the Barents Sea–Lofoten area. The presentation below is only intended to give an outline of its main features.

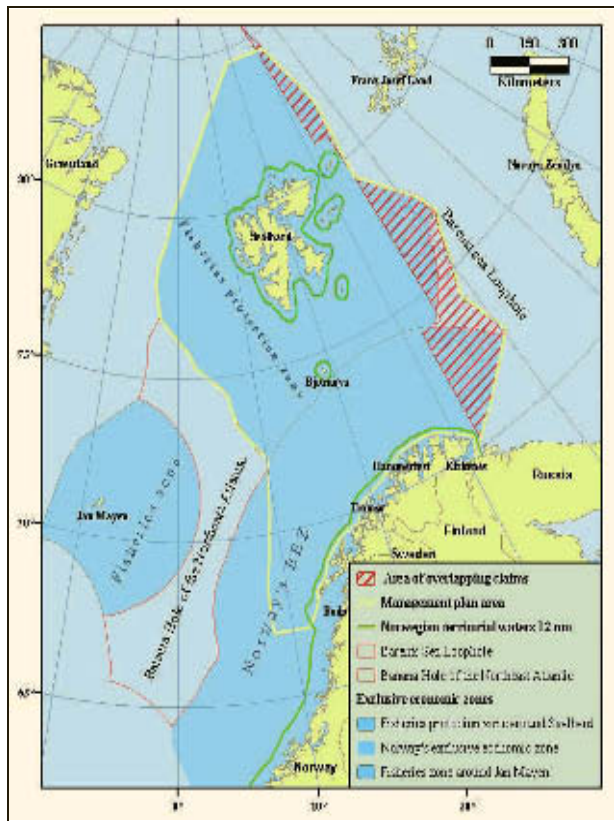


Figure 4.1 Norway's exclusive economic zone. Norway has established three 200-nautical-mile zones: the Norwegian economic zone off the mainland, the fisheries protection zone around Svalbard and the fisheries zone around Jan Mayen. The Loophole and the Banana Hole are international waters.

Source: Norwegian Coastal Administration

4.2 Law of the Sea

The 1982 United Nations Convention on the Law of the Sea, which Norway has adopted, entered into force in 1994 and lays down fundamental international rules for all maritime activity. It therefore also constitutes the overall legal framework for activities in and the management of the Barents Sea–Lofoten area. It establishes rights and duties that apply to Norway as a coastal state regarding jurisdiction over maritime transport, utilisation of living resources and petroleum resources, and environmental protection. The Convention also provides the international legal basis for the establishment of Norway's 12-nautical-mile territorial limit and 200-nautical-mile exclusive economic zone, the 200-nautical-mile fisheries protection zone around Svalbard, and for

determining the extent of the Norwegian continental shelf.

4.3 The fisheries

The Convention on the Law of the Sea gives coastal states the right to establish exclusive economic zones (EEZs) stretching up to 200 nautical miles from the baseline and gives them sovereign rights to natural resources in these zones. The Convention sets out principles for management of such zones and the rights and duties of coastal states and other states. It makes a distinction between management within and outside the zones. Within the zones, coastal states must ensure that management and conservation of fisheries resources are based on the best available scientific evidence and that living resources are not endangered by over-exploitation. Where a coastal state does not have the capacity to harvest the entire allowable catch, it shall give other states access to the surplus.

The 1995 United Nations Fish Stocks Agreement elaborates on and strengthens important provisions of the Convention on the Law of the Sea. The agreement provides a firm basis in international law for applying the precautionary principle to fisheries management and contains provi-

Box 4.1 ICES – determination of spawning stock and fishing mortality reference points

The International Council for the Exploration of the Sea (ICES) sets reference points for the levels of spawning stocks and fishing mortality to ensure that the stocks are harvested within safe biological limits. These reference points are based on statistical calculations using historical stock data. Precautionary reference points are used to allow for uncertainties in the calculations. These reference points have been used as the basis of a system whereby catches are reduced if a spawning stock is approaching a level where it suffers reduced reproductive capacity. ICES is working on the development of target reference points for individual fish stocks. These will make it easier to draw up harvesting strategies and to ensure that stock sizes do not fall below safe biological limits.

sions for implementing this principle. The agreement also requires States to establish regional cooperation arrangements for fisheries management and provides for more effective enforcement of fisheries regulation. The agreement entered into force on December 2001 and is important for the development of new principles for marine resource management and their practical implementation. The agreement has also played an important part in the development of regional fisheries cooperation.

Historically, the living marine resources in the Barents Sea–Lofoten area have been harvested by several nations, and Norway and Russia, as the coastal states, have been the most important of these. They also have the main responsibility for the management of these resources today.

The International Council for the Exploration of the Sea (ICES) was established in 1902 in response to scientific questions and uncertainty about catches and fluctuations in the major fish stocks. ICES now has many working groups and committees that provide scientific advice on the state of and outlook for fish stocks. Annual negotiations on total allowable catches are based on recommendations from ICES. ICES has worked on ways of translating the precautionary approach set out in the UN Fish Stocks Agreement into operational advice and has been giving management advice on this basis since 1998, see box 4.1.

Norway and Russia have been members of ICES since its establishment in 1902. This is an important factor behind the close cooperation between Norway and Russia in environmental and resources issues. In 1957 an agreement on research cooperation was signed between Norway's Institute for Marine Research in Bergen and the Russian marine research institute PINRO in Murmansk. This included coordination of research cruises, which has now been developed into a system of joint ecosystem surveys, see box 8.2.

The establishment of the Joint Norwegian-Russian Fisheries Commission in 1975 provided a political basis for the joint management of living marine resources, based on the principles that harvesting must be sustainable and that it must be as predictable as possible. The scope of this cooperation has gradually been extended and now includes practical aspects of management and control and enforcement issues. In 1993, the Permanent Russian Norwegian Committee on Fisheries Management and Control was established under the Commission. This led to the introduc-

tion of reciprocal arrangements for satellite tracking of fishing vessels, and work is now in progress on control and enforcement measures, for example in connection with transshipment of fish in the Barents Sea.

Some of the stocks that are harvested in the Barents Sea–Lofoten area are also fished in areas outside Norwegian and Russian jurisdiction. The regulatory area of the North East Atlantic Fisheries Commission (NEAFC) is outside the 200-nautical-mile zones of individual states. The primary function of the Commission is to coordinate the regulation of fisheries for stocks that migrate between different countries' exclusive economic zones and international waters. The coastal states have negotiated a special regional arrangement for Norwegian spring-spawning herring and blue whiting, while the international component of these stocks is managed by NEAFC. The conclusion of the UN Fish Stocks Agreement has increased the importance of such regional agreements, not least as regards enforcement of fisheries legislation. NEAFC has thus implemented a comprehensive system for satellite tracking of fishing vessels in the Northeast Atlantic. The Northwest Atlantic Fisheries Organization (NAFO) plays a similar role to NEAFC in the Northwest Atlantic. It will be a considerable challenge to combat illegal, unreported and unregulated fishing (IUU fishing) in the Barents Sea–Lofoten area.

Norway uses a wide range of measures in its management of living marine resources at national level. Important measures in fisheries management include the development of selective fishing gear such as sorting grids and the temporary or permanent closure of areas to certain types of gear such as trawls.



Figure 4.2 Sorting grid in a herring trawl

Source: Institute of Marine Research (Photo: Bjørnar Isaksen)

Norway has traditionally also exploited the minke whale stock, and much of the catch is taken in the area covered by the management plan. The International Whaling Commission (IWC) was established to ensure sustainable management of whale resources throughout the world. In 1982, the IWC imposed a moratorium on all whaling. Norway entered a reservation against this moratorium and is thus not bound by it. The IWC Scientific Committee developed a system called the Revised Management Procedure for calculating catch quotas for all baleen whale stocks. The Norwegian quota is based on this system and set by Norway. The North Atlantic Marine Mammal Commission (NAMMCO) was established in 1992, and its main task is to promote protection and management of marine mammals in the North Atlantic.

4.4 Petroleum activities

4.4.1 General framework

The overall objectives of Norway's petroleum activities have remained unchanged for many years and are founded on broad-based political consensus. Petroleum activities are intended to promote value creation and secure welfare and business development to the benefit of the country as a whole. Further development of the petroleum sector will be facilitated by ensuring that the Norwegian shelf remains an attractive area for investment, value creation and industrial development in Norway. Norway must combine its role as a major producer and exporter of oil with a role as a leading nation in environmental issues.

Over the years, comprehensive legislation and control and enforcement procedures have been built up to ensure that the impact of petroleum activities on the environment and any inconvenience to other industries are dealt with satisfactorily. The authorities play a central role in all important phases of petroleum activities and in the implementation of specific projects from the time when an area is opened for petroleum activities until operations are complete and installations have been disposed of.

Licences to engage in petroleum activities in an area can only be obtained for areas that are open for petroleum activities. The decision to open an area for petroleum activities is made by the Storting. For the areas that are open for petroleum activities, the authorities issue exploration and production licences and separate licences for

the installation and operation of facilities in which they have the right to specify conditions for how activities are to be carried out. Such conditions are most relevant in particularly vulnerable areas. One possible example is a ban on exploration drilling during biologically vulnerable periods. The Government also requires operators to carry out environmental monitoring programmes on all oil fields to monitor the impact on the surrounding environment. Guidelines for environmental monitoring are issued by the Norwegian Pollution Control Authority.

The authorities also play a key role in specific operations at each stage of petroleum activities. The Norwegian Petroleum Directorate, the Directorate of Fisheries and the Ministry of Defence must be notified of exploration activities. Moreover, a fisheries expert must be present on vessels carrying out seismic surveys. Exploration drilling takes place under the terms of a production licence and also requires a drilling permit from the Petroleum Directorate. Approval for health, safety and environmental aspects of an activity must be obtained from the Petroleum Safety Authority Norway, the Norwegian Board of Health and the Norwegian Pollution Control Authority. The approval procedures are coordinated by the Petroleum Directorate. Before development of a field, the licensee must submit a plan for development and operation and have it approved. Similarly, a plan for installation and operation must be submitted and approved before new installations are constructed. The processing of these plans is coordinated by the Ministry of Petroleum and Energy and they are submitted either to the Government or to the Storting depending on the size of the project. A field must also have a production licence from the Ministry of Petroleum and Energy. Approval from the authorities is also required at important stages and decision-making points for each project and operators must demonstrate that they have sufficient control to ensure that activities will proceed in accordance with the legislation and with key decisions that have been made. On termination of a petroleum activity, the licensee must submit a decommissioning plan. On the basis of this plan, the Ministry of Petroleum and Energy will make a decision on disposal. Proposals to leave installations in place are subject to review by OSPAR, and in such cases the final decision is made by the Storting.

The authorities take environmental impacts and inconvenience to other industries into consid-

eration when making decisions at all stages of petroleum operations. One of the most important ways of obtaining information for these decisions is through the impact assessments required by the Petroleum Act. These must include analyses of impacts on the environment and on other industries. Impact assessments are carried out before an area is opened up for petroleum activities, in connection with development and operation and on termination of the activity. Both the study programme and the impact statement itself are distributed for public comment.

Planned discharges from individual petroleum installations in the Barents Sea–Lofoten area are regulated through discharge permits issued pursuant to the Pollution Control Act. Permitted discharges are laid down within the framework of the licences issued pursuant to the Petroleum Act and within the framework of international law.

In the case of activities in the Barents Sea, there are special requirements relating to drill cuttings, drilling mud and produced water, see Chapter 5.3. These requirements are supplementary to the general zero-discharge requirements. Injection or another suitable technology must be used to prevent discharges of produced water to the sea. Drill cuttings (other than those from the tophole section) and drilling mud must be reinjected or taken ashore for treatment. These requirements are based on the precautionary principle.

In practice this means that, during normal operations, no discharges of any substances with a negative impact on the environment are permitted from petroleum installations. There are also strict requirements for emergency response systems for acute pollution and for emissions to air. Further conditions may be added when licences are awarded.

4.4.2 Regulatory framework for risk management

The Petroleum Act and the Pollution Control Act and pursuant regulations apply from the time when an area is opened for petroleum operations. The supervisory authorities for the health, safety and environment regulations for the oil and gas industry are the Petroleum Safety Authority, the Norwegian Pollution Control Authority and the Norwegian Board of Health. Responsibility for environmental risk management is shared as follows:

- The Petroleum Safety Authority is responsible for ensuring compliance with requirements relating to the prevention of accidents that may lead to acute discharges, and to emergency response measures to deal with such accidents at the source.
- The Norwegian Pollution Control Authority is responsible for ensuring compliance with requirements relating to reporting of releases of pollutants, remote sensing measurements, analysis and testing of oil and chemicals, emergency response systems for acute pollution and testing of emergency response equipment. Based on assessment of a specific activity, the Authority may lay down requirements for the emergency response additional to those set out in the health, safety and environment regulations.
- The Petroleum Safety Authority and the Norwegian Pollution Control Authority have had joint responsibility for regulations relating to risk management in the oil and gas industry since 1991, and this is still the case under the health, safety and environment regulations. The purpose of this system is to provide an efficient, integrated risk management regime for the oil and gas industry. It makes it possible to achieve greater risk reduction to the benefit of both people and the environment, and to resolve conflicts between different interests.

In addition to their joint responsibility for the health, safety and environment regulations, the Petroleum Safety Authority and the Norwegian Pollution Control Authority cooperate on the processing of applications for approval and licences, supervisory activities, development of legislation, etc. Approval for health, safety and environmental aspects of an activity must be obtained from the Petroleum Safety Authority, the Board of Health and the Norwegian Pollution Control Authority. The Petroleum Safety Authority is responsible for coordinating these procedures. There are also cooperation agreements between the Petroleum Safety Authority and the Norwegian Maritime Directorate and between the Petroleum Safety Authority and the Norwegian Coastal Administration. These facilitate practical cooperation between the private and governmental emergency response systems, and make it easier to deal with conflicts of interest between petroleum activities and maritime transport.

There is already a comprehensive national framework for risk management in the form of

statutory requirements, management principles, trend monitoring projects, follow-up and control mechanisms, and a broad range of possible sanctions. The existing framework is based on extensive knowledge and experience of risk management and is being further developed in response to new knowledge, experience, trend monitoring results and feedback from the parties.

The health, safety and environment regulations are risk-based, and requirements will therefore vary from one installation or activity to another in accordance with their distinctive features. This makes it possible to take regional characteristics into account in risk management in the Barents Sea–Lofoten area. For example, stricter requirements will apply in vulnerable areas. The analytical models that are used can be adapted to different areas. The differences between international major accident statistics for the oil and gas industry and statistics for the Norwegian shelf indicate that strict regulation and control by Norway have been important in preventing acute oil spills and minimising their impact.

The oil industry complies with its emergency response requirements by establishing systems for each facility. In practice this is increasingly being done through regional cooperation between the operators combined with arrangements for rapid response as near as possible to the source of any pollution. Furthermore, the Norwegian Clean Seas Association for Operating Companies has established regional plans on behalf of its members, which strengthen both ocean-going response and the near-shore and shoreline response. The Association has entered into an agreement on the use of governmental emergency response resources in order to meet parts of its emergency response obligations.

The scale of the Government's emergency response system is not intended to be sufficient for the oil and gas industry. Private emergency response organisations have a statutory duty to assist the government. An agreement has been reached on reciprocal public-private assistance in the event of major oil spills. It is therefore essential that the requirements laid down by the Norwegian Pollution Control Authority for the private organisations are always sufficient to ensure that

their resources can be coordinated with public emergency response resources. Coordination of private and public resources is therefore included as a statutory requirement in the health, safety and environment regulations.

The existing framework for risk management should be used as a basis in developing a more integrated management regime for the Barents Sea–Lofoten area. Cooperation between the authorities should be strengthened and translated into practical terms in order to increase their contribution to the prevention of oil spills, improvement of emergency response systems and continuous monitoring of risk in the Barents Sea–Lofoten area.

4.5 Maritime transport

4.5.1 The international framework

Maritime transport is an international industry. The framework conditions for safe, environmentally sound and efficient transport are therefore largely laid down at international level and shipping is regulated to a large extent in international law. The trend is towards increasingly stringent environmental standards. International rules thus provide an important framework for how Norway can regulate maritime transport in the Norwegian part of the Barents Sea. International rules for ships and crews are also extremely important.

International efforts have traditionally been organised under the International Maritime Organization (IMO) and have reflected the interest of flag states in uniform global technical standards for ships and crews, although the interests of coastal states have also been safeguarded. In recent years, the EU has been playing a more active part in this work, in response to accidents in European coastal waters, and the interests of coastal states have been given more weight. The EU has also expedited the implementation of international legislation by adopting it as community law. This has influenced the work of the IMO.

The IMO has adopted a number of global conventions to protect the marine environment from the negative impacts of maritime transport, see list in box 4.2.

Box 4.2 Selected IMO conventions with particular relevance for the management plan

SOLAS – International Convention for the Safety of Life at Sea, 1974

MARPOL 1973/78 – International Convention for the Prevention of Pollution from Ships

STCW – International Convention on Standards of Training, Certification and Watch-keeping for Seafarers, 1978

COLREG – Convention on the International Regulations for Preventing Collisions at Sea, 1972

Convention on Limitation of Liability for Maritime Claims, 1976 and Protocol of 1996

International Convention on Civil Liability for Oil Pollution Damage, 1992

International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage, 1992

Protocol of 2003 to amend the International

Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage, 1992

AFS – International Convention on the Control of Harmful Anti-Fouling Systems, 2001 (not yet in force)

International Convention for the Control and Management of Ships' Ballast Water and Sediments, 2004 (not yet in force)

International Convention on Liability and Compensation for Damage in connection with the Carriage of Hazardous and Noxious Substances by Sea, 1996 (HNS Convention) (not yet in force)

BUNKERS 2001 International Convention on Civil Liability for Bunker Oil Pollution Damage, 2001 (not yet in force)

In the present context, the most important of these conventions are the International Convention for the Safety of Life at Sea (SOLAS 1974) and the International Convention for the Prevention of Pollution from Ships (MARPOL 1973/78). The requirements in these conventions are under continuous revision. One example is the adoption of an accelerated phase-out schedule for single-hull tankers. In October 2001, the IMO also adopted a new convention on the control of harmful anti-fouling systems and in 2004 a new convention regulating ballast water intake, discharge and management.

As part of its work on maritime safety and anti-terrorism measures, the IMO's Maritime Safety Committee has initiated the establishment of a long-range vessel identification and tracking system (LRIT). The design of the system has not yet been finalised. The system can also be used to supplement maritime safety and oil spill response measures, just as the land-based AIS network is used to identify traffic in near-shore waters.

As a coastal state, Norway is entitled to implement measures to safeguard maritime transport in its coastal waters and in waters outside this, but the extent of these rights varies depending on the type of waters involved. Norway has complete jurisdiction in its internal waters. As the coastal state, Norway also has considerable freedom to regulate shipping, but vessels have the right of

innocent passage. Figure 4.1 shows Norway's exclusive economic zones.

Outside territorial waters, all ships enjoy freedom of navigation. Accordingly, Norway's exclusive economic zone and the fisheries protection zone in the Barents Sea are open for passage by ships from other states. Even if it should wish to, a coastal state does not have the right to stop ordinary transport of oil along its coast. Flag states are responsible for control and compliance with general IMO requirements for vessels flying their flag. In addition, port states can exercise control over ships calling at their ports. Under IMO rules, mechanisms have been developed making it possible for coastal states to regulate maritime transport outside their territorial waters. Some of the international processes that can be followed when there is a special need are as follows:

- A sea area may be classified as a Special Area (SA) under the MARPOL Convention. Stricter rules apply to the discharge of chemicals, oil and waste in an SA. Guidelines have been drawn up for applications for SA status. The North Sea is the only SA that currently includes waters under Norwegian jurisdiction.
- Under the SOLAS Convention, coastal states may apply to IMO for approval for routeing systems in sea areas outside their territorial waters for safety and environmental reasons. A routeing system can include mandatory traffic

lanes, separation of opposing streams of traffic and geographical areas to be avoided. Information on such systems is regularly updated by IMO.

- Coastal states may apply to IMO for the designation of a sea area as a Particularly Sensitive Sea Area (PSSA). These areas are marked as such on international navigation charts. An application for PSSA designation should also include a proposal for protective measures, for example navigational measures such as routeing systems and traffic lanes, areas to be avoided and/or reporting requirements. Guidelines have been drawn up for PSSA applications. There are currently no PSSAs in Norwegian waters.

Applications for these designations are assessed separately, and the designations are not mutually exclusive.

4.5.2 Norwegian management

Norway has implemented a comprehensive range of preventive safety measures in its coastal waters by establishing and operating maritime infrastructure and services and has instituted a government oil spill response system to prevent or limit negative impacts of incidents and accidents at sea. The maritime infrastructure consists of lighthouses, buoys, signs and the physical improvement of channels to keep them clear and safe. The maritime services include the pilot service, traffic surveillance and control, electronic navigation aids, charts and notification and information services.

Traffic regulation and surveillance, reporting systems and extensive international cooperation to improve maritime safety are among the most important accident prevention measures for maritime transport. In view of the growing transit of oil tankers to and from Northwestern Russia, a mandatory routeing and traffic separation scheme was established with effect from 1 January 2004 in Norway's territorial waters off the coast of Finnmark. Previously, ships carrying dangerous or polluting cargo could sail through these territorial waters close to the baseline. A minimum distance from the coast has now been set for these ships. The traffic lanes are positioned as far out towards Norway's new 12-nautical-mile territorial limit as practically possible.

The Norwegian authorities are working within the framework of international law to move transport of dangerous and/or polluting cargo outside Norway's territorial waters between Vardø and

Røst (i.e. from eastern Finnmark to the southern tip of the Lofoten Islands). In response to a white paper on maritime safety and the oil spill response system published in 2005 and the subsequent Storting debate, the Government has given high priority to establishing a mandatory routeing and traffic separation scheme outside territorial waters between Vardø and Røst. The Government will submit an application to the IMO as early as possible in 2006. The Norwegian Coastal Administration has circulated the proposal for comment, see box 4.3.

Bilateral cooperation with other countries is also of great importance to Norway. Cooperation has already been established between the Norwegian and Russian authorities in the fields of maritime safety and emergency response for acute pollution, with a view to preventing prevent acute oil spills and establishing a stronger emergency response system in the High North.

A number of risk-reducing measures have already been implemented in Norway:

- Traffic surveillance by the vessel traffic service centres in Horton, Brevik, Kvitsøy, Fedje (and from 2007 onwards in Vardø) in order to prevent dangerous situations and accidents.
- In 2005 AIS coverage of Norwegian waters was established along the entire coast out to about 30 nautical miles from land. Det Norske Veritas estimates that AIS on board vessels combined with other electronic navigation instruments can reduce ship collisions by 20 per cent. Traffic surveillance and the use of AIS are very important risk-reducing measures for the waters between Vardø and Røst.
- A traffic separation scheme has been introduced for vessels sailing inside Norway's territorial limit between Vardø and Røst. Det Norske Veritas has estimated that this combined with AIS will reduce the number of ship collisions by 40 per cent.
- In 2003, government emergency tugboat services were established for maritime transport off Finnmark, Troms and the Lofoten Islands. Det Norske Veritas considers that this, combined with traffic surveillance and regulation of traffic out to Norway's territorial limit, will considerably reduce the number of groundings following engine failure. An increase in the level of petroleum activity will normally mean that the tugboat service is also scaled up.
- Today, surveillance is efficient and a rapid response can be mounted in the event of accidents involving vessels in the management

Box 4.3 Mandatory routeing and traffic separation scheme

The establishment of mandatory routeing and traffic separation schemes is an important traffic-regulating measure, which contributes significantly to the reduction of the risk of acute oil pollution from ships. On 1 January 2004, Norway extended the breadth of its territorial sea from four to 12 nautical miles. At the same time, a mandatory routeing and traffic separation scheme was established in the territorial waters between Vardø and the North Cape for vessels carrying polluting cargo. These traffic lanes are positioned as far out towards the new territorial limit as practically possible.

Given the estimates for future transport of petroleum and petroleum products from Russia, the authorities have concluded that further measures are needed to ensure that this transport takes place in the safest possible way. With the anticipated increase in the volume of traffic, regulation will be needed to shift the traffic farther away from the coast.

The Government has therefore resolved to submit a proposal for a mandatory routeing and traffic separation scheme outside the territorial limit between Vardø and Røst to the International

Maritime Organization (IMO). This is in accordance with the white paper on maritime safety and the oil spill response system published in 2005 and the subsequent Storting debate and recommendations. The Government plans to submit the proposal to IMO in the course of spring 2006.

The proposed position of the traffic lanes is about 30 nautical miles from the coast. This means that the ships will still be within the coverage area of the Coastal Administration's AIS system. The establishment of the scheme, combined with AIS coverage by the vessel traffic service centre in Vardø, will provide an integrated system for regulation and control of the traffic.

Safe maritime transport is also in the interest of the oil and gas and fisheries industries. In determining the exact position of the routeing scheme, consideration will therefore be given to petroleum activities and to the areas where fishing is most intensive, in addition to safety and environmental concerns. Rules will be drawn up for fisheries and petroleum activities within the area covered by the scheme.

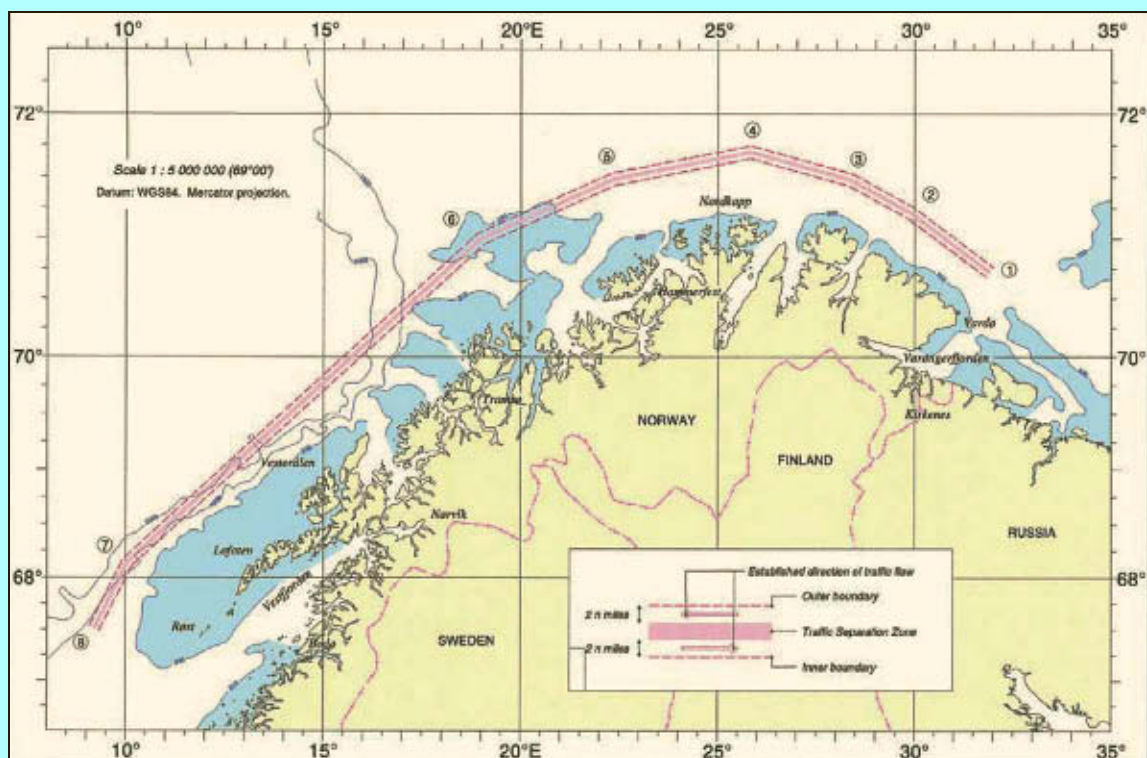


Figure 4.3 Proposed mandatory routeing and traffic separation scheme outside territorial waters between Vardø and Røst

Source: Norwegian Coastal Administration

Box 4.4 Northern Maritime Corridor (NMC) – an Interreg IIB project

This project is funded by two Interreg IIB programmes, the Northern Periphery and North Sea programmes, and was started in 2002. Interreg is an EU initiative to promote transnational and regional cooperation. The project is coordinating activities involving central and regional authorities in 20 regions in eight countries in the fields of *logistics and transportation, maritime safety, regional business development and “business to business” cooperation*. The project partners include all Norwegian coastal municipalities from Vest-Agder to Finnmark, the Faroe Islands, Iceland and Greenland, the E12 Alliance (counties and municipalities in Sweden), the Barents Secretariat, Highlands and Islands Enterprise, the Highland Council, the Shetland Islands Council, the Orkney Islands Council, Archangel and Murmansk counties, Aberdeenshire Council, Amsterdam Port Authority, Groningen Seaports, the province of West Flanders and the City of Cuxhaven.

The two Northern Periphery and North Sea programmes focus on the same topics and will cooperate closely on the Northern Maritime Corridor project. They share the same overall objective for this project, which is to develop an efficient, safe and sustainable maritime corridor for maritime transport between the North Sea region and the Barents region and to bring businesses in the two regions closer together to promote industrial development.

The overall budget for the Northern Maritime Corridor project is about EUR 5 million.

Russia’s interest in the project arises from its work on the Northern Sea Route.

In Norway, a central coordinating group has been set up with representatives from eight ministries, headed by the Ministry of Local Government and Regional Development.

plan area. The Coastal Administration works closely with the Norwegian Defence Forces on surveillance and rapid response in order to prevent incidents involving vessels from causing acute oil pollution. Following the establishment of the Defence Forces’ coastal emergency response and on-scene command (KYBAL), risk-reducing oil spill response measures can be initiated immediately by the Defence Forces on behalf of the Coastal Administration.

- In 2004, in accordance with the IMO guidelines, a procedure was established for intervention and action by the Coastal Administration when Norwegian or foreign ships in need of assistance constitute a danger to safety and the environment. The aim is to ensure that decisions on ports of refuge are made quickly. The procedure is based on fast interaction between central and local government agencies and private actors, where the Coastal Administration is responsible for decision-making.
- The Coastal Administration’s notification and information system, “ShipRep”, is linked to a number of registers containing information about vessels.

Unlike the oil industry, the shipping industry is not required to provide oil spill response equipment. The governmental emergency response system for acute pollution is therefore mainly designed to prevent and limit damage from incidents involving ships. In addition to its responsibility for the private emergency response system and operations, the Coastal Administration therefore has operational responsibility for the governmental emergency response system for acute pollution targeted at maritime transport as well as the responsibility for ensuring that damage-reducing measures implemented by other bodies are adequate. In 2005, the Coastal Administration drew up new plans including procedures for coordination of the whole coastal emergency response system, operational emergency response services and all available expertise. The Norwegian Maritime Directorate acts as advisor to the Coastal Administration on the handling of vessels that represent an acute pollution hazard. An advisory group for acute pollution, consisting of members with environmental, fisheries and marine engineering expertise, has also been set up under the leadership of the Coastal Administration.



Figure 4.4 Cleaning up the beach at Bleiknstranda near Haugesund after the *Green Ålesund* accident

Source: Norwegian Coastal Administration

The Norwegian Maritime Directorate is responsible for ensuring compliance with regulations and standards for ships. Its work is important in increasing safety levels. The directorate cooperates with the maritime industry throughout the country, other countries' maritime authorities and international fora. Work is based on experience from accidents and near-accidents, research and risk analyses. Norway's marine accident database, DAMA, plays a vital role here. Every ship must have contingency plans for emergencies.

The Directorate has three key tasks:

- To ensure that Norwegian ships and shipowners meet the highest safety and environmental standards,
- To ensure that seamen on Norwegian ships are well-qualified and have good employment and living conditions,
- To ensure that foreign ships in Norwegian water and ports comply with international rules for vessel standards, equipment and manning.

There is already a comprehensive national framework for risk management in the form of statutory requirements, management principles, trend monitoring projects, follow-up and control mechanisms, and a broad range of possible sanctions. The existing framework is based on extensive knowledge and experience of risk management and is being further developed in response to new knowledge, experience, trend monitoring results and feedback from the parties. The existing framework for risk management should be used as a basis in developing a more integrated man-

agement regime for the Barents Sea–Lofoten area. Cooperation between the authorities should be strengthened and translated into practical terms in order to increase their contribution to the prevention of oil spills, improvement of emergency response systems and continuous monitoring of risk in the Barents Sea–Lofoten area.

The international legal framework for liability and compensation for damage caused by oil pollution from ships has been considerably strengthened in recent years. New limits for compensation and the establishment of funds also apply to accidents in the Barents Sea–Lofoten area. In addition, flag states are responsible for control and compliance for vessels flying their flag.

4.6 Onshore activities of particular importance for the Barents Sea–Lofoten area

Releases of pollutants from Norwegian industry and other Norwegian onshore sources are regulated through the Pollution Control Act and pursuant regulations.

Long-range transboundary pollution is of particular importance for the Barents Sea–Lofoten area. There is a large body of international law to regulate pollution, and particularly chemicals, at both global and regional (EU) level. The white papers on the Government's environmental policy and the state of the environment in Norway describe developments in this legislation. Norway plays an active role in efforts to strengthen international cooperation in this field. Important instruments include the Stockholm Convention, which regulates the twelve most dangerous persistent organic pollutants (POPs), and the Rotterdam Convention on the Prior Informed Consent (PIC) Procedure for Certain Hazardous Chemicals and Pesticides in International Trade, both of which entered into force in 2004. Moreover, two new protocols on POPs and heavy metals under the ECE Convention on Long-range Transboundary Air Pollution (LRTAP) entered into force in 2003. The international regime for long-range transboundary pollution has thus been significantly strengthened. The Strategic Approach to International Chemicals Management (SAICM) was adopted in February 2006. It is intended to improve international management of hazardous chemicals, particularly in developing countries. The new EU chemicals legislation (REACH – Registration, Evaluation and Authorisation of Chemi-

als) is expected to be adopted in the near future. This legislation is EEA-relevant and will also be implemented in Norway. The regional OSPAR Convention sets limits for discharges from petroleum activities in the Barents Sea–Lofoten area and from a number of onshore sources. The Convention on Climate Change, Kyoto Protocol, and the international agreements on emissions of NO_x , SO_2 and VOCs are also relevant for management of activities in the management plan area.

4.7 Marine protected areas and areas with special environmental status

The Ministry of the Environment, in consultation with the Ministry of Fisheries and Coastal Affairs and the Ministry of Petroleum and Energy, appointed an advisory committee to draw up a plan for marine protected areas. The committee submitted its final recommendations in June 2004. It proposed 36 protected areas located from Østfold county in the south to Finnmark in the north and from inner fjord areas to the outer limits of

the Norwegian continental shelf and continental slope. Most of the proposed areas in the Barents Sea–Lofoten area are in the coastal zone, see figure 4.5. The areas were selected to give a representative selection of areas and for their distinctive qualities. Some of the areas are proposed as reference sites which can be used for research and environmental monitoring and which must be kept as undisturbed as possible for comparison with areas that are under different kinds of pressure. Based on the proposal from the advisory committee and guidelines from the ministries, the Directorate for Nature Management, in cooperation with other relevant authorities, will draw up a draft plan and study programme that can be circulated for comment in 2007. The Ministry of the Environment, in cooperation with the Ministries of Fisheries and Coastal Affairs, Trade and Industry, and Petroleum and Energy, will decide which areas are to be included in the final plan for marine protected areas. A decision on marine protected areas is expected in the course of 2008.

In Norway, including the Barents Sea–Lofoten area, the Nature Conservation Act provides the

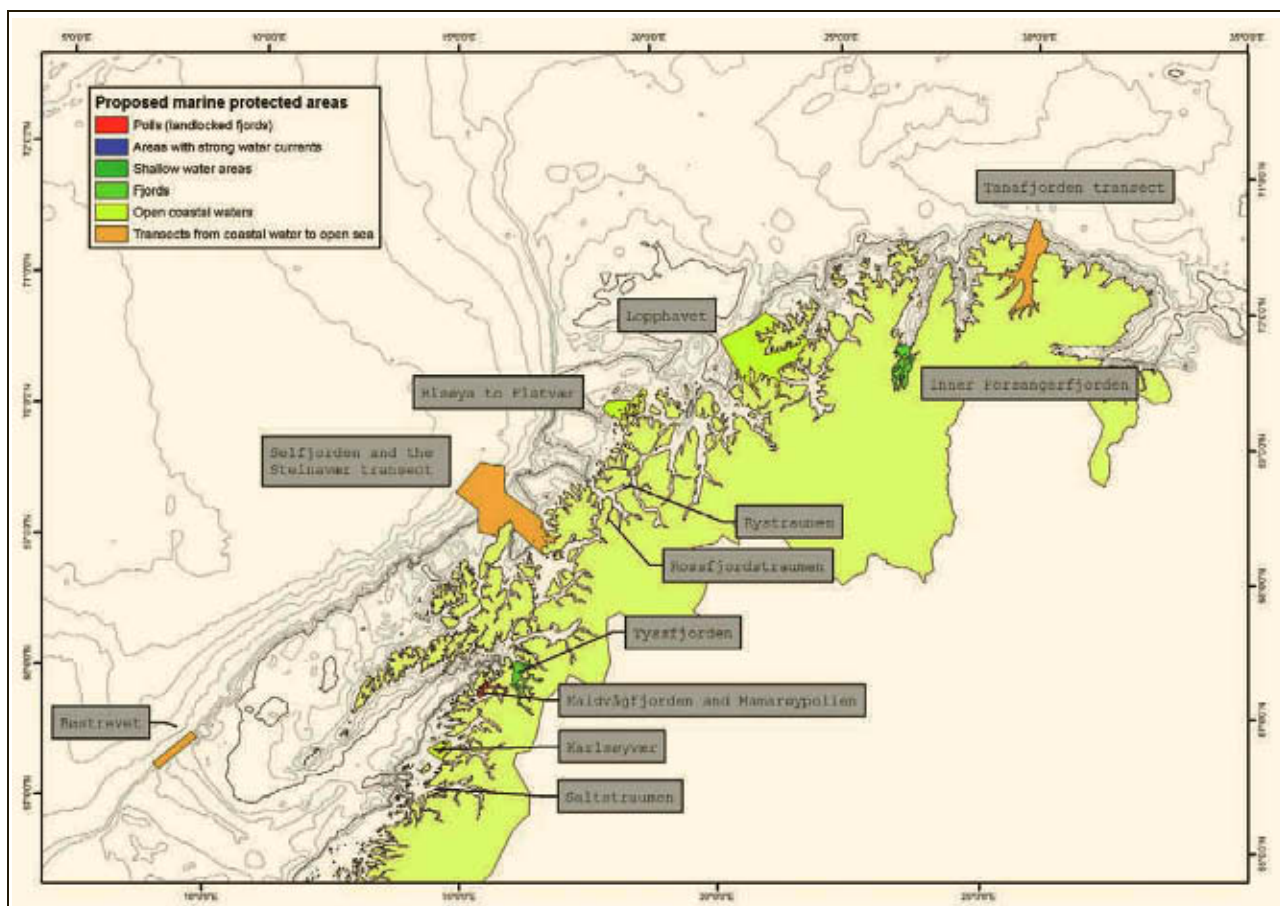


Figure 4.5 Marine protected areas proposed by the advisory committee in the management plan area

Source: Institute of Marine Research

legal basis for permanent and general protection of areas against all activities that have an impact on the environment and natural resources. The Act applies to the land areas of Norway and its waters out to the 12-nautical-mile territorial limit. So far, one purely marine protected area has been established under the Act: the Selligrunnen coral reef in the Trondheimsfjorden, which has been temporarily protected. An Official Norwegian Report (NOU 2004: 28) on an Act on the protection of the natural environment, landscape and biological diversity contains a proposal to extend the geographical scope for the protection of sea areas from 12 nautical miles to include the Norwegian continental shelf and Norway's exclusive economic zone.

Under the fisheries legislation, protective measures have been implemented both in the form of prohibitions on fishing in specific areas in annual fisheries regulations and in the form of more permanent restrictions. Several of the annual prohibitions on fishing are extended year after year and in practice represent permanent protection. Protection of redfish in Norway's exclusive economic zone is a case in point. Five marine protected areas have been established under the fisheries legislation to protect coral reefs from damage caused by bottom trawling. These are Iverryggen, Røstrevet (in the Barents Sea–Lofoten area), Sularyggen, Tislerrevne and Fjellknausene.

Most of Svalbard's coastal areas and 84 per cent of its territorial waters are included in the large nature reserves and national parks that were established in 1973 and in 2002–2003. With the extension of Norway's territorial waters, the outer boundary of these protected areas was moved from four to 12 nautical miles from the baseline with effect from 1 January 2004. An exception was made in the case of the Bjørnøya nature reserve, which was not extended. However, a proposal to extend it from four to 12 nautical miles will be circulated for comment in spring 2006. In most of the marine protected areas the seabed is protected. However, shrimp fishing at a depth of 100 metres or more is permitted and the protection regulations for the Hopen and Bjørnøya nature reserves do not apply to seawater fisheries. The protection regulations are laid down pursuant to the Svalbard Environmental Protection Act, which applies to Svalbard's land areas and territorial waters.

In 2002, Kongsfjorden near Ny-Ålesund in Svalbard was closed to shrimp fishing by the fisheries authorities because the fjord is an important

nursery area for shrimps. The Ministry of Justice is now heading an initiative to give the Kongsfjord area permanent protection as a research area. Special restrictions will then also be imposed on other types of activity in the area.

As party to the UNESCO Convention concerning the Protection of the World Cultural and Natural Heritage, Norway has recognised its duty to identify, protect, conserve, present and transmit to future generations any world heritage on its own territory, as set out in Article 4 of the Convention. Norway has ratified the Convention and submitted a tentative list to UNESCO. As of September 2005, the Lofoten Islands were one of two Norwegian candidate areas for nomination to the World Heritage List. A tentative list is a list of properties that a state party considers to be of "outstanding universal value" and that it intends to consider for nomination during the next ten years. According to plan, Norway will submit a nomination to UNESCO in January 2009 at the earliest. The inclusion of the Lofoten Islands on the tentative list is supported by the Nordic Council of Ministers' joint Nordic recommendation on potential new world heritage areas (Nord 1996:30/31). This report describes the area as being of international importance in both natural and cultural terms.

The report mentions the landscape and natural beauty of the area, its geology and bird life, the cultural landscape and traditional way of life, and the built environment as valuable features of the area. A study will be made of the Lofoten Islands to determine whether the area can meet the criteria under the Convention. This process will focus in particular on the spawning-season cod fishery and the natural and cultural value of this 1000-year-old tradition. This will probably be the main focus if the Lofoten Islands are nominated for inclusion on the World Heritage List. The process will also clarify how the area should be delimited and which concerns should be addressed in managing the area as a world heritage site.

4.8 Management of endangered and vulnerable species

Norway has signed a number of conventions on species protection and management. The Convention on Biological Diversity sets out a general framework for these efforts, and proposals and decisions on which species should be given special protection are made under the regional and

global nature conservation conventions, primarily the Bern, Bonn and CITES Conventions. The environmental authorities cooperate closely with other sectoral authorities in work under the nature conservation agreements and their national implementation. If evidence indicates that a species is or may be at risk of extinction if a negative population trend continues, it is listed as endangered or vulnerable respectively on the national red list. Norway's current Red List is from 1998. Of the species that are associated with the marine environment, only marine mammals and seabirds have been evaluated. Since no other marine species have been evaluated, the current Red List gives an incomplete picture of the situation in Norwegian territorial waters. A revised Red List, which will also cover marine species, is to be published in 2006.

The current Norwegian Red List includes about 20 birds and mammals associated with marine environments that occur or have occurred in the Barents Sea–Lofoten area. The North Atlantic right whale is the only species that is considered to be extinct. The bowhead whale and the lesser black-backed gull (subspecies *Larus fuscus fuscus*) are classified as endangered, and five other species of birds (two of which breed in Svalbard) are designated as vulnerable. Other species that occur in the Barents Sea–Lofoten area and are included on the current Red List are rare, care-demanding or monitor species. Box 4.5 defines the categories used in the Red List. In addition, several of the species that occur in the area are species for which Norway has a special responsibility.

Box 4.5 Red list species, species for which Norway has a special responsibility and key species

Red List species – species which are included on an official list of plants and animals that are in some way at risk of extinction, whose populations are declining significantly or that are naturally rare. The official Norwegian Red List is published by the Norwegian Directorate for Nature Management (current edition 1998). A revised edition is to be published in the course of 2006.

The following categories are used in the current Norwegian Red List:

Endangered species – a species that is considered to belong to Red List category E, endangered, i.e. a species that is at risk of extinction in the near future if negative causal factors continue to operate.

Vulnerable species – a species that is considered to belong to Red List category V, vulnerable, i.e. a species in serious decline that may move into the endangered category if negative causal factors continue to operate.

Declining, care-demanding species – a species that is considered to belong to Red List category DC, declining, care-demanding species, i.e. a species that does not belong in category E, V or R, but that has a declining population that gives cause for concern.

Rare species – a species that is considered to belong to Red List category R, rare, i.e. a species

that is not endangered or vulnerable but is in a vulnerable position due to a small population or sparse distribution.

Declining, monitor species – a species that is considered to belong to Red List category DM, declining, monitor species, i.e. a species that has declined, but that is not regarded as threatened. The situation for these species should be monitored.

Species for which Norway has a special responsibility. This is not a Red List category but a supplementary category.

The following criteria are used for determining whether a species belongs to the “special responsibility” category:

1. it is endemic to Norway or Scandinavia, or
2. more than 25 per cent of the European population is found in Norway, or
3. it is included on the European or global Red List.

Key species – a species of great importance to ecosystem dynamics, structure or function. The loss of a key species or a major change in its abundance has major impacts on other species in the ecosystem.

5 Pressures and impacts on the environment

5.1 Introduction

The marine environment of the Barents Sea–Lofoten area shows large natural fluctuations. The main anthropogenic pressures on the environment are a result of activities in the fisheries, petroleum and maritime transport sectors. There is also a risk of pollution incidents, for example oil spills, in connection with various activities. In addition, the state of the environment is affected by external factors such as long-range transboundary pollution and climate change. This chapter reviews the anthropogenic pressure from each sector and then the overall pressures on the environment. Wherever possible, expected trends up to 2020 are also discussed.

Emissions to air affect the marine environment as well, but are not dealt with specifically in this white paper. Climate change together with its impacts on the marine environment is a global issue that is discussed in section 5.5.2. Noise and seismic surveys are primarily of importance in relation to the fisheries sector, and are discussed in Chapter 6 on co-existence between industries. Environmental pressures affecting land areas, such as infrastructure development and onshore facilities for the petroleum industry, are not discussed here since this is outside the geographical scope of the management plan. Major oil spills and other accidental discharges to the sea are discussed in section 5.7.

5.2 Pressures and impacts associated with the fisheries industry

5.2.1 Introduction

Sustainable harvesting of living marine resources requires maintenance of the diversity, structure, functioning and productivity of ecosystems. This means that harvesting must be adjusted to ensure that the natural interplay between different components in an ecosystem is maintained.

Within the time frame of the management plan, the human activity that will probably have the greatest effect on the ecosystem is the fisher-

ies industry. The level of pressure exerted depends on how much of a stock is harvested, how it is harvested, and the trophic level to which the stock belongs.

The effects of external factors such as winds, temperature and currents must also be taken into account in evaluating the pressure and impacts associated with the fisheries. In some cases, external factors and natural fluctuations in fish stocks due to competition between species and variations in food supplies may be more important than anthropogenic pressures on the same stocks. Our knowledge of pressures and impacts varies widely from one species and area to another, and it is a difficult task to distinguish between the effects of human activity and other effects. Some commercial fish stocks have been harvested and managed for many years, and a considerable body of knowledge has been obtained by research and in other ways. On the other hand, relatively little is known about the impacts of the fisheries on species that are not harvested commercially and on other parts of the ecosystem, see Chapter 8.

5.2.2 Impacts on commercial fish stocks

The most important impact of the fisheries industry today is the deliberate harvesting of commercial stocks, which results in changes in stock sizes. In addition, harvesting results in changes in the size and age structure, genetic make-up and mortality of these stocks.

The most important commercial fish stocks in the Barents Sea–Lofoten area are cod, haddock, saithe, Greenland halibut, herring and capelin. The shrimp fishery is also relatively important in economic terms. These species represent different trophic levels in the food chains.

Cod is the most important species in the Barents Sea in economic terms. It is also one of the top predators in the marine food chain, and its distribution area includes almost the entire Barents Sea. It is therefore a key species in this area. Capelin is the preferred prey species of cod, and historical figures show strong links between the

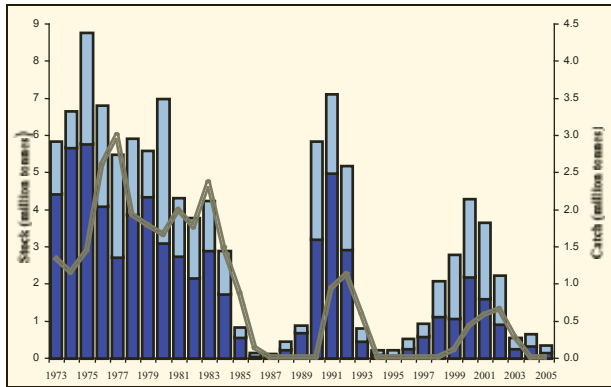


Figure 5.1 Barents Sea capelin. Total stock of capelin and maturing component of the stock in autumn (light blue) in the period 1973–2005. The line indicates total annual catches.

Source: Institute of Marine Research

two stocks. Increasing fishing pressure on capelin has a direct impact on the cod stock, and a large cod stock has a direct impact on the capelin stock. If the capelin stock is low, the cod change their feeding habits. These links are illustrated by the collapse of the capelin stock in the 1980s, which had a major impact on the cod stock, leading to slower growth and delaying sexual maturity. However, when the capelin stock collapsed again in the 1990s, the impact on the cod stock was much weaker, and the low level of the capelin stock in 2003 and 2004 does not seem to have had such severe negative impacts. This may be because numbers of juvenile herring, blue whiting and haddock have been high, so that the cod have been able to find alternative food sources.

The close links between these two stocks are also taken into account in management models and in setting total allowable catches (TACs). An important element of a management strategy for capelin should therefore be to ensure an adequate food supply for cod. Recommended TACs for capelin now take account of the consumption of capelin by cod, and competition between herring and capelin should if possible also be incorporated into the model. This is an example of the ecosystem approach, which seeks to take into account the structure and functioning of the ecosystem as well as evaluating each commercial species separately. However, it is by no means a simple matter to predict or model interactions between species, and management of fish stocks is still largely based on single-species management. Thus, the recommended TACs for cod are still based on a single-species model, but the man-

agement regime should in future also take into account the stocks of capelin and shrimps and their availability for cod, and predation pressure on cod by harp seals and minke whales.

In theory, severe depletion of the cod stock could result in a larger harvest of capelin and shrimps, but removing such an important species at the top of a food chain can also destabilise the entire ecosystem. This seems to have been precisely what happened when the Newfoundland cod stock collapsed. There was no subsequent increase in the capelin stock – on the contrary, it has also decreased. However, these changes have resulted in increases in the stocks of shrimps, certain species of flatfish and crabs.

The spawning stocks of haddock, saithe and cod in the area covered by the management plan are currently above the precautionary limits, but the capelin stock has once again reached a very low level. Haddock and saithe are now being harvested sustainably. However, the harvest of cod is higher than that intended under the management plan because of unreported landings. The lump-sucker stock has been decreasing in recent years, and ICES has therefore recommended a reduction in the catch level. The Greenland halibut stock is being rebuilt slowly, and scientists recommend that the low catch level should be maintained. Stocks of redfish (*Sebastes marinus* and *S. mentella*) have been low for many years. ICES recommends introducing stricter restrictions on catches of these stocks.

The shrimp stock in the Barents Sea and around Svalbard is low compared with previous estimates. This may be a result of low recruitment in the last few years combined with over-harvesting of three- to four-year-old shrimps. Shrimps do not become sexually mature females until they are about five years old, and for the stock to remain healthy it is important to ensure that enough shrimps reach this age.

Bycatches of fish by various types of fishing gear, particularly bycatches of fish below the minimum size in shrimp trawls, represent another important pressure on the ecosystem. Considerable efforts are being made to reduce bycatches, for example by developing selective gear, using sorting grids in trawls, and temporarily closing areas to fishing when bycatches exceed specified limits.

The red king crab is managed as a commercial species east of 26 °E (Nordkapp). In 2005, it was estimated that there were 800 000 king crabs above the minimum size in Norwegian waters

east of this line. The species is widespread both in coastal waters and further out to sea in the southern part of the Barents Sea. Recruitment to the stock in eastern Finnmark (the Varangerfjorden area) has been very strong, although it now appears to be decreasing, but numbers of the species are still growing strongly further west. West of 26 °E, fishing for king crabs is unrestricted. In this area, Norway is solely responsible for management of the species, and the Norwegian authorities wish to keep the numbers as low as possible.

The fisheries industry can influence the genetic diversity of particular stocks and the evolution of all fish species, including non-commercial species, by altering the relationships between species and the size structure of stocks. Heavy fishing pressure and selective harvesting of the largest individuals in a stock can favourise fast-growing specimens that mature when still relatively small. However, it is not known whether this can have a permanent effect on the genetic com-

position of stocks and their ability to adapt to changed environmental conditions.

Ghost fishing, which is the term used when lost or abandoned fishing gear (gill nets and long-lining gear) continues to catch fish, is a problem because it results in an unregistered harvest and is ethically unacceptable. Since 1980, the Norwegian Directorate of Fisheries has run an annual programme to retrieve gear that has been reported as lost and other lost gear that for various reasons has not been reported.

There is considerable illegal, unreported and unregulated fishing (IUU fishing) in the Barents Sea, and this is a threat to sound, sustainable management of the fish stocks.

5.2.3 Impacts on other parts of the ecosystem

The fisheries can also have major impacts on other parts of the ecosystem. If the size of commercial fish stocks is reduced by an increase in the harvest or recruitment failure, this has reper-

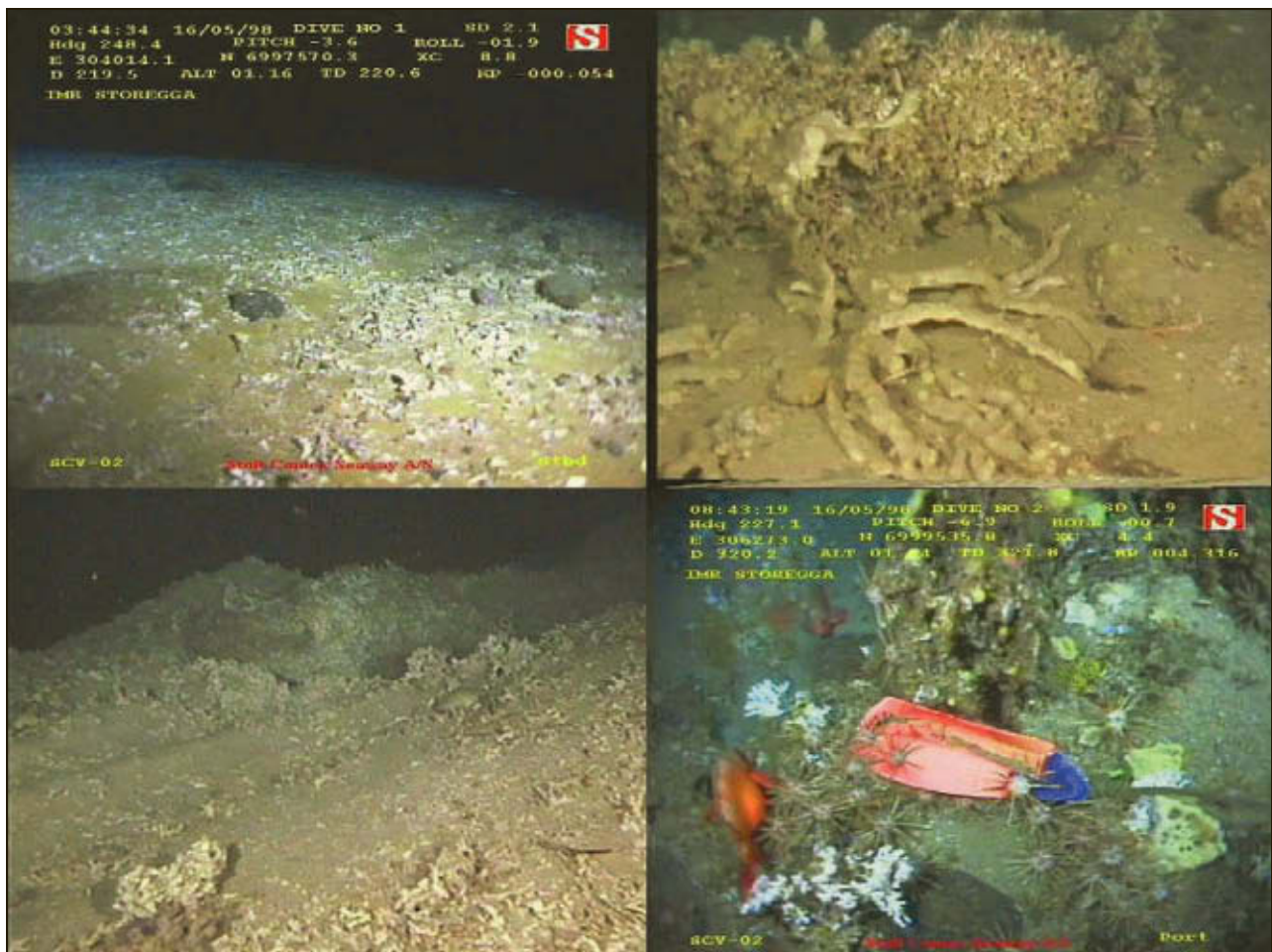


Figure 5.2 Damaged coral reef

Source: Institute of Marine Research

cussions for the whole ecosystem, regardless of whether the reduction is a result of human activity or is caused by natural events. A reduction in fish stocks can result in poor food supplies for both seabirds and marine mammals. This is an important reason behind the serious decline in populations of some seabirds in the Barents Sea–Lofoten area. For example, a depleted capelin stock utilises a smaller proportion of the rich production in the marginal ice zone. Capelin transport energy from production in the marginal ice zone to coastal waters, so that a reduction in the capelin stock also has an impact on coastal ecosystems. A clear link has been shown between the breeding success of puffins and kittiwakes and the availability of first-year herring and capelin. Common guillemots take larger prey, and their breeding success appears to be more dependent on the stock of capelin, which is their most important prey species. The fisheries appear to have a more moderate impact on species such as common and king eider, which are not as dependent on fish as prey.

Certain types of fishing operations also have direct effects on the seabed. Benthic communities are particularly vulnerable to the impact of trawling. Both trawls and other gear types that are towed along the seabed can seriously damage and disturb benthic communities, and also resuspend particles and shift sediments. Near coral reefs, the use of these types of gear can smother corals with sediment in addition to causing mechanical damage. Sediment deposition is one of the most important causes of the death of tropical corals all around the world. Little is known about the growth rates and recruitment potential of corals and sponges, but it is reasonable to assume that they are lower in the Barents Sea than further south because temperatures are lower. Coral reefs and sponge communities in northern waters may therefore be very sensitive to mechanical disturbance. Little work has been done so far on mapping species-rich habitats such as these in the Barents Sea–Lofoten area, see Chapter 8. However, environmental conditions (substrate type, temperature and salinity) are suitable for corals even further north than the currently known limit of their distribution. For example, a new coral reef was only recently discovered in the Lophavet area off western Finnmark, see figure 8.5.

It is difficult to draw definite conclusions about how seriously coral reefs have been affected by fishing activities. An initial survey by the Institute of Marine Research in 2000 suggested that 30–50

per cent of the reefs were damaged, mainly by bottom trawling. However, the Institute has since then mapped a number of previously unknown reefs that are not damaged, so that the proportion of damaged reefs may be lower than previously thought.

Benthic habitats such as coral reefs are also important for benthic-spawning species of fish, for example redfish.

Alien species such as the red king crab may also have significant impacts on benthic communities. The Institute of Marine Research has started a five-year research programme to study the ecological impacts of this species.

To protect coral reefs from damage, a provision has been laid down in the Regulations relating to sea-water fisheries (section 66) requiring special care to be exercised near known coral reefs. In addition, the use of bottom gear is prohibited on and near certain large coral reefs, such as Røstrevet.

5.2.4 Bycatches of seabirds and marine mammals

Bycatches of seabirds and marine mammals in fishing gear can be a problem in certain areas and at certain times of year. Bycatches increase the mortality of the species affected, and are a nuisance and cause extra work for fishermen. The species caught as bycatches in gill nets are mainly diving birds, which become entangled and drown. This is one explanation for the decline of several species of auks in North Norway. The prohibition on drift netting for salmon introduced in 1989 has substantially reduced bycatches in gill nets. Fulmars are the seabirds most seriously affected by longlining, but their numbers are so large that bycatches do not constitute a threat at population level. Fishermen try as far as possible to avoid bycatches of seabirds. This is both because bycatches make fishing operations less efficient and because they are an ethical problem. Considerable efforts are being made to reduce bycatches.

Marine mammals can also become entangled in gill nets and drown. Seals and porpoises are particularly at risk. When food supplies are poor, seals may undertake mass migrations, as exemplified by the harp seal invasion along the Norwegian coast in the winter of 1986–87. Records show that about 60 000 harp seals drowned in fishing nets that winter. Although migrations on this scale are rare, this shows that bycatches can at times be

a serious problem. Before it was prohibited in 1989, drift netting for salmon was having a serious impact on the porpoise population.

5.2.5 Fisheries and the underwater cultural heritage

Fishing gear that is towed along the seabed has three main impacts on the underwater cultural heritage:

1. Mechanical damage.
2. Displacement of part or all of the underwater cultural heritage. This results in loss of site integrity and alters factors important in the preservation of the site.
3. Removal of objects that become entangled in the fishing gear.

Impacts of all three types have been registered where underwater cultural heritage has been affected by trawling in the Norwegian Sea and North Sea and by dredging for molluscs north of Spitsbergen. The cultural heritage authorities have not been able to survey the extent of the damage caused by ordinary fishing operations in the Barents Sea–Lofoten area. However, it should be noted that commercial fishing largely takes place in areas where underwater cultural heritage is likely to be found. It is known that wrecks often function as artificial reefs, so that fish concentrate

around them and attract fishermen. More knowledge of these issues is needed, see Chapter 8.

5.3 Pressures and impacts associated with the oil and gas industry

5.3.1 Introduction

Seismic surveys and exploration drilling for oil and gas began in the Barents Sea–Lofoten area in 1980, see figure 5.4. Some discoveries have been made, mainly of gas but also some oil, but so far there has been no year-round petroleum activity in this area. However, the plan for development and operation for the gas and condensate field Snøhvit north-west of Hammerfest has now been approved, and it is expected to come on stream in 2007. There are plans to drill two more appraisal wells on the nearby Goliat oil field before a decision is taken on whether it can be developed. So far, 65 exploration and appraisal wells have been drilled in the Barents Sea–Lofoten area. In 2005, 54 new blocks or parts of blocks were announced in connection with awards in predefined areas (around Snøhvit) and in the 19th licensing round. Petroleum activities in the Barents Sea are not believed to have had significant environmental impacts up to the present..

In general, the oil and gas industry can have negative impacts on the environment through operational discharges of chemicals and oil to the

Box 5.1 General zero-discharge targets for the oil and gas industry on the Norwegian continental shelf

Environmentally hazardous substances

- Zero discharges or minimal discharges of naturally-occurring environmentally hazardous substances that are also priority substances (as defined in national target 1 for hazardous substances in the white papers on the Government's environmental policy and the state of the environment in Norway).
- Zero discharges of chemical additives that are black-category (use and discharges prohibited as a general rule) or red-category substances (high priority given to their replacement with less hazardous substances). The categories are from the system used by the Norwegian Pollution Control Authority, and further details are given in the Activities Regulations for the petroleum industry).

Other substances

Zero discharges or minimal discharges of the following if they may cause environmental damage:

- oil (components that are not environmentally hazardous),
- yellow-category substances (not defined as belonging to the black or red categories and not on the OSPAR List of substances/preparations used and discharged offshore which are considered to pose little or no risk to the environment (PLONOR)),
- drill cuttings,
- other substances that may cause environmental damage.

Box 5.2 Special requirements for oil and gas activities in the Barents Sea

The requirements for activities in the Barents Sea–Lofoten area were described in a white paper on oil and gas activities (Report No. 38 (2003–2004) to the Storting) and are listed below:

- Injection or another suitable technology must be used to prevent discharges of produced water.
- A maximum of 5 per cent of the produced water may be discharged during operational deviations provided that it is treated before discharge. Precise requirements for treatment will be set by the licensing authorities in each case.
- Drill cuttings and drilling mud must be reinjected or taken ashore for treatment.
- Drill cuttings and drilling mud from the top-hole section may be discharged provided that they do not contain substances with unacceptable properties, i.e. environmentally hazardous substances or other substances that may have a negative impact on the environment. However, such discharges are only permitted in areas where assessments indicate that damage to vulnerable components of the environment is unlikely. Such assessments must be based on thorough surveys of vulnerable components of the environment (spawning grounds, coral reefs, other vulnerable benthic animals). Operators will be required to apply for permits for such discharges.
- Petroleum activities in the area must not result in damage to vulnerable flora and

fauna. Areas that might be affected must be surveyed before any activities are started.

- There must be no discharges to the sea in connection with well testing.
- Oil spill response measures must be at least as effective as on other parts of the continental shelf.

The requirement for zero discharges of drill cuttings and produced water to the sea is considerably stricter than the standards that apply on other parts of the Norwegian continental shelf. This is illustrated in figure 5.3, which compares discharges from two of the wells drilled in the Barents Sea in 2005 according to the new, stricter rules with discharges from a well drilled in 2000 following the earlier rules. The overall reduction in discharges is large, particularly for red- and yellow-category substances, see box 5.1. Discharges of green-category substances consist mainly of clay, salt and starch. The discharges in 2005 were mainly from drilling of the tophole sections of the well. These discharges have no significant environmental impacts provided that they are not released in areas that are vulnerable to sedimentation.

Licensees who have been awarded licences for blocks within the Barents Sea–Lofoten area will not be permitted to engage in year-round petroleum operations unless they can substantiate that their operations will meet the requirement for zero discharges to the sea.

sea, mechanical disturbance of the seabed, the effects of seismic surveys on fish and marine mammals, and emissions of NO_x, VOCs and CO₂ to air. Given the strict standards that apply to petroleum activities in the Barents Sea, see box 5.2, discharges to the sea and mechanical disturbance of the seabed are not expected to have significant environmental impacts.

5.3.2 Oil and other chemicals

For the Barents Sea–Lofoten area, there is a general requirement to achieve zero discharges to the sea from petroleum activities during normal

operations. No discharges of drill cuttings are permitted, except for cuttings from the tophole section in certain cases, and nor are discharges of produced water, see box 5.2. The general zero-discharge targets apply to the limited discharges that cannot be avoided, see box 5.1 for further details.

These standards can be achieved using existing technology and methods and new technology that is being developed. The petroleum industry is continuing to work on alternative technology that combines better environmental results with satisfactory technical performance. Assuming that current requirements for zero discharges to the sea, stable injection of produced water, and injection or

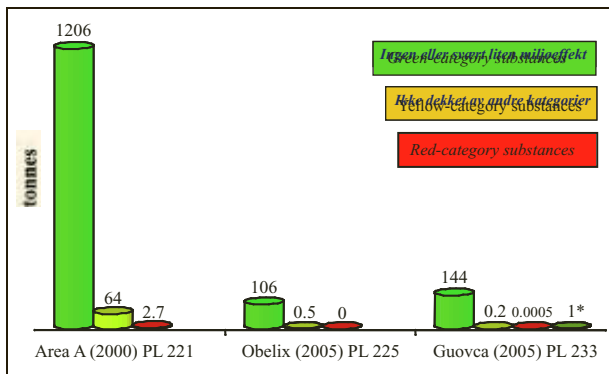


Figure 5.3 Operational discharges from two exploration wells drilled in the Barents Sea in 2005 compared with discharges from an exploration well drilled in 2000

Source: Norwegian Petroleum Directorate

transport ashore of drill cuttings are met, petroleum operations are not expected to have significant negative impacts on the marine environment. Operational discharges during current exploration activities have not been shown to have any environmental impact. Work is in progress to learn more about any impacts green- and yellow-category substances may have in Arctic areas.

There will inevitably be some small-scale accidental spills, for example of drilling fluids, diesel oil or hydraulic fluid, and operational deviations during injection of produced water. Such discharges generally only have local, short-term environmental impacts of no great significance. However, they may attract disproportionate interest because the planned operational discharges are so limited. Systematic efforts are therefore being made to minimise such spills. The probability of a major oil spill during drilling is very low, but a large spill could have serious effects, see section 5.7 for more details.

5.3.3 Impacts on the seabed and the underwater cultural heritage

A condition for drilling in the Barents Sea is that only drill cuttings from the tophole section may be discharged to the sea. Cuttings from the remainder of the well must be taken ashore or reinjected. The impact of deposition of drill cuttings from the tophole section will be very limited and local. To ensure that local sedimentation does not harm vulnerable benthic organisms including corals, the sites for wells must be selected to

avoid such impacts. Sites are selected on the basis of surveys of the seabed made before drilling starts. Thus, petroleum activities in the Barents Sea are expected to have only an insignificant impact on the seabed

In connection with plans for exploration drilling and field development on the Norwegian continental shelf, operators are always required to map any underwater cultural heritage in the vicinity of possible drilling sites and pipeline routes.

5.4 Pressures and impacts associated with maritime transport

5.4.1 Introduction

The Barents Sea–Lofoten area is used by a variety of vessel types – fishing vessels, tankers and bulk carriers, other cargo vessels and passenger ships. Many parts of North Norway are completely dependent on maritime transport for the normal functioning of business activities and society. Shipping 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. The extent of these impacts will depend on various factors, including the scale and frequency of pressure factors and the vulnerability of the environment. The volume of maritime transport is much lower in this area than in other areas under Norwegian jurisdiction, and the overall pressure on the marine environment will therefore also be lower than elsewhere. Maritime transport also represents a risk of spills of oil and chemicals, see section 5.7. Systematic efforts are in progress, particularly under the auspices of the International Maritime Organization, to make maritime transport a more environmentally sound form of transport, as described in Chapter 4.5.

The volume of shipping in the management plan area will be influenced by general trends in the development of society. 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. In future, transit of oil from Northwestern Russia and transport of gas from the LNG plant at Melkøya near Hammerfest is expected to result in a further increase in the volume of shipping.

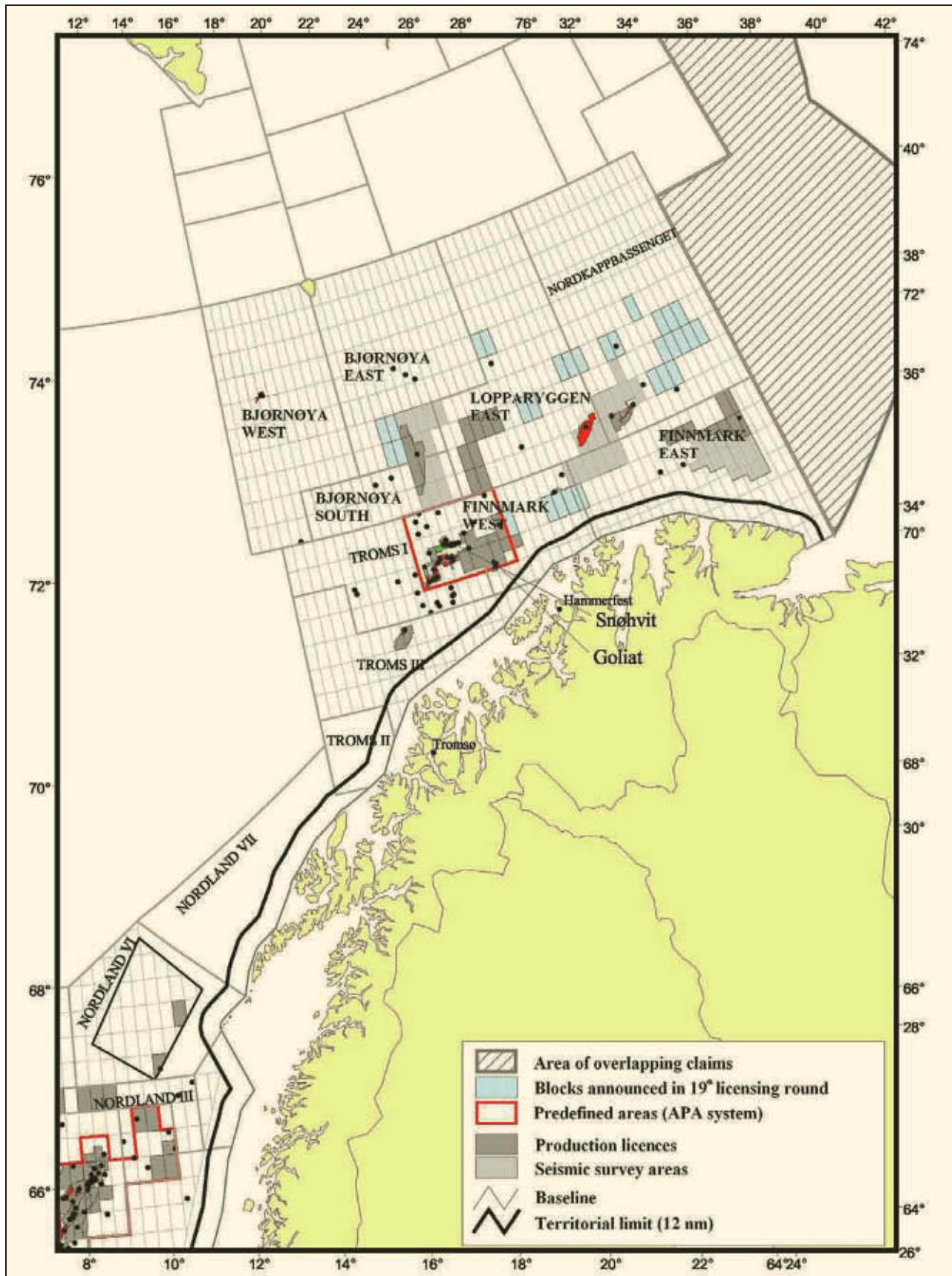


Figure 5.4 Areas where production licences have been awarded, seismic survey areas, predefined areas (APA system), and blocks announced in the 19th licensing round

Source: Norwegian Petroleum Directorate

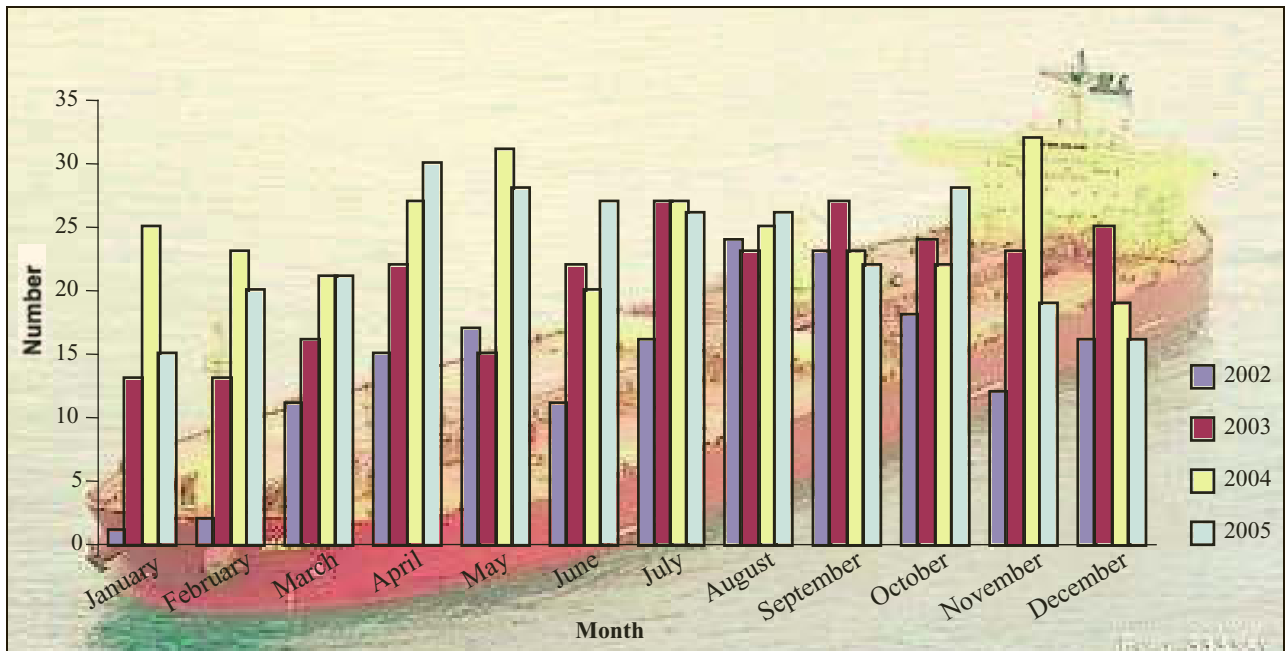


Figure 5.5 Number of oil tankers sailing from Northwestern Russia along the Norwegian coast in the period 2002–2005

Source: Regional Command North Norway

5.4.2 Operational discharges to the sea

The day-to-day impacts of shipping on the environment are caused by ordinary operational discharges. The routine discharges to the sea that have most impact on the environment are operational discharges of oil and the release of organotin compounds from anti-fouling systems. Discharges of sludge and oily bilge water from machinery spaces and discharges of oil and oily mixtures from the cargo area (slops) are regulated internationally by MARPOL 73/78 (International Convention for the Prevention of Pollution from Ships). The Convention permits a certain level of discharges of oily bilge water and oily mixtures from tank washings. However, all ships are required to have segregated ballast tanks by 2010, and this will eliminate discharges of oily ballast water. Oil slicks on the sea are reported every year, and most of these are believed to be from illegal discharges from ships. The frequency of such discharges is assumed to be proportional to traffic density, but there are uncertainties in the models used to estimate discharge figures.

The steady pressure on the marine environment caused by oil pollution will have negative impacts, particularly on seabird populations. However, it has not been possible to quantify the impacts on the management plan area.

To protect ships against corrosion, zinc

anodes are used in addition to special paints. If zinc anodes are used in ballast tanks, the zinc content in the water discharged may exceed the tolerance limits of fish eggs and larvae by a factor of 10 to 100. This may have local impacts in areas where ballast water is discharged, but no such impacts have been registered.

5.4.3 Introduction of alien species

Today, the introduction of alien species is considered to be one of the most serious threats to biodiversity in marine ecosystems. However, we know little about the impacts of this, see Chapter 8.3.5.

The most important anthropogenic transport routes for alien species into the Barents Sea–Lofoten area have thus far been maritime transport and aquaculture. Vessels from other parts of the world where the climate and ecological conditions are similar to those in the Barents Sea–Lofoten area represent the greatest risk. Organisms from regions where the climate and ecological conditions are different are unlikely to survive. Maritime transport to Norway and tanker traffic to Northwestern Russia are currently dominated by vessels from large European ports. These tend largely to call at ports in the same biogeographical area, and take ballast water from areas where the flora and fauna is similar to that in Norwegian waters. However, there is a risk of the further

spread of alien species that are established in these waters to the management plan area, either in ballast water or attached to ships' hulls. Other categories of vessels such as general cargo and container ships operate in a global market. A good many of these are likely to come from foreign ports in other biogeographical zones, but where physical and chemical conditions are similar to those in Norway. In future, there may be a particularly high level of risk associated with use of the Northwest Passage combined with failure to treat ballast water. This could result in the introduction of a number of species from the species-rich Pacific Ocean, which would be well adapted to conditions in the Barents Sea–Lofoten area.

In 2004, IMO adopted the International Convention for the Control and Management of Ships' Ballast Water and Sediments (Ballast Water Convention). The Convention lays down that during a transitional period, ballast water exchange shall be conducted in open waters (at least 200 nautical miles, or if this is not possible, at least 50 nautical miles, from the nearest land and in water at least 200 metres in depth). Requirements for treatment of ballast water will be introduced over a period of time from 2009 to 2016, depending on the size of the ship and the year of construction. The Convention has not yet entered into force, and the

introduction of alien species with ballast water will therefore continue to be a threat throughout the period up to 2020.

Alien species, particularly benthic species and species with a benthic stage in the life cycle, may also be introduced as fouling on ships' hulls. This is very difficult to prevent, and this route of introduction will therefore continue to be a problem in the period up to 2020.

International agreements on ballast water exchange and treatment, and the general increase in awareness of the problems associated with ballast water, are expected to reduce the risk of negative impacts. It is much more difficult to reduce the risk of introduction of alien species attached to ships' hulls. This is because the most effective anti-fouling systems themselves have negative impacts on the environment.

5.5 External pressures

5.5.1 Introduction

The state of the environment in the Barents Sea–Lofoten area is also affected by activities in other parts of the world. Environmentally hazardous substances can be transported over long distances by air and ocean currents. The climate in this

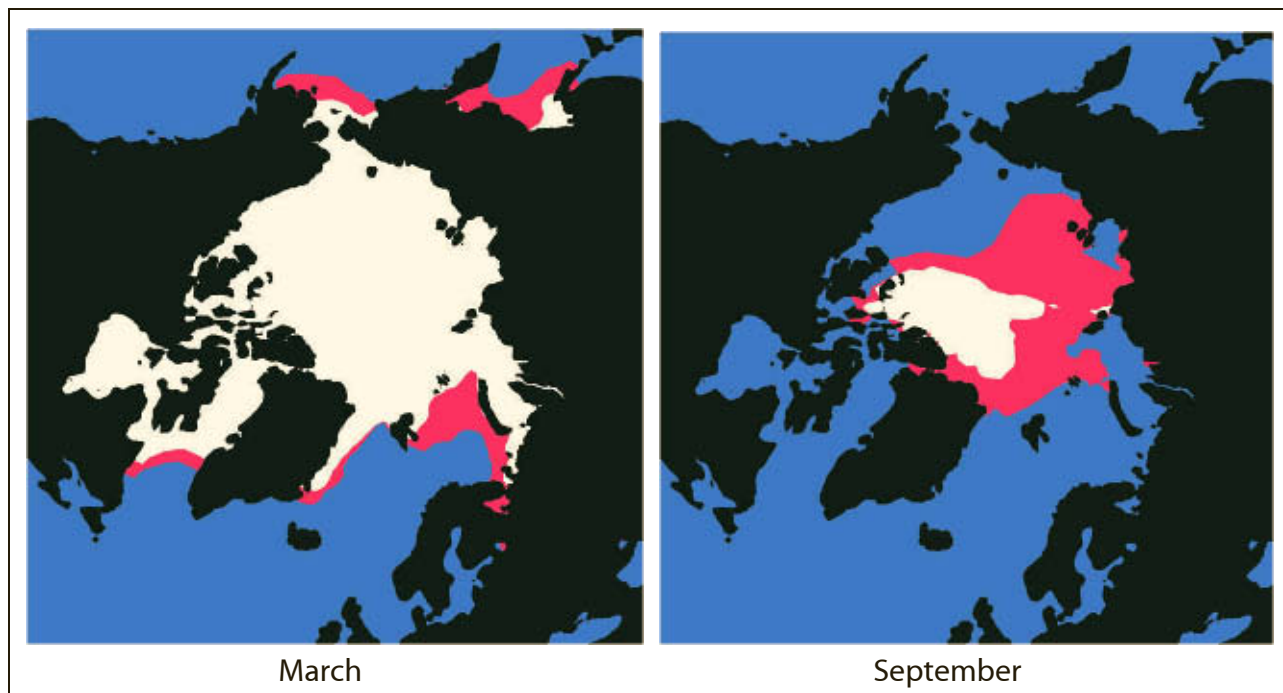


Figure 5.6 Extent of sea ice in March and September modelled using the Bergen Climate Model (BCM). The maps show ice cover in today's climate (white and pink areas) and after doubling of the atmospheric concentration of CO₂ in about 75 years' time (white areas). Ice cover averaged over 10 years.

Source: Bjerknes Centre for Climate Research

area may change as a result of greenhouse gas emissions worldwide, and alien species may be introduced from other oceans. The most important external pressures are:

- climate change,
- long-range transboundary pollution,
- pollution originating in neighbouring areas,
- alien species, see also section 5.4.3.

5.5.2 Rising atmospheric greenhouse gas concentrations and climate change

The Intergovernmental Panel on Climate Change (IPCC) has documented that the world's climate is changing. There is general agreement that most of the rise in greenhouse gas concentrations in the atmosphere has been caused by anthropogenic emissions. This rise has altered the heat balance of the earth-atmosphere system and enhanced the greenhouse effect. This will probably result in continued global warming and changes in the climate system. These changes may have major impacts on ecosystems and on society, and in the longer term this may be the most important pressure in the Barents Sea–Lofoten area as well.

The reports from the Arctic Climate Impact Assessment (ACIA), which was carried out for the Arctic Council, clearly show that climate change is already taking place in the Arctic. This was discussed further in the most recent white paper on the Government's environmental policy and the state of the environment in Norway (Report No. 21 (2004–2005) to the Storting). However, according to the regional-scale climate models used by the ACIA, and the Bergen Climate Model (BCM), no major changes in any of the key climate parameters are expected in the area covered by the management plan in the period up to 2020. This is because the climate models show long-term trends, and the period up to 2020 is too short for any significant changes to become apparent. The annual mean air temperature is projected to rise by about 1 °C in the Arctic as a whole, and any impacts of climate change on ecosystems in this area are not therefore expected to exceed the range of natural variation before 2020. However, the temperature rise has been about twice as fast in the Arctic as in the rest of the world in the past few decades, and this trend is expected to accelerate. Melting of ice and snow is increasing, and as a result heat from the sun is being absorbed by the sea, soil and atmosphere rather than being reflected back to space. It is projected that the

accelerating global warming trend will result in a temperature rise of 4–7 °C in the atmosphere over the next 100 years. One result may be the total loss of summer sea ice cover in the Arctic seas over the next 60–80 years.

The uncertainty of the climate scenario after 2020 and of the impacts of the projected climate change is high. However, in the longer term it is expected that the marginal ice zone will move northwards and eastwards. By 2080, there may be no ice cover in the Arctic in summer, see figure 5.6. However, in winter the marginal ice zone may still stretch as far south as Spitsbergen. The sea surface temperature may rise by 1–1.5 °C throughout the Barents Sea–Lofoten area. It is estimated that mean wind strength will rise by 10–20 per cent during the course of this century. There may be fewer winter storms, but their intensity is likely to increase. There is a certain probability that the Icelandic Low will be displaced northeastwards, which may mean that more Atlantic water will flow into the Barents Sea. These changes in the climate may have major impacts on biodiversity

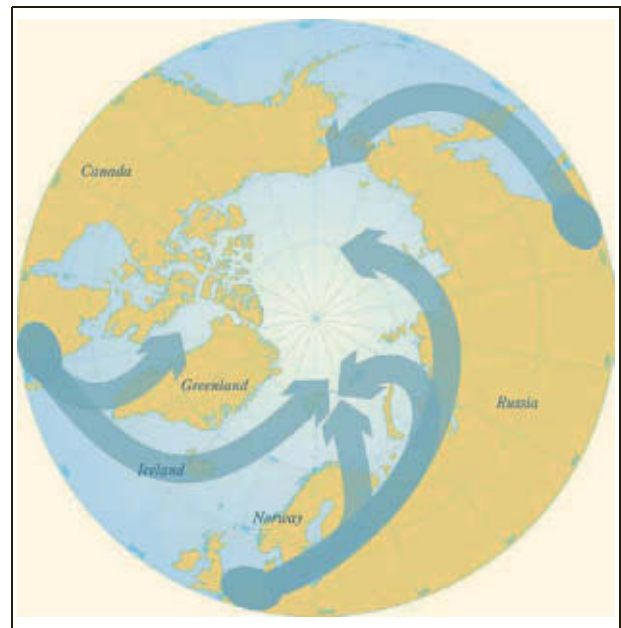


Figure 5.7 Main atmospheric transport routes for chemicals entering the Arctic. Long-range transport is the main source of environmentally hazardous substances in the Arctic, although there are also local sources. Svalbard and the surrounding seas are particularly vulnerable because atmospheric conditions and the Gulf Stream carry pollutants from major industrial centres in Europe and on the east coast of North America to this area.

Source: Norwegian Pollution Control Authority and Norwegian Polar Institute

Box 5.3 Environmentally hazardous substances follow food chains

Many chemicals are toxic, but there is special concern about substances that accumulate in the tissues of living organisms and become more concentrated from one level to the next in food chains. They are dangerous because even if they are only found in low concentrations in products or are released in small quantities, their concentrations in animals and people can build

up over time. Species at the top of food chains, such as birds of prey, polar bears, whales and large predatory fish, are therefore particularly vulnerable to environmentally hazardous substances. People are also at the top of the food pyramid, so that such substances are also a long-term threat to our own food supplies.

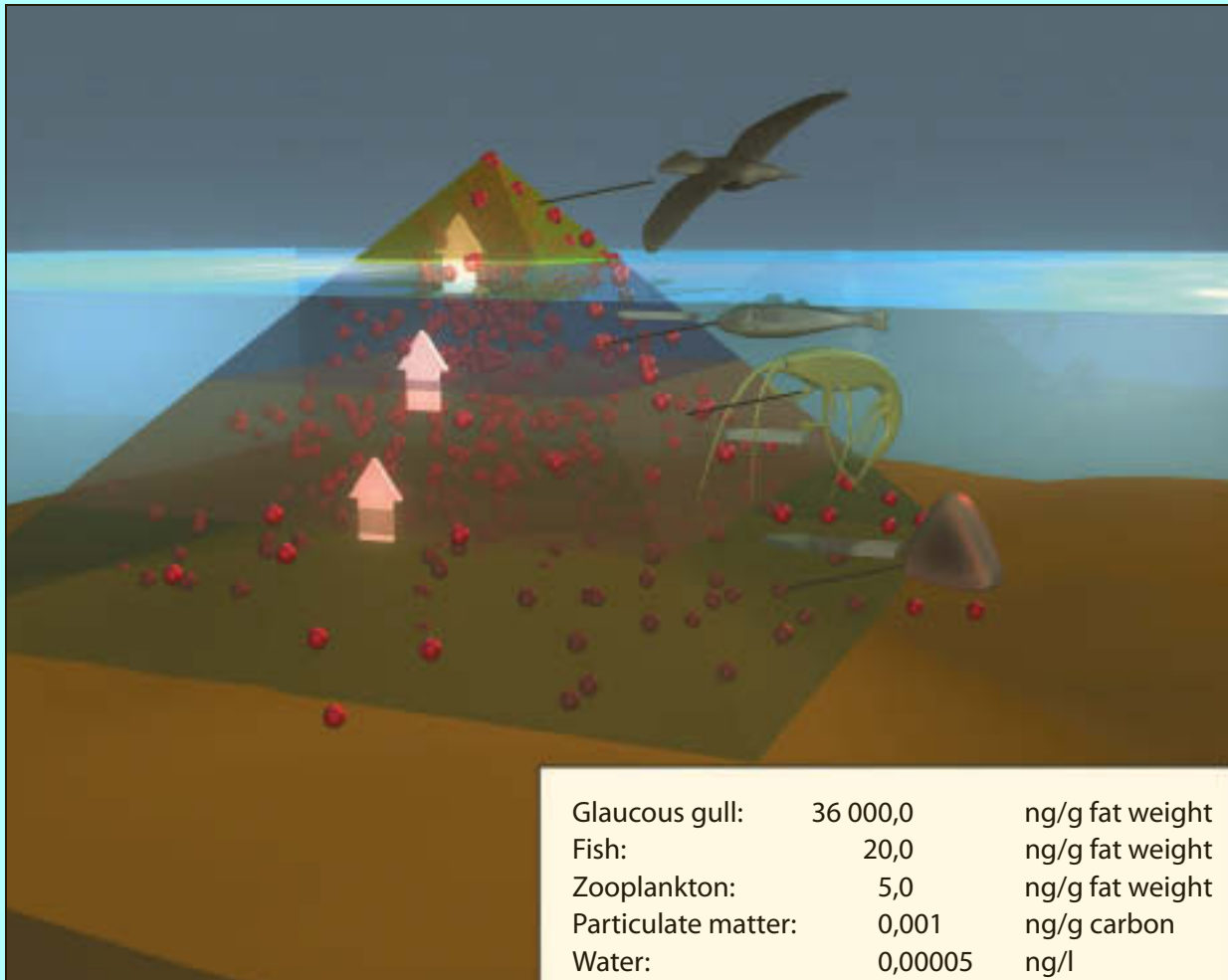


Figure 5.8 Bioaccumulation of PCBs (red spheres) in an Arctic food chain.

Source: Norwegian Polar Institute

and the distribution and biomass of different species in the management plan area. For example, a rise in sea temperature may displace the southern distribution limit of cold-water species northwards, while southerly species shift northwards. The range of species such as cod and herring is expected to extend northwards, whereas the distribution of capelin, polar cod and Greenland hali-

but will shrink. Migration patterns are also expected to change, but the degree to which this happens may vary over the year: for example, herring may respond differently during spawning, larval drift and in winter. The polar bear population will decline as a result of lower reproductive success and higher mortality, because suitable habitat will be lost as the ice cover retreats. Blooms of cocco-

Box 5.4 Environmentally hazardous substances of very high concern, and radioactive substances

The most environmentally hazardous substances are persistent and bioaccumulative as well as toxic (PBT substances). Because such substances persist in the environment after they are released, they can cause irreversible long-term damage to health and the environment. They can be transported over long distances to other parts of the world, and thus end up in vulnerable areas such as the Arctic. Many of the most dangerous of these substances condense out of the atmosphere in the cold Arctic climate and then enter food chains.

Substances that are very persistent and very bioaccumulative are also of high concern, even if we do not currently know what kind of damage they can cause to health or the environment.

A number of *heavy metals* and *organic pollutants* can bioaccumulate and are toxic, and there-

fore pose serious risks to the environment. *Endocrine disruptors* can affect the hormone balance in humans and animals, and for example reduce their reproductive capacity.

Radioactive substances emit ionising radiation. Some occur naturally, whereas others are formed by human activities. Radiological toxicity varies widely from one substance to another depending on how readily they are absorbed by living organisms, the type of radiation they emit and its intensity. Radioactive substances are unstable and decay over time. Half-life is used as a measure of how long-lived a radioactive substance is, and can vary from only a few seconds to several hundred thousand years. Substances with long half-lives, like PBT substances, can be transported over long distances and bioaccumulate and harm living organisms.

lithophorids have become more frequent in the Barents Sea–Lofoten area in the last few years, and some species, such as the blue whiting, are expanding into the area. Greater changes in climate are expected in the northern part of the management plan area than further south. Improving knowledge of climate change and its causes and impacts is a global task that requires further effort, see Chapter 8.

5.5.3 Long-range transboundary pollution

Long-range transport of persistent organic pollutants and certain metals from the rest of the world is currently the most important pollution-related pressure on the Barents Sea–Lofoten area, see box 5.4. Pollutants are transported into the area by winds, ocean currents, rivers and ice.

Atmospheric transport is the most rapid route for persistent organic pollutants (POPs) such as polychlorinated biphenyls (PCBs) and mercury. These substances mainly enter the Arctic through long-range transport from sources in Europe, North America and Asia. There are no large rivers that transport pollution directly into the management plan area. However, there are indications that PCB pollution in the Barents Sea may derive indirectly from releases in Russia. Pollutants such as PCBs and oil components in large

Russian rivers such as the Yenisey and Ob can be carried into the Kara Sea where they are incorporated into ice and can be transported onwards into the Barents Sea. In addition, ocean currents, particularly the Norwegian coastal current, transport pollution into the Barents Sea. Transport routes and the deposition of organic compounds and heavy metals in the Arctic may be strongly influenced by climate change, especially after 2020.

Levels of *heavy metals* such as mercury and cadmium are so high in certain species of seabirds and marine mammals today that they are expected to cause damage to the nervous system and disrupt the hormone balance and immune system in species at the top of the food chains (top predators), for example glaucous gulls and polar bears, see box 5.3. The rise in mercury pollution is expected to continue up to 2020, whereas inputs of other metals such as lead and cadmium are expected to drop as a result of international regulation of their use, such as the phase-out of leaded petrol. However, levels of metals such as platinum, rhodium and palladium are rising rapidly as a result of emissions from catalytic converters fitted in car engines. It is not known what the impacts of these metals may be.

Persistent organic pollutants (POPs) such as PCBs, dioxins and dioxin-like compounds and DDT (dichloro-diphenyl-trichloroethane) have

also been shown to have negative impacts on top predators. They cause such serious damage that whole populations can be affected. One reason is that the pollution load they carry impairs the ability of such species to withstand other forms of stress like food shortages. Despite international efforts to reduce the use and releases of these substances, DDT and other POPs are still entering the Arctic, and elevated levels will persist for many years. Inputs of new substances with the characteristics of POPs are expected to rise. For example, rising levels of the extremely persistent compound PFOS perfluorooctyl sulphonate have been registered in Arctic animals.

The concentrations of radioactive substances of anthropogenic origin in the Barents Sea–Lofoten area are not so high that current knowledge indicates any likelihood of adverse environmental impacts. However, an accident involving releases of radioactivity could result in considerably higher inputs of radioactive substances.

5.5.4 Pollution originating in neighbouring areas

5.5.4.1 Petroleum activities outside the management plan area

Operational discharges from petroleum activities outside the management plan area are not expected to have any significant impacts on this area, although it is possible that pollutants discharged to the North Sea and Norwegian Sea can be transported to the Barents Sea–Lofoten area with ocean currents. Pollutants released by the Russian oil and gas industry will mainly be transported away from areas off mainland Norway, but may have some impact on the northern Barents Sea and Svalbard. Chapters 4.4 and 5.3 give further information on sources of pollution from the petroleum sector, how the industry is regulated, and its environmental impacts.

There have been few studies of the extent to which individual pollutants (for example alkyl phenols) released during petroleum activities in the North Sea and Norwegian Sea are in fact transported into the management plan area. Until now, measurements have not revealed the presence of alkyl phenols or any negative impacts of petroleum-related pollutants in the management plan area. However, methods for effects monitoring in the sea have not been sufficiently standardised. Methods for identifying and monitoring the effects of releases from the oil and gas industry are being developed and tested further



Figure 5.9 Concentrations of environmentally hazardous substances increase from one level to the next in food chains. Polar bears and other top predators are therefore particularly vulnerable.

Source: Norwegian Polar Institute (Photo: Magnus Andersen)

south on the Norwegian continental shelf. The most recent research results from investigations of alkyl phenols indicate that these substances do not have population-level effects on cod, and that effects are only likely in the immediate vicinity of discharges. As a result of dilution, and given the distance to the Barents Sea–Lofoten area, discharges further south on the continental shelf are not expected to have effects in the management plan area. A research programme on the long-term effects of discharges to the sea from petroleum activities (PROOF) will add to our knowledge in this field and develop methods for effects monitoring. Continual efforts are being made to improve effects monitoring methodology, particularly in view of the rising discharges of produced water on other parts of the Norwegian shelf.

Acute oil pollution originating from a field south of the Barents Sea–Lofoten area could have far-reaching effects, as could a tanker accident. Either type of accident could affect important fish stocks, seabirds and beaches. However, even a



Figure 5.10 Red king crab

Source: Photo: Bjørn Gulliksen

major spill is not expected to pose a threat at population level, except in the case of species that are already vulnerable and where a significant proportion of the population could be affected, for example common guillemot and puffin. The probability of a major spill is low.

There is no offshore oil or gas production in the Russian sector of the Barents Sea today. However, a number of possible deposits have been discovered on the Russian continental shelf, some of them in the Barents Sea. At present, there is so little activity in the Russian offshore industry that there is only a low probability of an acute pollution incident in the period up to 2020. Discharges from the Russian sector would mainly affect the marginal ice zone and populations of animals that migrate between Russian and Norwegian waters. Pollution released from Russian onshore petroleum facilities may be transported into the northern part of the management plan area if oil components or other pollutants are incorporated into ice from the large Russian rivers or into sea ice.

5.5.4.2 Maritime transport outside the Barents Sea–Lofoten area

The growing tanker transport of crude oil and petroleum products represents the greatest risk of acute pollution that could have an impact on the management plan area, see section 5.7. A shipwreck just south of the management plan area could affect the Lofoten Islands and waters around them, and have effects on important fish stocks, seabirds and the shoreline. However, even a major spill is not expected to pose a threat at population level, except in the case of species that are already vulnerable and where a significant proportion of the population could be affected, for example common guillemot and puffin. A spill northeast of the management plan area would only affect Norwegian waters if conditions were unfavourable, since the current systems would normally carry oil away from these areas. However, oil could be frozen into the ice and later transported into the northernmost part of the management plan area and towards Svalbard. This could have local effects when the ice melts.

5.5.4.3 Alien species

The introduction of alien species is considered to be one of the most serious threats to biodiversity in marine ecosystems today. Alien species can be a threat to ecosystems and valuable marine resources in several ways, but mainly by competing for food with native species or through overgrazing/overforaging of resources. However, we know little about the effects of alien species, particularly invasive species that may alter the structure of the whole ecosystem.

The red king crab is an introduced species. In Norwegian waters, it occurs mainly and at highest density along the coast of Finnmark. In the Barents Sea itself, king crabs are regularly caught in trawls, but the numbers indicate that their density is fairly low here at present. However, further east in the Russian zone of the Barents Sea, densities are much higher, probably because the habitat is more suitable. The red king crab is a vector for the parasite *Trypanosoma murmanensis*, and the presence of the crabs may therefore result in an increase in the level of infection in cod. However, it is too early to determine how serious a problem this is. Research is in progress on the ecosystem effects of king crabs, and the results so far indicate that the species is not having major ecosystem effects.

However, there has generally been little research on the effects of alien species on ecosystems and biodiversity, and it is therefore difficult to predict what effects can be expected in the period up to 2020.

5.5.4.4 Pollution from onshore and near-shore sources

There are relatively few large sources of onshore or near-shore pollution close to the Barents Sea–Lofoten area, and pollution levels are relatively low in near-shore waters. However, small-scale releases from many different sources such as landfills, fish farms, contaminated sites and small enterprises may have the overall effect of raising pollution levels in near-shore waters. In many harbours where there are or have been shipyards or boat-builders' yards, the sediments are polluted by tributyl tin (TBT) and tar. PCBs have also been found in some areas. However, onshore and near-shore pollution in these areas has most impact on coastal waters outside the management plan area, see Chapter 2.4. This situation is not expected to change before 2020.

5.5.5 Impacts of external pressures – summary

The impacts of external pressures on the Barents Sea–Lofoten area are not expected to change significantly in the period up to 2020. According to current climate models, any impacts of climate change on ecosystems in this area are not expected to exceed the range of natural variation before 2020. However, the possibility of much more rapid climate change cannot be ruled out, and more knowledge is needed of how climate change may affect the marine environment. In the longer term, substantial impacts are expected. Long-range transport of environmentally hazardous substances will continue to be a serious problem, as these substances accumulate in top predators in the Arctic. Unless inputs are reduced, these species will continue to suffer damage to the immune system and reduced reproductive capacity. With few exceptions, too little is known about pollutants in the management plan area, including environmentally hazardous substances and radioactive substances, and particularly about their effects on species and ecosystems.

Current knowledge indicates that other pollution from activities outside the management plan area, such as petroleum activities and maritime transport, will not have significant impacts. Nor are any significant impacts expected as a result of the introduction of alien species outside the management plan area. Current knowledge and the need for knowledge are further discussed in Chapter 8.

There is currently no specific evidence to indicate a rise in the probability of a major accident outside the Barents Sea–Lofoten area that could have a serious impact within this area, for example a nuclear accident. However, the possibility of such an accident can never be ruled out completely.

5.6 Overall pressures and impacts

5.6.1 Introduction

The state of the environment in the management plan area is ultimately dependent on the overall pressures and impacts of all the different activities that take place both within and outside this area. To ensure integrated, ecosystem-based management of the management plan area, it is therefore important to have ways of assessing overall pressures and impacts from the ecosystem from the

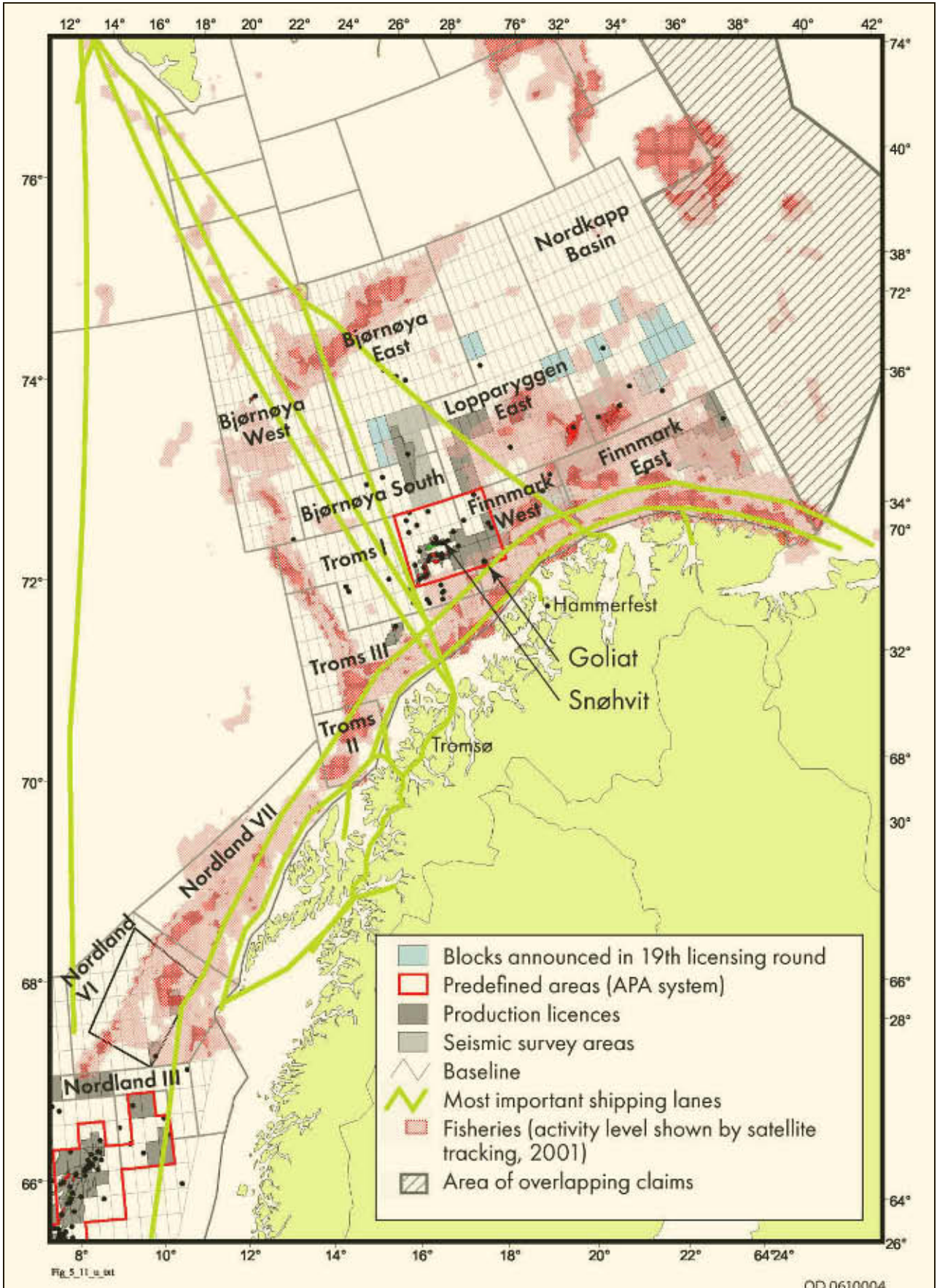


Figure 5.11 Overall pressures in the Barents Sea–Lofoten area

Source: Norwegian Petroleum Directorate

Box 5.5 Combined impacts of environmentally hazardous substances and other stress factors on glaucous gulls

Examples of interactions between the impacts of parasites, foraging costs and hazardous substances on glaucous gulls.

Example 1: Environmentally hazardous substances and low/high foraging costs

Group 1: Adults fly far out to sea to forage for food for their young (high foraging costs). A close relationship has been shown between chick growth and levels of environmentally hazardous substances. Nestlings of adults with high levels of contamination grow slowly.

Group 2: Adult diet dominated by eggs and nestlings from nearby seabird colonies (low foraging costs). In this group, no relationship could be found between nestling growth and levels of contamination.

Example 2: Environmentally hazardous substances and parasites

Group 1: Adult birds were treated to reduce the parasite load. No relationship could be shown between breeding success and levels of environmentally hazardous substances.

Group 2: Adult birds received a placebo. In this group, there was a strong relationship between breeding success and levels of hazardous substances. The higher the contamination level, the lower the probability of breeding success.

These two examples show that environmentally hazardous substances have negative effects on glaucous gulls in combination with other natural stress factors. It seems likely that environmental pressures frequently interact, but that such cases are difficult to identify.

fisheries, petroleum activities and maritime transport, and from external factors such as long-range transboundary pollution.

Overall pressures and impacts have been assessed for different components of the ecosystem. The combined impacts of pressures such as harvesting, unintentional damage, pollution and climate change will not necessarily be the same on primary and secondary production in the sea, benthic communities, fish, seabirds and marine mammals.

The purpose of assessing the overall pressures and impacts, or the way in which these pressures interact, is to identify the components of the ecosystem that are under the greatest overall pressure. This will make it possible to set priorities for measures targeting different parts of the ecosystem.

It is also necessary to assess how much maritime transport, the fisheries, the petroleum industry and external pressures contribute to the overall level of pollution and to overall impacts on biodiversity other than from pollution. Thus, the importance of each sector, particularly as regards pollution, can be identified, making it possible to evaluate measures across sectors.

Both these elements of an overall assessment are difficult to carry out with the knowledge and methods currently available. There are two main reasons for this. Firstly, we only have limited knowledge of the combined impacts of different pressures. For example, little is known about the impacts on polar bears of exposure to several different hazardous substances. It is also a difficult task to develop a sound scientific understanding of the overall impact on seabirds of harvesting of fish, climate change, hazardous substances and oil pollution, see box 5.5. Gaining a better understanding of these issues will require a considerable research effort lasting for some years, see Chapter 8.

Furthermore, it is difficult to quantify total pollution levels and their impact on biodiversity because in many cases, little is known about inputs from particular sectors. For example, one reason for the uncertainty in the estimates of overall pollution levels in the Barents Sea–Lofoten area is that we have no reliable figures for pollution from shipping. In addition, the impacts of operational discharges of oil vary with the type of oil discharged, when and where it is discharged, and the species affected; this adds to the uncer-

tainty of estimates of the overall impact on biodiversity. The impacts of pollution on different species may vary widely depending on factors such as how healthy the population is, its capacity for recovery, and the year class of fish involved.

Despite these problems, it is possible to assess overall pressures and impacts at present and up to 2020 in general terms. However, more work is needed in this field. The projections described below are based on the assumptions that there will be an expansion of petroleum activities in both the Norwegian and the Russian sector of the Barents Sea, and that the volume of shipping will also rise. Expected technological and operational developments can also be used as a basis for projections. The assumptions of growth in the volume of shipping and rising petroleum activity add to the level of uncertainty in the projections that have been made.

The risk of acute oil pollution is discussed separately in section 5.7.

5.6.2 Overall pressure and impacts on primary and secondary production

Primary production (phytoplankton production) is dependent on supplies of nutrients, light, and a stable water surface layer. Phytoplankton consists of many different species, a few of which are dominant. The dominant species change during the growing season. Primary production takes place throughout the management plan area, and the phytoplankton drifts with the current systems. Thus, direct local impacts from activities in the area will not have any impact on total production. Climate change may result in larger ice-free areas in the Barents Sea and thus in an increase in the productive area. A rise in water temperature and greater inflow to the Barents Sea may alter the species composition of the phytoplankton, but not necessarily total production expressed as carbon fixation per area of sea surface.

Secondary production (zooplankton production) in the Barents Sea is dominated by a few species of varying size. The copepod *Calanus finmarchicus* and krill are the most important of these. Zooplankton species graze on the phytoplankton and thus form the link between plants and animals in the marine food chains. Zooplankton distribution is also largely determined by the distribution of the different water masses. Although zooplankton may be more concentrated in certain areas such as the polar front and the marginal ice zone, local pressures in the form of pollution will

not have a significant impact on total secondary production in the management plan area. Pollutants, particularly substances that are fat-soluble and only slowly degradable, can be introduced into marine food chains by uptake from the water by zooplankton. However, even if this happens, the concentration of pollutants in the water is so low that any impact on the zooplankton will be very small. Such pollutants only begin to have a significant impact after accumulation through several levels of the food chain.

5.6.3 Overall pressure and impacts on benthic communities

There are currently serious gaps in our knowledge of conditions on the seabed, but the MAREANO programme and the planned monitoring programme, see Chapter 9.7, will improve the situation. It was initially estimated on the basis of the information available that 30–50 per cent of known coral reefs were damaged, probably by bottom trawling, see figure 5.2. However, more recently the Institute of Marine Research has mapped a number of previously unknown reefs that are not damaged, so that the proportion of damaged reefs may be lower than previously thought. Few surveys have been made of the extent of the damage caused by bottom trawling and the ecological effects on sponge communities. However, fishermen tend to avoid such areas, because large concentrations of sponges damage their gear and cause extra work.

Alien species such as the red king crab may also have significant impacts on benthic communities. The Institute of Marine Research has started a five-year research programme to study the ecological impacts of this species.

The organotin compound TBT is found at elevated concentrations in sediments near shipyards, marinas and heavily trafficked ports and shipping lanes. Elevated TBT levels have also been found in mussels and dogwinkles. Imposex has been observed in dogwinkles in polluted areas, and also far away from point sources of pollution, in areas with a high volume of shipping.

Current activities are putting appreciable pressure on benthic communities. Up to 2020, damage already caused to coral reefs by trawling will continue to have an impact, since corals are slow-growing organisms. Success in limiting further negative impacts from the fisheries in this period will require better surveys and the dissemination of information on vulnerable benthic communi-

ties. The impact of anti-fouling systems will gradually be reduced through new measures implemented by IMO, which will be fully in effect from 2008.

5.6.4 Overall pressure and impacts on commercial fish stocks

The greatest anthropogenic impacts on commercial fish stocks in the management plan area are caused by direct fishing operations for these species. Harvesting within the framework of the established management regime does not generally have significant negative impacts on the stocks. However, there is generally considerable pressure to take catches equivalent to the highest recommended levels. The fisheries management regime is still being developed, which is necessary to ensure a sound ecosystem-based management regime in which stocks are considered in relation to each other and to other parts of the ecosystem. It is possible that catches of certain stocks that are being rebuilt, such as redfish (*Sebastes mentella* and *S. marinus*) and Greenland halibut, are too large, even though the fisheries are strictly regulated. However, the Greenland halibut stock does appear to be growing slowly.

Further development of an ecosystem-based fisheries management regime is necessary to ensure sound management of the stocks in relation to each other and other parts of the ecosystem.

IUU fishing in the Barents Sea makes it difficult to know whether management targets for different stocks are being achieved, and the impact of IUU fishing on the ecosystem is uncertain.

Seismic surveying in connection with petroleum activities has not been shown to have impacts at population level, and current knowledge indicates that there is no significant pollution in the management plan area. However, there are important gaps in our knowledge about the possible impacts of external pressures on fish stocks. International efforts to limit releases of hazardous substances will help to reduce inputs of substances that are already in use in the years ahead, but new pollutants will also appear in food chains. It is therefore important to intensify monitoring in this field.

Current activities are considered to have little negative impact on fish resources apart from the impact of deliberate harvesting. In the period up to 2020, there is nothing to indicate that this situation will change to any great extent.

5.6.5 Overall pressure and impacts on seabirds

There is considerable anthropogenic pressure on seabirds in the Barents Sea–Lofoten area as a result of a combination of poor food supplies, bycatches in gill nets, local pollution as a result of oil spills, and bioaccumulation of hazardous substances. The position of seabirds in the ecosystem means that they are considered to be the most vulnerable group of marine organisms. In addition, seabirds from this area are presumably affected by environmental conditions in areas further south where they spend the winter, but too little is known about this.

In the period up to 2020, this situation is not expected to change significantly, so that human activities will continue to have considerable impacts on seabirds unless steps are taken to prevent this. In the longer term, climate change may result in an increase in the overall pressure on seabirds from human activity.

5.6.6 Overall pressure and impacts on marine mammals

Although direct harvesting and unintentional bycatches in fishing gear could have a considerable impact on marine mammals, there is no information to suggest that this is currently happening on a scale that is having an impact on the viability of populations or their growth potential. However, the impacts on vulnerable and endangered species may be greater. Commercial fisheries also have an impact on food supplies for marine mammals. There is no information to suggest that local pollution is having an impact on marine mammals, but there is cause for concern about long-range transport of pollutants, and particularly about the bioaccumulation of slowly degradable organic compounds.

There is no information to suggest that the situation will change significantly up to 2020, so that external pressures will continue to be most important in relation to marine mammals. In the longer term, climate change will be of central importance.

5.6.7 Overall pollution levels

The Barents Sea–Lofoten area can be characterised as generally clean and unpolluted. Current knowledge indicates that there is no significant pollution from maritime transport, the petroleum

industry or the fishing industry in the area. However, we know too little about local pollution as a result of illegal discharges from ships. This could be of importance, primarily for seabirds. Up to 2020, the most important pollution problem will continue to be the long-range transport of environmentally hazardous substances that subsequently bioaccumulate in Arctic food chains. This primarily has impacts on seabirds and marine mammals, and is also important in relation to exports of Norwegian seafood (both wild-caught fish and aquaculture products). Clean seas are essential for the production of safe seafood, which in turn is of crucial importance for sales and exports of Norwegian seafood products. The risk of acute oil pollution is discussed in section 5.7 below.

5.6.8 Overall impacts on biodiversity other than from pollution

The Barents Sea–Lofoten area can be characterised as generally rich; its biodiversity is more or less intact, and the area is under less pressure than other Norwegian waters. Harvesting of fish and marine mammals is the human activity that has most impact, and this is generally carried out sustainably. However, there are gaps in our knowledge of ecosystem interactions, species distribution and unintentional or irregular harvesting (illegal fishing, unintentional bycatches, ghost fishing). Dealing with IUU fishing will be the greatest challenge in the years ahead. It is only possible to develop a responsible resource management regime with adequate knowledge of the entire harvest. If there are large uncontrolled catches, important fish stocks may collapse, leading to changes in the entire ecosystem. The fisheries also have other negative impacts such as unintentional bycatches of seabirds and destruction of benthic communities by bottom gear. Alien species such as the red king crab may have significant impacts on benthic communities, but scientists have not so far shown that this particular species is having an impact. The petroleum and maritime transport industries have not been shown to have significant impacts in the management plan area. No significant changes are expected in the period up to 2020, even with an increase in the volume of shipping and the level of activity in the petroleum industry. However, this conclusion is based on the assumption that the development of a sound fisheries management regime will be continued. The risks associated with alien species and their possible impacts on biodiversity are uncertain for the period up to 2020.

5.6.9 Summary

In summary, the assessments described here confirm that the state of the environment in the Barents Sea–Lofoten area is generally good: the area can be characterised as generally clean, rich and productive. As might be expected, the greatest anthropogenic impact on the ecosystem is caused by the fisheries. The most important task for the fisheries authorities is to continue the development of an ecosystem-based management regime for harvesting biological production, and to halt IUU fishing. It is also essential to rebuild certain fish stocks that have been severely depleted. Improving knowledge of the distribution of fish species, preventing the destruction of vulnerable benthic communities and preventing bycatches of seabirds, fish and other species will be of central importance in ensuring that harvesting continues to be sustainable. In addition, it is important to improve our knowledge of the effects of alien species such as the red king crab on ecosystems and biodiversity. Inputs of hazardous substances to the management plan area from external sources currently give cause for concern. The overall pressures are having most impact on seabirds, but human activities are also having a marked impact on the benthic fauna and marine mammals. Clean, rich seas are of crucial importance for Norwegian exports of safe seafood.

In the period up to 2020, these will continue to be the most important issues unless new instruments or measures are introduced to deal with them. It will also be important to take steps to deal with the risk associated with the introduction of alien species. Up to 2020, it is likely that human activities will continue to have most impact on seabirds, as a result of a combination of poor food supplies, long-range transboundary pollution, bycatches in the fisheries and oil pollution. After 2020, anthropogenic climate change is expected to be the most important pressure on all important components of the ecosystem, including primary production in the sea.

Another key issue is what trend the risk of acute oil pollution is likely to follow. This is discussed below.

5.7 The risk of acute oil pollution

5.7.1 Introduction

No activity can be undertaken without risk, that is to say without some uncertainty about its poten-

tial consequences. This is also true of petroleum activities and maritime transport in the Barents Sea–Lofoten area. An essential part of risk management and communication is to ascertain what knowledge has already been accumulated through the activity in question. We need to know something about experience and future expectations, about technological developments and about how risk can be constrained to increase the safety of the activity. It is therefore important to provide comprehensive information on risk-related issues and to identify clearly:

- the limitations of the analyses and their results, given the evaluations and assumptions on which they are based, and
- the uncertainty underlying every risk-based decision.

The starting point for all safety work is risk identification and understanding of possible accident scenarios and their consequences. An understanding of risk is necessary to prevent accidents, establish an appropriate emergency response system and reduce uncertainty.

The level of uncertainty can be reduced by drawing on accumulated knowledge, experience and scientific methods. Thus, risk-based decisions also involve deciding whether there is an adequate basis for decision-making and what action must be taken to reduce uncertainty. The precautionary principle is one of several possible risk management strategies in this context.

5.7.2 Risk, risk analysis and risk management

In the context of risk analysis, risk is often calculated as the product of probability and consequence, using different risk figures or risk categories. This can be a useful method for comparing risks and finding out which aspects of an activity represent a major or minor risk.

Risk analysis is a decision support tool and an integral part of risk management. Risk analyses and studies are used to acquire as much knowledge about an activity as possible, including knowledge about gaps in the knowledge base. Analysts seek to understand how a dangerous situation can arise and develop, with a view to implementing the most relevant measures where they will be most effective in:

- preventing risks from resulting in actual accidents
- limiting the consequences if an accident does occur.

Risk analyses must necessarily be based on certain assumptions and evaluations, supported to a varying degree by experience, knowledge, scientific methods and future expectations. It is therefore essential to know what a risk analysis is based on and to be aware of the inherent limitations of risk analysis. Part of the process is to identify what we know and what we do not know, what has happened in the past, what we expect in the future, and how we can reduce the risk in order to ensure that activities can be carried out safely.

In focusing on the results or figures that are generated by risk analyses, it is important not to forget the original reason for assessing these factors, which is to obtain the necessary knowledge to control risk in every activity. Carrying out a risk analysis increases understanding of the risks prior to implementing risk-reducing measures.

Risk is not a static property that is inherent in a given activity and cannot be influenced. Risk changes over time, for example in step with traffic developments, implementation of measures, lessons learned from accidents, failure and success, introduction of new technology, development of new working methods, updating of legislation and follow-up activities initiated by the industry and by the authorities.

5.7.3 Impacts of acute oil pollution and the environmental risk concept

The impacts of acute oil pollution on the marine environment are many and varied, but the most important can be summarised as follows:

- Drifting oil slicks may contaminate seabirds that are closely associated with the water surface when feeding, diving or resting.
- Oil that drifts ashore may contaminate seabirds and other birds which use the littoral and supra-littoral zone when feeding or resting. Under particularly unfavourable conditions, oil may affect a considerable proportion of the populations of vulnerable species such as the common guillemot and the Atlantic puffin.
- Oil that drifts on the water surface and on to beaches may contaminate mammals that are closely associated with the sea (for example seals, otters and mink).
- Oil that drifts ashore may foul or smother and cause damage to plants and animals in the littoral and supra-littoral zone, and may also penetrate deep into the soil and sediments. It will

then leach into the water, causing long-term exposure to oil.

- Oil that drifts ashore may be whipped up by strong winds and foul beaches and salt marshes, where it will smother and have toxic effects on plants and animals that live in and above the spray zone.
- Oil that is dispersed or dissolved in the water masses may have toxic effects on fish (particularly eggs and larvae) and planktonic organisms and under particularly unfavourable conditions may affect a substantial proportion of a year class of fish.
- Oil drifting on the sea and/or that drifts ashore will reduce the recreational value of affected areas for varying lengths of time.
- Oil pollution may result in restricted access to certain areas and restrictions on sales of seafood for varying lengths of time, and this may have an impact on the fisheries and aquaculture industries.

The environmental risk, or the risk that an oil spill will affect seabirds, the supra-littoral zone or other elements of the ecosystem, depends on a number of factors. The most important of these are the probability of an oil spill, the magnitude of a particular spill, its geographical position in relation to vulnerable areas and resources, when it occurs in relation to periods when vulnerability to oil spills is particularly high, and the spill trajectory. The efficiency of the emergency oil spill response system, which may vary considerably depending on the weather conditions at the time, is another important factor.

5.7.4 Risks associated with maritime transport

The current volume of maritime transport is low in the High North compared with other parts of the Norwegian coast and other parts of Europe. This means that the probability of accidents and incidents that can lead to oil spills is also lower than in areas further south. However, the environmental impact of an accident may be considerable. Human error is the predominant reason for accidents involving ships. Oil spills from maritime transport may be the result of groundings, collisions, structural errors or fire/explosion.

The Norwegian Coastal Administration has carried out more detailed environmental risk analyses for maritime transport along the Norwegian coast and in the waters off Svalbard, see figure

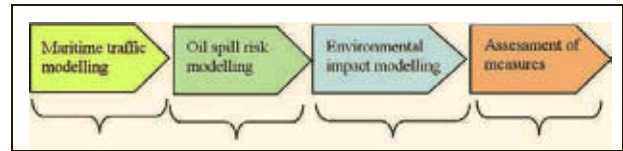


Figure 5.12 The risk analysis process for maritime transport

Source: Working group report on managing the risk of acute oil pollution in the Barents Sea–Lofoten area, October 2005

5.12. These analyses reflect the level of environmental risk given the current volume of maritime traffic and the projected volume in the future. The risk trend has been analysed for the Barents Sea–Lofoten area up to 2020. The main elements of the risk analysis process are:

- Traffic analysis and identification of accident frequency and oil spill volumes (oil spill risk)
- Oil drift modelling and assessment of possible spill trajectories for identification of impact areas and the probability that sensitive areas or species will be contaminated by oil
- Vulnerability calculation – calculation of the vulnerability of impact areas based on the vulnerable environmental resources that are present and using certain assumptions
- Assessment of the impact on selected vulnerable environmental resources and aquaculture facilities
- Environmental risk – combination of the calculated vulnerability, accident frequency, probability of pollution and impact weighted according to spill volume.

International and Norwegian accident statistics have been used in oil spill risk modelling for the Barents Sea–Lofoten area, corrected for the type and age of ships sailing in the area, traffic density, the measures implemented to reduce the probability of accidents and the distinctive features of the area.

A scenario for the traffic situation in 2020 is based on a number of assumptions, including the following:

- 57 million tonnes of petroleum products will be shipped from Russia each year.
- Exports to the USA will increase from 2012 onwards.
- The Stockman field will start production in 2016.
- Petroleum products will be exported from the management plan area.

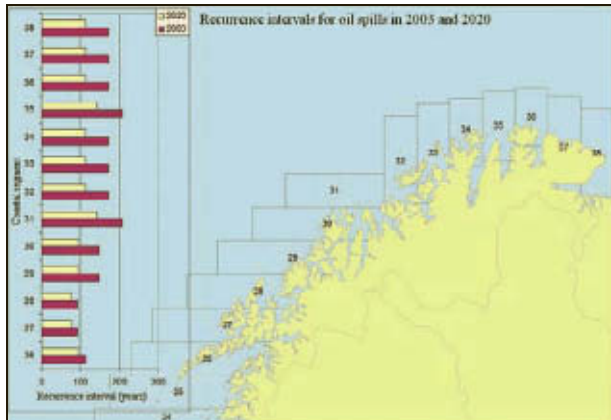


Figure 5.13 Average recurrence interval for acute oil pollution from maritime transport along the coast of North Norway

Source: Working group report on managing the risk of acute oil pollution in the Barents Sea–Lofoten area, October 2005

- Mandatory routeing and traffic separation schemes will be in operation all along the coast of North Norway from 2007 onwards.
- The vessel traffic service station in Vardø will go into operation in 2007.
- There will be an increase in activity off Svalbard.

The most important measures to reduce the probability of major oil spills from ships are the introduction of a minimum sailing distance from the coast, traffic separation schemes and the establishment of vessel traffic service centres.

Statistics show that ships transporting oil to and from Northwestern Russia along the coast of Norway are generally of a high standard. This is because oil tankers delivering oil in Europe are subject to strict port state control.

According to the risk analysis, the probability of accidental oil spills in both 2003 and 2020 is highest in the southern coastal segments in the area covered by the management plan, while the greatest change in probability from 2003 to 2020 will be in the northern and eastern coastal segments. The recurrence interval, i.e. the expected number of years between each accident per 100 nautical miles of coastline, is estimated to be 11 years for the entire management plan area in 2003. This includes all types and sizes of oil spills from all types of vessels of gross tonnage over 5000, see figure 5.13.

Oil and gas tankers will account for most of the increase in traffic between now and 2020. Russian exports of crude oil pose the greatest risk of

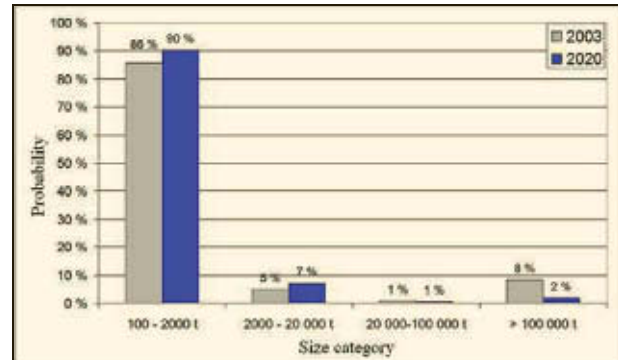


Figure 5.14 Probability of oil spills from maritime transport in the Barents Sea in 2003 and 2020, by size categories

Source: Working group report on managing the risk of acute oil pollution in the Barents Sea–Lofoten area, October 2005

oil spills. The probability of oil spills may increase somewhat throughout the management plan area during the period and give a shorter recurrence interval than 11 years. However, the requirement of a minimum sailing distance from the coast for loaded oil tankers and other risk-reducing measures that are to be implemented will considerably reduce the probability of major oil spills (>100 000 tonnes) from ships from 2003 to 2020.

Thus, despite the higher volume of traffic in 2020, the risk of oil spills will be more than halved as a result of the measures that will be implemented between 2003 and 2020. The most important of these are the minimum sailing distance from the coast, traffic separation schemes and the establishment of vessel traffic service centres.

Other factors that influence environmental risk are the position of the ship, the environmental value of the affected areas and the time of year when the oil spill occurs.

The analysis indicates that environmental impacts in 2020 will be similar to those in 2003. Compared with the risk in coastal areas further south, the overall environmental risk throughout the Barents Sea–Lofoten area can therefore still be characterised as low in 2020, and the level will be similar to that in 2003.

However, just as is the case for petroleum activities, accidents cannot be ruled out and the impacts of oil spills from maritime transport may be considerable, see section 5.7.3.

Shipping in Svalbard's waters can be split into three categories: 1) fishing vessels, 2) transport to and from mining operations and 3) cruise ships. The predominant category is fishing vessels. They generally carry only small amounts of

bunker oil on board and the environmental risk they pose is limited. Transport associated with Norwegian mining operations is strictly regulated, and the probability of oil spills is regarded as small. Other commercial traffic to the settlements in Svalbard is more limited. An oil spill is most likely to be caused by the grounding of a large cruise ship and the subsequent release of bunker oil. The calculated frequency is low, but given the major impact of such an incident the environmental risk is set at medium to high. The conditions on Svalbard will make oil spill response and clean-up operations difficult.

An oil spill resulting from a grounding in the approach to the Svea mine could also cause considerable damage to the environment, but is considered to be very unlikely, given the measures that have been implemented.

In the light of the emergency response situation in Svalbard, an interministerial working group has recommended regulating the type of bunker oil that ships may carry on board around Svalbard. This would reduce the risk of large spills of heavy bunker oil in the event of an emergency. It would also considerably reduce the environmental risk associated with maritime transport in this area. It has been suggested that this requirement should apply in the large protected areas established from 1973 onwards, and which now include most of Svalbard's territorial waters.

It will be necessary to evaluate which exemptions should be made for commercial transport to and from the settlements in Svalbard and whether fishing vessels should be exempt from the requirement, given the small amounts of bunker oil they carry. An assessment must also be made of whether cruise traffic to established destinations should be exempt from the requirement. Shipping in the areas that are exempt from the requirement should follow specific traffic lanes/zones where navigational aids will be upgraded.

5.7.5 Risk associated with petroleum activities

There is always a possibility of acute oil pollution during any activity where oil is produced or where drilling is done in oil-bearing formations. During *exploratory* drilling, acute oil pollution is generally the result of a blowout. During *production* it is usually the result of a blowout, pipeline leakages or large-scale process leakages from installations.

Since the start of petroleum activities on the Norwegian continental shelf about 40 years ago,

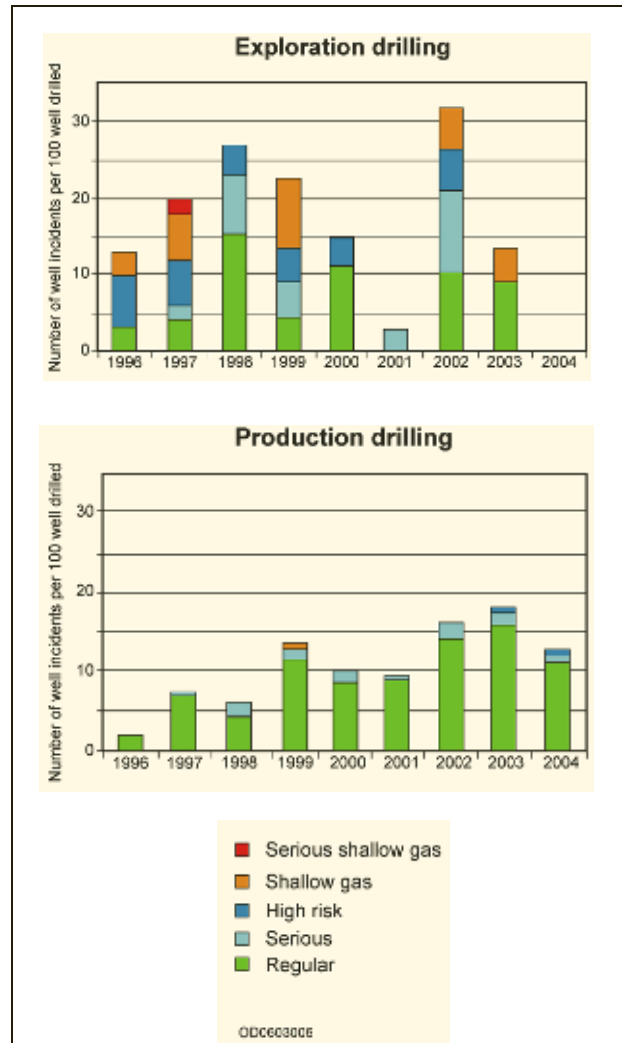


Figure 5.15 Well incidents per 100 wells drilled, for exploration drilling and production drilling

Source: Working group report on managing the risk of acute oil pollution in the Barents Sea–Lofoten area, October 2005

there has been only one oil spill larger than 1000 m³, resulting from the Ekofisk Bravo blowout in 1977. In relation to international accident statistics and given the scale of the activities on the Norwegian shelf, this is a very low figure.

Statistics issued by the Norwegian Pollution Control Authority for the period 1982–2000 were presented in the impact assessment of year-round activities in the Barents Sea–Lofoten area and show that a number of smaller oil spills, defined as less than 1000 m³, occur each year on the Norwegian shelf. However, only 10 to 15 of these have been larger than 1 m³.

Statistics show that all reported incidents involving oil spills have been production accidents or accidents during the handling of hoses and valves during normal operations. There have been

leakages from risers and riser couplings on piping. The Pollution Control Authority has concluded that none of these incidents has had any significant impact on the environment.

In order to obtain the most up-to-date picture of risks on the Norwegian continental shelf and to monitor risk trends, the Norwegian Petroleum Safety Authority collects and analyses extensive data and information about a number of risk factors in the oil and gas industry. It issues an annual report on trends in risk levels on the Norwegian continental shelf, and the information in this report is used to adjust priorities for the necessary accident-prevention effort in the oil and gas industry and by the authorities.

Figure 5.15 is taken from the 2004 report on trends in risk levels on the Norwegian continental shelf. It shows well incidents (regardless of type of hydrocarbons) for exploration drilling and production drilling, normalised per 100 wells drilled. For easier comparison the two charts are shown on the same scale. The total well incident frequency is higher for exploration drilling than for production drilling, except in the years 2001, 2003 and 2004.

The probability calculations that were made for the impact assessment of year-round petroleum activities in the Lofoten–Barents Sea area were based on international statistics. However, these statistics are of limited value as a basis for estimating the probability of future oil spills in Norway, as they do not reflect actual experience on the Norwegian shelf. In the 40 or so years since petroleum activities started on the Norwegian shelf, there have been far fewer and far smaller oil spills than would be expected on the basis of the international statistics, which indicates that the probability of such incidents in future is also lower. Thus, it seems that the regulatory framework and risk management by the authorities and the oil and gas industry have so far helped to maintain a low risk of acute pollution in the Norwegian oil and gas industry.

In the impact assessment of year-round petroleum activities in the Lofoten–Barents Sea area, specific probabilities for three activity levels (low, medium, high) were calculated for incidents such as blowouts and pipeline leakages for the period 2005–2020. At a medium level of activity, which is regarded in the impact assessment as the highest realistic level of activity for the petroleum sector, the probability of oil spills is estimated to be low. Thus, the possibility of an oil spill cannot be ruled out, and a spill may have a substantial impact, see section 5.7.3.

The uncertainty regarding possible causes of oil spills was not found to be any greater in this area than elsewhere along the Norwegian coast.

The emergency response system for acute pollution from petroleum activities is described in Chapter 4.4.

5.7.6 Overall risk

A number of models and analyses are used today to estimate risk. These focus on different aspects of risk, such as the probability of accidental discharges, the probability of oil contamination, the risk of damage and the risk of damage-related costs. The different models and analyses used are described in box 5.6.

Each sector and each activity must make use of risk management in order to prevent oil spills, and must establish an adequate emergency response system. It is necessary to carry out a variety of analyses to ensure sound risk management. The various models are all sound in their own way, but they have different areas of use and they focus on different aspects of risk. As described above, it is important to provide comprehensive information on risk-related issues and to identify clearly the limitations of the analyses and their results, given the evaluations and assumptions on which they are based.

The models used to calculate risk also demonstrate that the potential damage, and thus the environmental risk, depends on the degree to which valuable and vulnerable areas and resources may be affected by any oil spills.

The current management regime is not based on the use of cross-sectoral environmental risk analyses. Cross-sectoral models are not considered appropriate, and they are difficult to establish. It is therefore not possible to determine a cross-sectoral risk acceptance criterion, nor is such a criterion considered to be suitable for integrated risk management in the Barents Sea–Lofoten area.

For management purposes, it is most important to develop a common understanding of risk, including an understanding of mechanisms that create risk, and of the limitations and uncertainty of our knowledge. This understanding must be seen in a solution-oriented context where the main reason for analysing risk is to pave the way for concrete action to control risk. An integrated risk management model must create an understanding of risk and facilitate the use of risk analyses to determine where there are gaps in the

Box 5.6 Models and analyses used to estimate risk

Probability of accidental discharges to the sea

This model only calculates the overall probability of acute pollution, i.e. oil spills. The results must be assessed together with the assessments of the consequences of accident scenarios to achieve the goal of integrated risk management.

Probability of oil contamination

By combining the probability of an oil spill with drift time (split into categories), it is possible to calculate the probability that oil will contaminate defined areas. This is easier to do for stationary sources (petroleum installations). The process is more complicated for ships; in this case, given discharge points in the shipping lanes are selected for the drift and dispersion models. In any case, the overall probability of oil contamination must be assessed qualitatively together with the potential consequences.

Exposure-based environmental risk analysis

Exposure-based analysis is based on calculation of the risk that oil will contaminate 10 x 10 km quadrats containing environmental components of high value and high vulnerability. Quadrats containing at least one environmental component that meets the selection criteria are used for further analysis. The selection criteria for environmental components are based on value (conservation status and importance, and utility value, i.e. whether an area is set aside for recreational use) and vulnerability to oil pollution. Both value and vulnerability are divided into three categories. Each quadrat is allocated to a value category corresponding to the environmental component with the highest value and to a vulnerability category according to the most vulnerable environmental component in the quadrat. Four damage categories are used in estimating the consequences of oil pollution. A combination of the frequency of oil spills and the probability of oil contamination, split into four volume categories for each quadrat, gives the damage frequency for each of the four damage

categories. The damage frequency calculated for each quadrat is then combined with risk acceptance criteria for damage frequency and the results are expressed graphically. By combining the probability of oil contamination in specific areas with a ranking of the vulnerability of these areas to oil pollution (sensitivity index), it is possible to obtain an estimate of the environmental risk.

Damage-based environmental risk analysis

In damage-based analysis, the frequency of environmental damage is calculated for a selected set of vulnerable species of seabirds and marine mammals, and for shore zone habitats such as salt marshes and wetlands. Each species is divided into populations, each of which has a relatively fixed geographical distribution at different times of year. In this analysis, the focus is on the reproductive part of the population, or sexually mature adults, because it is mortality in this part of the population that is of importance for the overall scale of the damage and the recovery period after an oil spill. Using data on the geographical distribution of the population, oil drift calculations are used to calculate a probability distribution for different levels of acute population reduction (percentage reduction of the population). The calculated population loss is combined with a damage factor to give a probability distribution for the time needed for the population to return to the same level as before the damage occurred (recovery period).

Probability of damage-related costs

This model uses the probability of environmental damage to estimate costs resulting from the damage. These may include both direct costs (such as loss of fish resources) and indirect costs (reduced tourism, lower market prices). Various methods have been developed, but they are not used very widely and require a good deal of preliminary work, for example in quantifying the value of environmental resources.

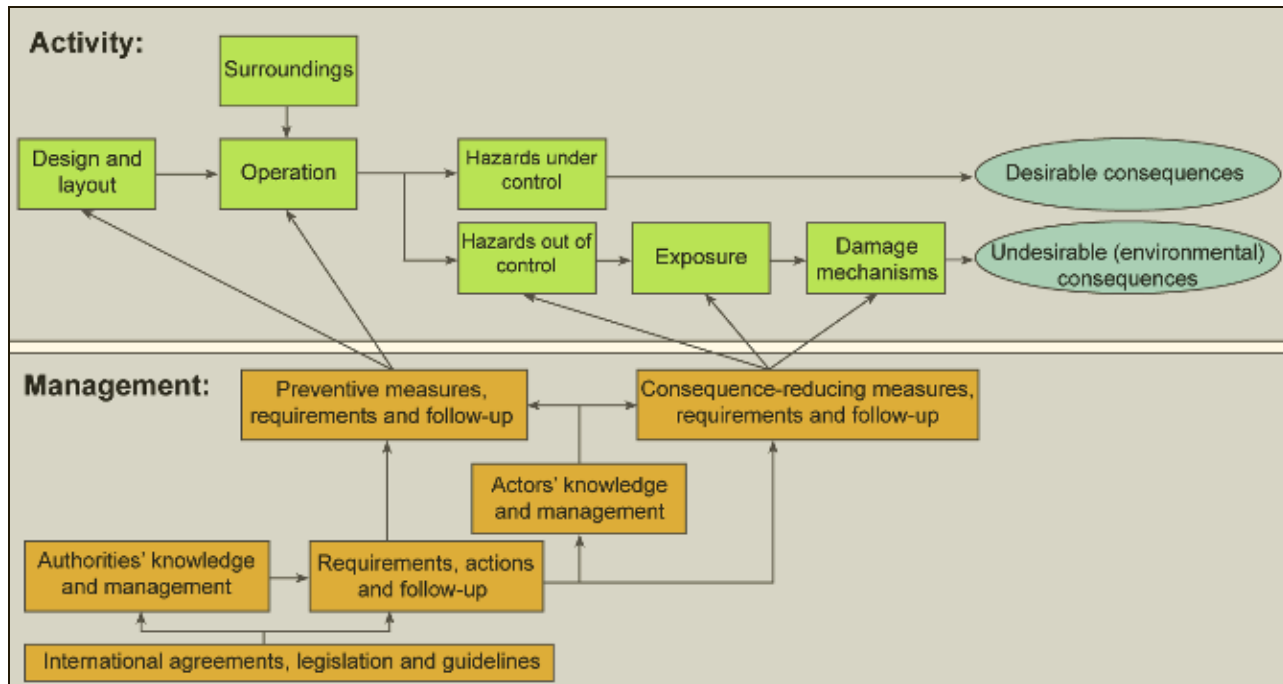


Figure 5.16 Links between risk management by the authorities and the actors themselves in different phases of their activities, and a framework for an integrated risk management regime

Source: Working group report on managing the risk of acute oil pollution in the Barents Sea–Lofoten area, October 2005

knowledge base, where the actors have to be mobilised to control the risk involved in their activities, and where the authorities need to improve the framework for risk management. Figure 5.16 illustrates the links between risk management by the authorities and the actors themselves in different phases of their activities, and the framework for an integrated risk management regime.

A qualitative comparison of risk levels given by analyses of the current situation and activity scenarios for 2020 indicates the following:

- the overall environmental risk associated with the two sectors (maritime transport and petroleum activities) will continue to be lower in the Barents Sea–Lofoten area than in other areas along the Norwegian coast,
- maritime transport contributes considerably more to the overall risk of acute oil pollution than the oil and gas industry. This is the case today and, given the estimated level of activity, will continue to be the case in 2020,
- maritime transport currently involves a higher level of risk exposure in the management plan area than the expected risk exposure from all planned activities in 2020. However, this conclusion is based on assumptions relating to knowledge development, technological advances and the introduction of traffic separation schemes between now and 2020 in line with existing plans, and may be affected by new, currently unplanned activities. Despite the expected increase in the volume of maritime transport by 2020, the analyses indicate that the implementation of measures such as a minimum sailing distance from the coast, traffic separation schemes and vessel traffic service centres will reduce the risk of oil spills associated with maritime transport by half from 2003 to 2020, and that the environmental consequences in 2020 will be comparable with those in 2003.

6 Co-existence between industries

6.1 Introduction

In addition to their impact on the environment, human activities within and outside the Barents Sea–Lofoten area may involve conflicts of interest between different sectors, particularly between the petroleum and fisheries industries, between maritime transport and the fisheries industry, and between maritime transport and the petroleum industry. The current extensive fisheries activity, combined with the establishment of new petroleum activities and the growing volume of maritime transport along the coast from Northwestern Russia and the LNG plant at Melkeøya outside Hammerfest, will make close coordination essential. This will be more important in some geographical areas than in others.

The more general problems facing the marine environment have been described in previous chapters: for example, see Chapter 5 for an account of operating discharges, the risk of acute oil pollution and the introduction of alien species. These problems are not further discussed here. A number of the issues described in the present chapter have an impact on the fisheries industry in cases where commercial fish species are affected

directly or indirectly. An overview of the most important of these issues and how they will be dealt with is given below. Co-existence between these industries will also be facilitated by a number of the measures described in Chapter 9.

6.2 The oil and gas industry and the fisheries industry

6.2.1 Introduction

Ever since oil and gas activities started on the Norwegian shelf about 40 years ago, the authorities have emphasised the importance of co-existence with other industries, and with the fisheries industry in particular. This has laid the foundation for value creation both from Norway's valuable oil and gas resources and from its rich fisheries resources. Two of the key elements of the Government's model for co-existence with other industries are a comprehensive system of impact assessments at all stages of petroleum activities and the prohibition of certain operations, such as exploration drilling and seismic surveying, at times of the year that are particularly important periods for the fisheries industry.

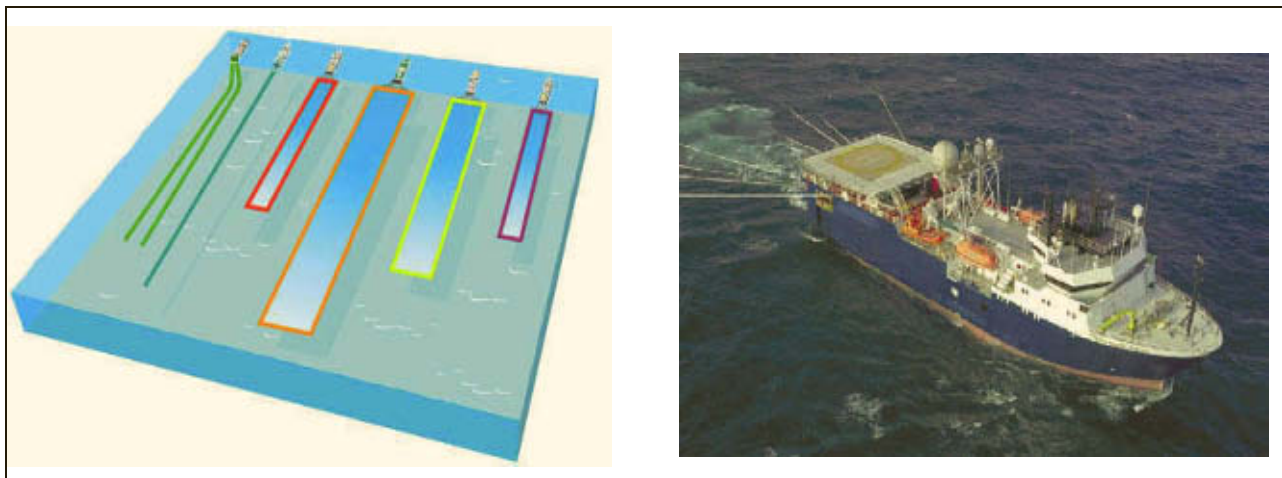


Figure 6.1 Seismic survey vessel *Western Pride* collecting data on the Visund field in the North Sea. The illustration on the left shows a variety of hydrophone cable configurations.

Source: Statoil

6.2.2 Acquisition of seismic data

Seismic surveys are carried out at all stages from the early exploration phase and well into the production phase, when they are used for reservoir surveillance purposes. The basic method used for seismic surveying is to discharge sound pulses from a survey vessel or from a signal source towed behind the vessel. These are reflected back from the boundaries separating the geological layers beneath the seabed, and the reflected signals are recorded by hydrophones (receptors) attached to a long cable and towed behind the vessel.

Comprehensive studies have been carried out by the Institute of Marine Research and others to establish what effects, if any, seismic shooting has on marine organisms. Although the studies have only demonstrated damage to fish larvae at very short distances from the source of the sound waves, seismic shooting is avoided as far as possible at times when there are large concentrations of fish larvae in the sea. In view of the limited extent of the possible damage, seismic surveying is not expected to lead to impacts at population level. It has been documented that adult fish are frightened away by the sound waves from seismic activities and that pelagic fish appear to be the most sensitive. If fish are exposed to this type of noise during migration to the spawning grounds or during spawning, spawning success may be affected. The fish may spend more energy on migration and shifts may occur in spawning times and locations. To avoid such impacts, restrictions have been introduced on when seismic activities are permitted in important spawning areas and in areas fish move through on spawning migration.

When fish are frightened away by seismic surveying, catch rates can be reduced for a short period after completion of the survey. The decline in catch rates seems to vary from species to species and from one type of gear to another. The impacts appear to be greatest in the core areas for seismic surveys.

As a general rule, the impact of seismic activities on the fisheries is considered to be limited. Nevertheless, local reductions in catches have been documented, and this can have a major impact on individual fishermen, particularly those engaged in seasonal fisheries. Impacts on the fisheries appear to be most likely in areas and at times when fishing operations are most intensive, for example during the spawning-season cod fishery in the Lofoten area and the capelin fishery off

Finnmark. Seismic activity may also affect fish stocks in other areas and at other times, but there is less likelihood of a conflict of interests.

Seismic activities in areas of importance for the fisheries are currently regulated to take into account both fish resources (spawning etc.) and the fisheries. The most important policy instruments to which the Government will continue to give priority are:

- temporal and spatial restrictions for seismic data acquisition
- restrictions on the scope of such activity
- requirement for seismic survey vessels to carry fisheries experts on board.

6.2.3 Occupation of areas by the oil and gas and fisheries industries

The development and operation of petroleum installations on the Norwegian shelf occupies areas of the sea for varying lengths of time. When activities are terminated, the area must be cleared and restored to its original state. There are currently no fields in production in the Barents Sea–Lofoten area. Snøhvit, which is a subsea development, will occupy only a small sea area while it is under development, see Figure 6.2.

Norwegian legislation requires operators to establish safety zones round petroleum installations that project above the surface of the sea. A safety zone covers an area extending to a distance of 500 m from the outer limits of the installation. An exploration rig including its anchor spread occupies an area of about 7 km² for a period of one to two months for each well. On the Norwegian shelf, safety zones occupy about 100 km² of the total area of 675 571 km² that is open for petroleum activities. The impact of occupied areas depends greatly on the position of the safety zones in relation to important fishing grounds.

The area occupied by fisheries depends on the availability of the fish, on whether or not they are seasonal fisheries, for example for capelin, spawning cod, Norwegian spring-spawning herring etc., and to some extent on the fishing gear that is used. The spatial requirements of trawl fishing differ from those of fishing with passive gear such as gill nets and longlines.

The space required for gill netting and longlining depends both on the location of the fishery and on the type of vessel used. During the major seasonal fisheries off parts of North Norway, the fishing grounds are utilised to the full, and if an area is occupied by the oil and gas industry, it is also

unavailable to the fishing industry. In such cases, it is not possible to compensate for the loss of fishing areas by intensifying efforts in other catch areas, since the fishing grounds are already fully utilised. At other times gill netting and longlining are less intensive, and it is not expected that the occupation of fishing areas will result in loss of catches.

Pelagic fisheries use purse seines or trawls to catch pelagic species such as herring and capelin. Spatial restrictions resulting from petroleum activities are not expected to lead to catch losses in these fisheries. If capelin migrate into an area where there are petroleum installations, an area corresponding to the safety zones round the petroleum installations will in practice be unavailable to the fishing industry. However, this will be small compared with the total area where capelin can be fished.

6.2.4 Fishing in the vicinity of subsea structures

It is not permitted under Norwegian law to establish safety zones round subsea structures. Subsea structures do not normally occupy areas used by vessels fishing with conventional gear such as gillnets and longlines or engaged in pelagic fisheries using purse seines and trawls, nor do they impede them in other ways. All subsea structures are required to be overtrawable, but in practice many fishing vessels avoid them for fear of trawl gear becoming snagged and damaged. In the North Sea this applies particularly to trawlers engaged in industrial fishing and to small shrimp trawlers. This means that areas are in effect unavailable to these vessels, just as they are around other known obstacles on the seabed. On the other hand, vessels that use large-meshed trawls to fish for cod, saithe and haddock frequently do trawl

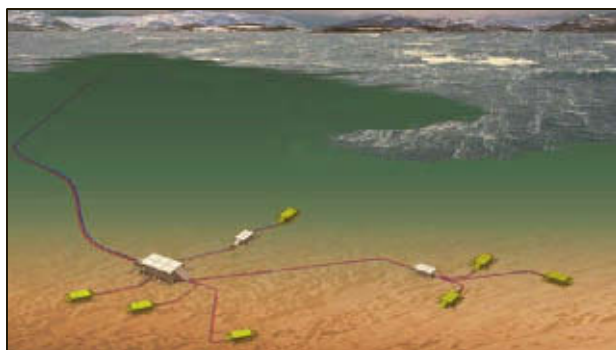


Figure 6.2 The Snøhvit field off Hammerfest in Finnmark

Source: Statoil

over subsea structures, because these fish often congregate near them. Experience from certain areas of the North Sea shows that gear does become snagged even though these structures are supposed to be overtrawable.

After pipelaying has been completed, pipelines are no hindrance to fisheries using conventional gear such as gillnets and longlines or fisheries using purse seines and pelagic trawls. Only fisheries using bottom gear such as trawls and Danish seines can be impeded by pipelines on the seabed. There is very little Norwegian fishing with Danish seines round pipelines on the Norwegian shelf, and there have been no reports of major problems linked with fishing near these pipelines.

It is very unlikely that existing pipelines will be the cause of noticeable catch losses for trawlers fishing on the Norwegian shelf. Most of the problems experienced by trawl fisheries are caused by pipelines with rock fillings, free spans or external damage. These can cause major disruptions in the operations of certain fisheries, and in some cases cause problems by occupying space, damaging gear and reducing catch rates. Trawl doors can also become lodged under free spans and this can endanger safety, particularly in bad weather conditions and for small vessels. Pipelines and cables that are buried in the seabed and stabilised will not interfere with fishing.

Key elements of future efforts to reduce these problems further will be the provision of advance information about developments, inspections and information about alterations to subsea structures.

6.3 Marine transport and fisheries

6.3.1 Collisions

Many of the fishing grounds that are most intensively used are on the seaward side of the baseline, stretching out to about 20 nautical miles from land in some areas. This means that the route followed by many vessels along the coast from the Lofoten Islands to Vardø in eastern Finnmark runs through or close to intensively used grounds. Conflicts can arise between fishery activities and general maritime transport if cargo vessels sail through or very close to the fishing grounds, particularly during the seasonal fisheries when there are large concentrations of fishing vessels. Problems may also arise in areas where fixed gear may sometimes be deployed.

The International Regulations for Preventing Collisions at Sea are the 'rules of the road' at sea.

They apply to all vessels on the high seas, whether they are fishing vessels, transport vessels, leisure craft or other vessels. Under the international regulations, vessels that are underway are required to keep out of the way of vessels that are engaged in fishing. This means that fishing vessels can generally carry out their activities without any form of conflict arising. Fishing vessels are, however, obliged to display signals showing that they are engaged in fishing. They must also keep watch and show due care in order to avoid collisions.

Vessel traffic movements are also regulated by special rules for routeing and traffic separation schemes. These may be recommended or mandatory. The general rules in the international regulations apply to traffic sailing in and traffic crossing recommended traffic lanes. However, vessels crossing mandatory traffic lanes must give way to vessels sailing in these lanes.

Coastal states have the right to establish mandatory and recommended routeing and traffic separation schemes inside their own territorial limits. These help to increase the predictability of the general traffic movement for all seafarers, including fishing vessels, and can thus also help to reduce the risk of collisions between fishing vessels and other shipping.

The establishment of mandatory and recommended routeing and traffic separation schemes outside territorial limits is subject to the approval of the IMO. In accordance with the recommendations of a white paper on maritime safety and the oil spill response system published in 2005 and the subsequent Storting debate, the Government has given high priority to the work of establishing such a scheme outside the territorial waters between Vardø and Røst about 30 nautical miles from land. An outline of this scheme is described in Box 4.3 in Chapter 4.

The sailing patterns of fishing vessels are taken into account in plans for the establishment of routeing and traffic separation schemes outside territorial waters. This will help to reduce the danger of collisions between fishing vessels and other shipping. Fishing is permitted in traffic separation zones or traffic lanes, provided that this does not impede the passage of any vessel following a traffic lane and provided that the vessel engaged in fishing does not move against the flow of the traffic while fishing in the traffic lane. A vessel which is required not to impede the passage of another vessel should take early action to allow sufficient sea room for the safe passage of the other vessel.

6.3.2 Vessel noise

The main sources of subsea noise from vessels are propellers and other machinery on board. Vessel noise can have a certain scaring effect on organisms such as fish and marine mammals, but no other harm has been recorded.

6.4 Maritime transport and petroleum activities

6.4.1 Introduction

When petroleum activities are at the planning stage, it may become apparent that there are conflicts of interest between maritime transport and oil and gas operations as regards the use of an area. Maritime safety considerations may indicate that priority should be given to traffic lanes rather than to petroleum activities. These differences should be resolved at the earliest possible stage so that conflicts can be avoided. Conflicts of interest may also arise between maritime transport and the petroleum industry if vessels cross into safety zones round petroleum installations. There may also be a risk of wrecked or drifting vessels colliding with installations and of anchor damage to pipelines. However, experience from the North Sea shows that there is little conflict between petroleum activities and maritime transport. Most sailing routes are positioned well away from petroleum installations.

6.4.2 Collisions

Petroleum legislation sets strict safety standards, and activities are monitored very closely by operators and authorities.

The positions of petroleum installations are published in the Norwegian Notices to Mariners, making it possible for all mariners to make themselves familiar with them. Furthermore, a safety zone is established round every petroleum installation. Their purpose is to keep a safe distance between the installations and general maritime transport and other activities. The safety regulations give the operators both a right and an obligation to prohibit traffic in safety zones and they require safety zones to be monitored to ensure early intervention if there is a danger of a collision. The safety regulations also require the presence of standby vessels for use in the event of a collision.

The probability of a ship colliding with an

installation is very small. Only two collisions with ships unrelated to petroleum activities have been registered by the Norwegian oil industry. In 1986 a submarine collided with an installation on the Oseberg field and in 1995 a vessel collided with the H7 compression platform.

Should a collision take place, it is very unlikely to result in the breakdown of an installation, a broken riser pipe or a blow-out. Stringent standards have been set for the design of load-bearing structures, and there must be at least two independent physical barriers between the reservoir and the surface. For a major blow-out to occur, both barriers must fail.

If mandatory or recommended routeing and traffic separation schemes are being planned outside the territorial limit, it will be possible to take into account the position of petroleum installations and thus avoid conflict between the location of traffic lanes and petroleum activities as far as possible. Surface installations are not permitted in traffic lanes. This helps to reduce the risk of vessels colliding with petroleum installations.

6.4.3 Anchoring over pipelines

Pipelines are shown on navigation charts. It is therefore very unlikely that a vessel will drop anchor over a pipeline under normal circumstances. This could, however, happen as a result of a navigation error or in a shipboard emergency, and the possibility can therefore not be ruled out.

6.5 Summary

Ever since oil and gas activities started on the continental shelf about 40 years ago, the authori-

ties have emphasised the importance of co-existence with other industries, and with the fisheries industry in particular. Two of the key elements of the Government's model for co-existence with other industries are a comprehensive system of impact assessments at all stages of petroleum activities and the prohibition of certain operations, such as exploration drilling and seismic surveying, at times of the year that are particularly important for the fisheries. Following the implementation of remedial measures, noise, occupation of areas and physical impediments to fishing are not considered to be serious problems in the Barents Sea–Lofoten area. The probability of a vessel colliding with an oil industry installation is considered to be small, and measures have been implemented to reduce this probability and the possible consequences of any accidents.

A key task in efforts to facilitate co-existence between the industries in the Barents Sea–Lofoten area is the prevention of collisions between fishing vessels and other shipping. Compliance with the International Regulations for Preventing Collisions at Sea and routeing schemes and traffic surveillance, for example using the AIS network that has been installed along the Norwegian coast, play a vital part in reducing the probability of accidents. The Government considers it important to continue its efforts to facilitate co-existence between the industries on the basis of the measures already implemented. A number of measures described in Chapters 9 and 10 will also facilitate co-existence.

7 Goals, current status and trends

7.1 Introduction

The purpose of this management plan is to provide a framework for the sustainable use of natural resources and goods derived from the Barents Sea–Lofoten area and at the same time maintain the structure, functioning and productivity of the area's ecosystems.

In order to set up an integrated ecosystem-based management regime for the Barents Sea–Lofoten area that is performance-oriented, the Government has decided on a set of goals against which performance can be measured. These consist of general objectives concerned with value creation and co-existence between industries, and more specific targets for managing biodiversity, combating pollution and ensuring safe seafood. The goals are in line with national goals and guidelines in these areas.

The present chapter outlines the goals and assesses current status and trends in the various fields. This will form the basis for follow-up by the authorities in the relevant sectors of the measures and tools proposed in Chapters 9 and 10. The assessments of status and trends are based on existing knowledge.

In order to measure progress systematically, the Government will establish a system for monitoring the state of the environment by means of indicators, reference values and action thresholds (see Chapter 9.5).

7.2 General objectives

The management plan is intended as a tool for promoting value creation and maintaining the environmental assets in the Barents Sea–Lofoten area. The plan is intended to provide a framework for activities in the area and facilitate co-existence between the industries involved, such as the fisheries, maritime transport and petroleum industries, while at the same time taking environmental considerations into account. The Government's objectives are that:

- management of the Barents Sea–Lofoten area will promote sustainable use of the area and its resources to the benefit of the region and the country in general.
- the management regime will ensure that activities in the area do not threaten the natural resource base and thus jeopardise opportunities for future value creation.
- the management regime will facilitate economically viable commercial activities and as far as possible promote value creation and employment in the region.
- management of commercial activities in the area will be coordinated to ensure that the various industries are able to co-exist and that the overall level of activity is adjusted to take account of environmental considerations.
- harvesting of living marine resources will promote value creation and secure welfare and business development to the benefit of the country as a whole.
- living marine resources are managed sustainably through the ecosystem approach.
- petroleum activities will promote value creation and secure welfare and business development to the benefit of the country as a whole.
- steps will be taken to facilitate the profitable production of oil and gas on the basis of health, environment and safety requirements and standards that are adapted to environmental considerations and the needs of other industries.
- favourable conditions will be provided for safe, secure and effective maritime transport that takes account of environmental considerations and promotes value creation in the region.

Today the waters of the Barents Sea–Lofoten are rich and clean, and the structure, functioning, productivity and biodiversity of ecosystems are largely undisturbed. However, if the environmental quality and resource base are to be maintained, value creation and other activities in the area must be conducted within a sustainable framework. One of the main challenges up to 2020 is to implement and further develop an ecosystem-based management regime. This will involve halting il-

legal, unreported and unregulated fishing (IUU fishing) and ensuring that all relevant environmental pressures are taken into account, including pressures on seabird populations and benthic habitats.

Although the environment of the Barents Sea is under less pressure than sea areas closer to large population centres, like the North Sea, there are other important challenges involved in management of the area. They include long-range transboundary pollution and the risk of acute pollution, both of which will continue to be of great concern. Provided that there are no serious acute pollution incidents, the general pollution level will probably not alter very much up to 2020, but this will depend largely on inputs from long-range transport of pollutants.

The greatest uncertainty as regards trends in the state of the environment is related to what impacts climate change will have on ecosystems. Even a small change in the climate that causes the temperature of the Barents Sea to rise will enable many new species to become established in the management plan area and thus alter the structure and dynamics of the ecosystems there. The introduction of alien species as a result of maritime traffic or in other ways may also have unpredictable effects. Climate change is not expected to have serious impacts on ecosystems until after 2020, but it may proceed more rapidly than predicted. This would have a significant impact on the framework conditions for the management regime, and also on the conditions for value creation and welfare in the region.

7.3 Goals, status and trends as regards pollution

7.3.1 General remarks

The Government has set the following objective for preventing and combating pollution in the Barents Sea–Lofoten area:

- *Releases and inputs of pollutants to the Barents Sea–Lofoten area will not result in injury to health or damage the productivity of the natural environment and its capacity for self-renewal. Activities in the area will not result in higher levels of pollutants.*

Today the Barents Sea–Lofoten area is generally speaking a clean sea area. Since the adjacent land areas are sparsely populated, the impacts of human activity are small and local. The main issues to be addressed are reducing inputs of

long-range transboundary pollutants, preventing acute pollution, and limiting operational discharges from activities in the area. Goals, status and trends in this regard are described and evaluated in the following.

7.3.2 Hazardous substances and radioactive substances

The Government has set the following target for limiting inputs and concentrations of hazardous substances in the Barents Sea–Lofoten area:

- *The environmental concentrations of hazardous and radioactive substances will not exceed the background levels for naturally occurring substances and will be close to zero for man-made synthetic substances. Releases and inputs of hazardous or radioactive substances from activity in the area will not cause these levels to be exceeded.*

Although pollution levels in the Barents Sea are generally low, it has been shown that concentrations of hazardous substances in animals at the top of food chains exceed the background levels for naturally occurring substances and are well above the target of close to zero for man-made substances. The largest exceedances have been found for POPs such as polychlorinated biphenyls (PCBs) and heavy metals like mercury. Certain sparse data indicate that the environmental concentrations of some substances like PCBs are gradually decreasing, but the levels are still disturbingly high in species such as polar bear and glaucous gull, and combined with other environmentally hazardous substances and pressures they may threaten the survival of these species in the long term.

The environmental levels of radioactive substances from anthropogenic inputs are low, but are still higher than the background level for certain naturally occurring substances. Pollution in the area is mainly due to fallout from the atmospheric nuclear testing of the 1950s and 1960s, the Chernobyl accident and releases from the European nuclear power industry. However, the levels are gradually decreasing, even though certain new man-made substances, especially technetium-99 in releases from Sellafield, are being found in measurable concentrations in seawater and seaweed. Releases of technetium-99 have now been halted, and concentrations are expected to decrease substantially in the next few years as a result of dilution. The current levels of radioactive substances are not hazardous to health or the



Figure 7.1 Concentrations of PCBs are disquietingly high in the glaucous gull

Source: Norwegian Polar Institute (Photo: Hallvard Strøm)

environment, and unless large amounts of these substances are released into the area through a nuclear accident in Norway's neighbouring areas, the level of radioactive pollution is likely to remain low and to decrease further towards 2020.

Inputs of hazardous substances from human activity in the Barents Sea–Lofoten area are currently so low that concentrations of these substances in the environment do not generally exceed the target levels. However, this is not true of inputs of tributyl tin (TBT) from ships' anti-fouling systems, which have resulted in elevated levels of this hazardous substance in sediments near shipyards, marinas and heavily trafficked ports and shipping lanes. Elevated TBT levels have also been found in mussels and dogwinkles. TBT levels are expected to decrease towards 2020 as a result of the IMO decision to prohibit anti-fouling systems containing TBT from 2008.

The situation regarding environmentally hazardous substances is not likely to change much by 2020, but the pollution load may decrease somewhat if long-range inputs of the most hazardous substances are reduced, as long as they are not replaced by inputs of new substances. However, this is based on the premise that multilateral environmental agreements relating to existing and new hazardous substances are further developed and effectively enforced. The situation is also complicated by the fact that new substances are continually being produced whose long-term effects are not known.

Operational discharges from the growing volume of petroleum activity in the Barents Sea–Lofoten area are not expected to result in a higher

level of hazardous substances in the environment up to 2020, given the stricter environmental standards that have been imposed on these activities (see Chapter 5.3.2, boxes 5.1 and 5.2).

7.3.3 Operational discharges

The Government has set the following target for limiting operational discharges in the Barents Sea–Lofoten area:

- *Operational discharges from activities in the area will not result in damage to the environment or elevated background levels of oil or other environmentally hazardous substances over the long term.*

At present, operational discharges in the Barents Sea–Lofoten area come mainly from maritime transport, and take the form of legal and illegal discharges of oily ballast and bilge water. The extent of illegal discharges is not known. Operational discharges can result in higher mortality in seabirds, including vulnerable species like the common guillemot.

Unless the structure of fleets and the size of ships are substantially altered, legal and illegal discharges and other environmental pressures from maritime traffic will probably continue to be proportional to the volume of traffic in the area. However, the observed trend towards larger ships may mean that the level of discharges relative to ship traffic will decrease, and this effect may be enhanced by the application of the provisions of 2003 relating to reception facilities for ship-generated waste and cargo residues in the Norwegian Pollution Regulations. Thus it is still uncertain whether the overall legal and illegal discharges will in fact increase as a result of growth in maritime traffic. This will depend on the size of the increase, changes in the structure of the fleet, the effects of the above-mentioned provisions of the Pollution Regulations and other measures. The planned establishment of mandatory routeing and traffic separation schemes about 30 nautical miles from land is also expected to reduce the risk of damage to the coastal environment from operational discharges.

Assuming zero discharges to sea, stable injection of produced water, and injection or transport ashore of drill cuttings (see Chapter 5.3.2, boxes 5.1 and 5.2), petroleum operations are not expected to have significant negative impacts on the marine environment.

7.3.4 Litter and environmental damage resulting from waste

The Government has set the following target for avoiding litter and environmental damage caused by waste from activities in the Barents Sea–Lofoten area:

- *Litter and other environmental damage caused by waste from activities in the Barents Sea–Lofoten area will be avoided.*

Discharges of waste from ships are a major source of litter on beaches in the area, and result in injury and suffering in animals. This does not affect population trends for any of the species concerned, but litter is also an aesthetic problem. The problem is thought to be largely due to illegal discharges, which are difficult to control. However new provisions in the Pollution Regulations relating to the management of waste from ships are expected to reduce the problem to some extent.

7.4 Goals, status and trends with regard to safe seafood

The Government has set the following objective for ensuring that seafood from the Barents Sea–

Lofoten area is safe:

- *Fish and other seafood will be safe and will be perceived as safe by consumers in the various markets.*

The relatively high concentrations of hazardous substances like PCBs in for example whale blubber and cod liver have also made the safety of seafood an issue. The level of radioactive substances from human activity is very low and does not constitute a danger to health. However, since the market for fish and seafood is very sensitive to reports on such substances, it is very important to be able to document the levels in seafood and the environment.

The safety of seafood in the period up to 2020 will depend on whether and how much long-range transboundary pollution increases the levels of environmentally hazardous and radioactive substances in the sea. Pollution levels are not expected to change to any great extent in view of the international efforts being made to reduce the use and emission of environmentally hazardous substances and the national and international efforts to prevent major accidents that could result in pollution of Norwegian waters. The market focus on the safety of seafood is likely to increase, and any rise in the levels of existing environmentally



Figure 7.2 Cod (*Gadus morhua*) is the most important commercial fish species in the Barents Sea. It is therefore important to be able to document the levels of hazardous and radioactive substances in the environment and in cod and other seafood.

Photo: Erling Svensen

hazardous substances like PCBs in seafood, or the introduction of new environmentally hazardous substances, could have negative effects on the market. As regards radioactive substances, the level of technetium-99 from Sellafield is expected to decrease within the next few years, but there will continue to be a risk of radioactive pollution from accidents at nuclear facilities in Norway's neighbouring countries.

7.5 Goals, status and trends with regard to acute pollution

7.5.1 Introduction

The Government has set the following objectives for risk management of acute pollution in the Barents Sea–Lofoten area:

- *The risk of damage to the environment and living marine resources from acute pollution will be kept at a low level and continuous efforts will be made to reduce it further. Activity that involves a risk of acute pollution will be managed with this objective in mind.*
- *Maritime safety measures and the oil spill response system will be designed and dimensioned to effectively keep the risk of damage to the environment and living marine resources at a low level.*

The Barents Sea–Lofoten area has a high environmental value and living marine resources that are vulnerable to acute pollution. Even though the probability of a major oil spill occurring is small, a spill could under certain circumstances have serious consequences, especially in areas that have been identified as particularly valuable and vulnerable to oil spills. Seabirds are the species most vulnerable to oil pollution, but the consequences for marine mammals, fish and the shoreline could also be serious.

The risk of an oil spill occurring in the management plan area is lower than for other Norwegian sea areas, since there is less activity in the form of maritime transport and petroleum operations here than in areas further south. Planned and implemented measures to reduce the probability and impact of spills are expected to prevent a significant rise in environmental risks up to 2020, in spite of the expected increase in the volume of maritime transport and petroleum operations.

The extent of the environmental damage caused by an oil spill depends on where and when it occurs. Thus the environmental risk depends

not only on the probability of such an event occurring but also on its location in relation to particularly valuable and vulnerable areas, and on the time of year, since ecosystems are more vulnerable at some times of year than in others.

Environmental impact assessments for oil spills have a high level of uncertainty, although this is lower for petroleum operations than for maritime traffic, since we know more about the type of oil that would be discharged and where spills are likely to occur.

7.5.2 Maritime transport

The risk of acute oil pollution from maritime transport in the area of the management plan is at present lower than for other Norwegian sea areas. One of the main aims of Norwegian risk management through maritime safety and oil spill response measures is to keep the risk of damage to the marine environment and living marine resources at a low level.

Most of the maritime transport in the area consists of vessels engaged in international trade that do not call at Norwegian ports, and the international nature of maritime transport means that the possibility of imposing special national requirements is limited. National requirements must be in line with international law, and it is important for Norway to participate in international forums where it can influence the global framework conditions applicable to shipping. Since Norway is a significant international player in the shipping sector, it is to our advantage that new rules for international shipping that will ensure equal conditions of competition are established in the IMO.

Within this global framework, Norway is also implementing its own risk management measures. There are a number of measures the authorities can take to lower the risk of acute pollution from shipping (cf. Chapter 4.5). Maritime safety measures are a key area of the national risk management system, and a number of these are already being implemented. An effective oil spill response system is also essential for preventing accidents and containing damage. The weather conditions off the Norwegian coast mean that oil spill response measures only provide effective damage limitation for about 60 per cent of the year. In the northern part of the management plan area, including most of the coastal waters around Svalbard, effective oil spill response operations pose special problems. However, the volume of

maritime transport in this area is much smaller, which means that the risk of oil spills is much lower. At present the risk of acute oil pollution in the management plan area is lower than in other Norwegian sea areas, but since the volume of maritime transport is expected to increase in the next few years, additional measures are being drawn up. As long as the planned and implemented measures have the predicted effects, the risk is expected to remain low up to 2020.

Plans for new measures must take into account that the increase in ship traffic may be larger than the estimate on which the risk assessment for 2020 is based (Chapter 5.7.4). An important measure in this connection will be the establishment of mandatory routing and traffic separation schemes outside territorial waters along the Vardø–Røst route. This will direct traffic away from the coast and thus reduce the probability of an oil slick reaching land, which in turn will reduce the risk to areas that are particularly valuable and vulnerable to acute oil pollution.

Given the special problems of conducting oil spill response operations off Svalbard, an interministerial working group has recommended the introduction of restrictions on the types of bunker oil that may be used on board ships inside the large protected areas that were established in 1973. The aim would be to reduce the risk of heavy bunker oil spills in the event of an accident. Necessary exceptions will be considered in connection with the drafting of the proposed requirements.

Vessel standards have risen in recent years in response to the introduction of stricter international requirements, and the international trend for accidents and oil spills is positive. Furthermore most of the traffic from Russia is destined for the US or Europe, where strict national and international requirements regarding tonnage apply and are enforced through effective port state control.

On the assumption that maritime traffic and vessel standards follow the expected trends, and that the planned measures are implemented, the risk of acute oil pollution from maritime transport is expected to remain low, and considerably below the risk level in other Norwegian sea areas, up to 2020.

Risk-reducing measures for maritime transport are described in Chapter 10.2.

7.5.3 Petroleum activities

One of the main goals of Norway's risk management of petroleum operations is to reduce the environmental risks to the minimum practical level.

Generally speaking the probability of major spills from petroleum operations is small, and will remain small up to 2020 according to conservative estimates based on realistic predictions of the level of activity in the area. To keep the risk low, measures can be taken to reduce this probability and, in the event of a spill, to limit the impacts, which depend on the size of the spill, the type of hydrocarbons released, and when and where the spill occurs in relation to valuable and vulnerable areas and living marine resources. Risk-reducing measures for petroleum operations are outlined in Chapter 10.2.

7.5.4 Overall evaluation

With technological advances, the introduction of new measures and the further development of risk management, the environmental risks in connection with oil spills from maritime transport or petroleum operations are not expected to change significantly up to 2020. This means that the risk of acute oil pollution in the Barents Sea–Lofoten area will continue to be considerably lower than in other Norwegian sea areas.

This conclusion is based on the assumption that petroleum operations and maritime transport do not increase further in scale or expand into completely different areas than predicted in scientific assessments of the risk level (see Appendix 2).

According to existing environmental risk assessments, petroleum operations pose less risk than maritime transport, and this situation can be expected to continue up to 2020. Thus measures in the field of maritime transport will have a substantial effect on the overall environmental risk trend.

There is reason to believe that generally speaking the goals for risk management for acute pollution can be reached by 2020. This assumes that every opportunity will be taken to implement risk-reducing measures and that risk management for maritime transport and petroleum operations is further developed. This includes risk management relating to oil spills, particularly valuable and vulnerable areas, and damage limitation in the event of a spill.

7.6 Goals, status and trends with regard to biodiversity

7.6.1 General objectives

The Government has set the following objective for the management of biodiversity in the Barents

Sea–Lofoten area:

- *Management of the Barents Sea–Lofoten area will ensure that diversity at ecosystem, habitat, species and genetic levels, and the productivity of ecosystems, are maintained. Human activity in the area will not damage the structure, functioning, productivity or dynamics of ecosystems.*

At the national level Norway is working to halt the loss of biodiversity by 2010, in line with our international commitments. The management plan will be an essential tool for achieving this objective in the Barents Sea–Lofoten area.

Our current knowledge of the biodiversity of in the area, and the current state of the biodiversity, varies, and is inadequate with regard to parts of the ecosystems. However, on the basis of what we do know, the state of biodiversity in the area is good. This means that the harvestable surplus provides for rich fisheries. As long as biodiversity in the area is managed sustainably, these renewable resources will continue to be harvestable and will form the basis of value creation and welfare for the foreseeable future.

However, pressures from human activity, other external pressures and gaps in our knowledge are important problems that have to be dealt with in the management of biodiversity in the area. Populations of some species of marine mammals and seabirds are seriously reduced, and some of them are threatened with extinction, or will be if the present negative trends continue. Damage to some vulnerable marine habitats like coral reefs has also been documented. We know little about the extent of such damage or its impacts on biodiversity.

Fisheries management has for a long time been based on the precautionary principle and on sustainable, ecosystem-based harvesting of resources. As a result, the spawning stocks of the most important commercial fish species are within safe biological limits. However, stocks of certain other harvestable species have been severely depleted, and catches are now strictly regulated with a view to rebuilding the stocks to sustainable levels.

The factor with the greatest direct and indirect impacts on biodiversity is harvesting, but inputs of long-range transboundary pollutants, oil spills and pressures on migrating stocks when they are outside the management plan area are also thought to be affecting the populations of certain species. In addition we know little about the possible impacts of the introduction of alien species

like the king crab. Oil spills are potentially very damaging to biodiversity, but the risk of these occurring is considered to be low. Anthropogenic climate change is expected to have a considerable impact on biodiversity in the long term, but not until after 2020.

Both the level of the risks and the state of the environment vary considerably within the management plan area. Generally speaking the ecosystems in the northern part of the area have been less affected and are less likely to be affected by local activities than other parts of the area.

If the planned preventive and emergency response measures are implemented, the pressures on biodiversity described above are not expected to change significantly up to 2020. This means that unless new measures are taken, human activity will continue to put substantial pressure on seabirds and vulnerable marine habitats in particular. Thus in order to achieve the goals for the management of biodiversity we must increase our knowledge of ecosystems and take steps to reduce pressures on them.

7.6.2 Management of particularly valuable and vulnerable areas and habitats

The particularly valuable and vulnerable areas identified for the purposes of the management plan are described in Chapter 3.

The Government has set the following targets for the management of biodiversity in particularly valuable and vulnerable areas and habitats:

- *Activities in particularly valuable and vulnerable areas will be conducted in such a way that the ecological functioning and biodiversity of such areas are not threatened.*
- *Damage to marine habitats that are considered to be threatened or vulnerable will be avoided.*
- *In marine habitats that are particularly important for the structure, functioning, productivity and dynamics of ecosystems, activities will be conducted in such a way that all ecological functions are maintained.*

A major oil or chemical spill can result in substantial damage to biodiversity. However, the probability of these events occurring is small. The current status and expected trends as regards acute pollution are described in more detail in section 7.5.

Trawling with heavy bottom gear is the activity most likely to cause such damage to the seabed that the structure of benthic communities is

altered. Fragile or habitat-forming benthic communities like coral reefs and sponge communities, which help to give the seabed a three-dimensional structure and are generally species-rich, are susceptible to this kind of pressure. Benthic communities are not only valuable in themselves, they are also important for other species such as fish. Petroleum operations have to comply with requirements relating to surveys of the seabed and choice of location, so that damage to vulnerable benthic communities like coral reefs can be avoided.

Given the lack of adequate surveys of the seabed, no definite conclusions can be drawn about the status of vulnerable and ecologically important benthic habitats in the management plan area. However, a survey of coral reefs along the Norwegian coast carried out by the Institute of Marine Research in 2000 revealed damage to 30 to 50 per cent of the coral reefs, mainly as a result of bottom trawling. On the other hand, more recent surveys by the Institute suggest that the damage is less extensive than the 2000 survey seemed to indicate. Corals grow slowly, and it can often take a very long time for damaged reefs to be restored. The lower temperature in the Barents Sea means that the growth rates and potential recruitment rates of corals and sponges are lower than in areas further south, and benthic habitats like these would be highly vulnerable to physical disturbance of the seabed.

We know little about how the species diversity of coral reefs is affected by damage, or about its recovery. So far most species identified on reefs also occur in other benthic habitats, but coral reefs may play an important role in the life cycles of certain other species, for example by providing a place where small fish can hide from predators. Since different habitats usually support different species, extensive damage to species-rich habitats like coral reefs is likely to have a negative impact on biodiversity. Under Norwegian fisheries legislation, five areas of the Norwegian continental shelf are closed to bottom trawling. One of these areas, Røstrevet, is the largest known cold-water coral reef, and is located in the management plan area. Fishermen are required to exercise special care in areas near known coral reefs. However, our knowledge of the distribution of coral reefs in the Barents Sea–Lofoten area is still limited, and it is possible that there are coral reefs north of those that have been found off Troms and Finnmark.

Bottom trawling also has an impact on other

benthic habitats where there are sessile, slow-growing organisms, but we know little about the distribution of these communities and the extent of any damage.

Sponge communities are a vulnerable habitat that is widely distributed in the Barents Sea–Lofoten area, and they are known to cover large areas of the Tromsøflaket and south and west of Svalbard. No studies have been made of the impact of bottom trawling on these communities, but surveys of other parts of the North Atlantic area with similar seabed conditions suggest that bottom trawling can cause substantial damage to sponge communities.

Satellite tracking data show that fishing in the Tromsøflaket area takes place in the area around the bank and not on the bank itself, where there are large sponge communities. More detailed surveys of sponge communities to establish their distribution and the extent of any damage, and to understand their importance, will be necessary before we can assess the need for protection and decide on the necessary restrictions on fishing.

Although the measures implemented so far seem to have reduced damage to known coral reefs, it will not be possible to prevent further damage and loss of vulnerable marine habitats in the period up to 2020 unless new measures are taken. Studies are being performed to improve our knowledge of these habitats and establish what measures are needed and what form they should take. The authorities in the relevant sectors will draw up a cross-sectoral action plan for the protection of coral reefs.

There may also be particularly valuable deep-sea benthic habitats in the western part of the management plan area, and these would be vulnerable to future activities in the area. They could include deep-sea mountains, hot springs, mud volcanoes and cold seeps. We know that most of the species in many of these types of habitats are endemic, i.e. they are restricted to a particular locality. Activities with an impact on the seabed put such species at high risk of extinction. However, current activity in the management plan area is not considered to be affecting such habitats.

So far no systematic assessment has been made of which marine habitats in the Barents Sea–Lofoten area are to be classified as endangered or vulnerable. However, a data set on endangered and vulnerable habitats throughout the country, including marine habitats, is being collected and will be available by 2010. MARE-ANO, a cross-sectoral programme to develop a

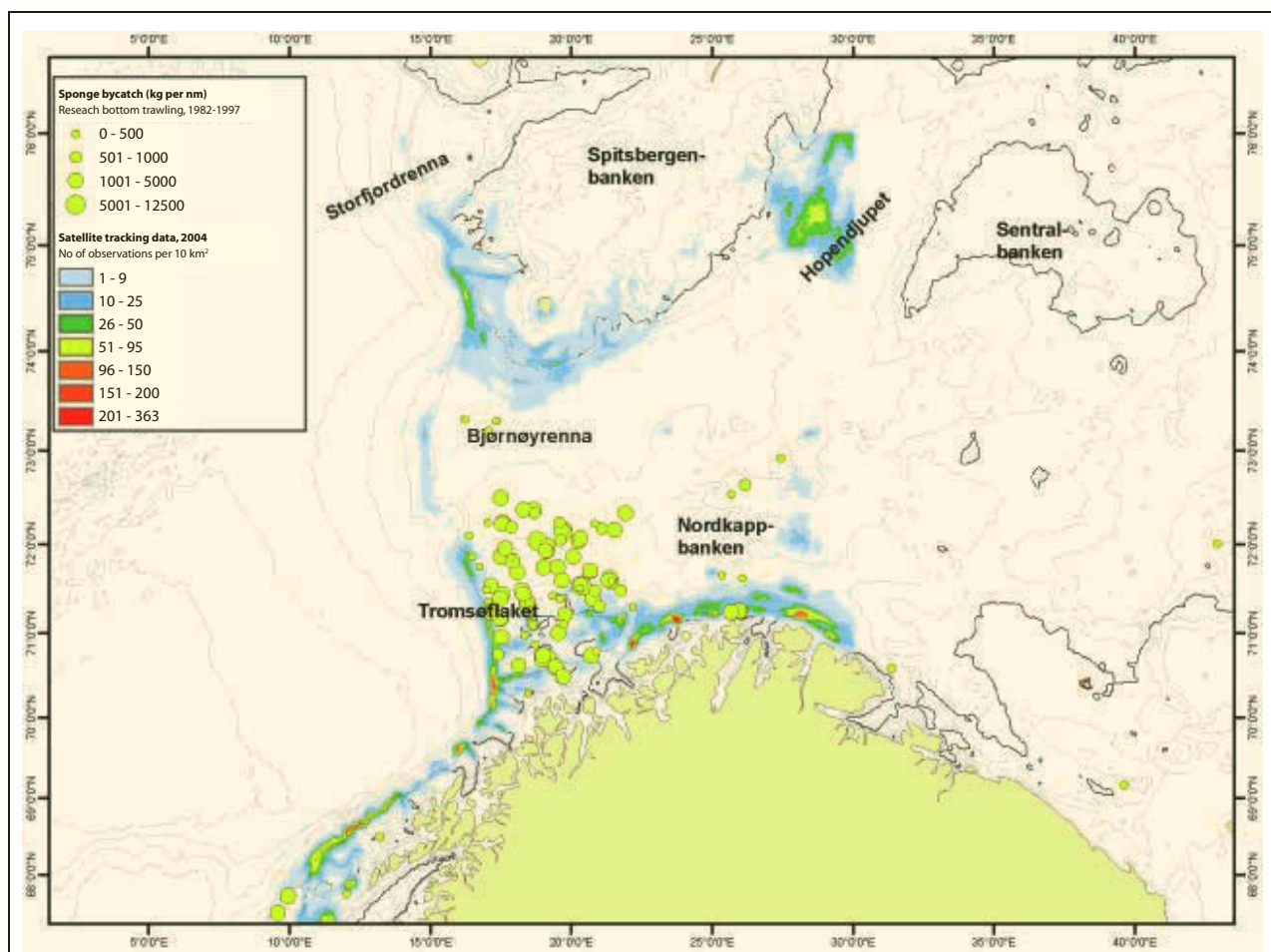


Figure 7.3 Few surveys have been made of the extent of the damage caused by bottom trawling and the ecological effects on swamp communities. However, satellite tracking data collected in 2004 indicate that most fishing is done outside the areas where sponges were found in samples during research bottom trawling in the period 1982–97.

Source: Directorate of Fisheries/Institute of Marine Research

marine areal database for Norwegian waters, has been set up to conduct more thorough surveys of the seabed, including vulnerable benthic communities. In the period 2005–2010 the programme will concentrate mainly on the northern areas. In addition, as part of the changeover to ecosystem surveys by the Institute of Marine Research, monitoring of benthic fauna at certain sampling stations has been started.

The above monitoring and survey activities will provide a much sounder foundation for deciding on measures to prevent further damage to vulnerable marine habitats, and on which areas should be closed to fishing with certain fishing gear or to other activities that could damage these habitats. The planned measures are described in more detail in Chapter 10.7.

7.6.3 Species management

7.6.3.1 Introduction

The Government has established the following objectives for species management in the Barents Sea–Lofoten area:

- *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.*

7.6.3.2 Management of key species and harvested species

When living marine organisms are harvested, part of the annual production is removed from the ecosystem concerned, creating a substantial environmental pressure. However, the pressure is managed, since the harvesting is based on management strategies that follow the principle of sustainable harvesting. Resource management depends on adequate knowledge about these stocks, which stocks are harvested, and the size of the catches. Management strategies will be further developed as we acquire more knowledge about the various elements of ecosystems.

There is considerable IUU fishing in the Barents Sea, and this is the most serious challenge to sound ecosystem-based resource management.

Cod, juvenile herring and capelin are the three key fish stocks in the production system harvested in the Barents Sea. Spawning stocks of cod, haddock and saithe in this area are above the precautionary levels, but the high level of IUU fishing (see Chapter 4.3) means that the total harvest of cod is now greater than the total allowable catch (TAC) specified in the current management regime. The spawning stock of herring is also considered to be above the precautionary level, and the population trend is positive. Herring is fished off the Lofoten Islands but not in the Barents Sea itself. The size of the capelin stock varies considerably with natural ecosystem fluctuations. It is currently very low and no fishing is permitted. At present the harvesting of haddock and saithe is sustainable. Stocks of the two redfish species are severely depleted, and harvesting is strictly regulated with a view to rebuilding the stocks. However, the harvest is above the level recommended by the International Council for the Exploration of the Sea (ICES). The Greenland halibut stock is severely depleted, and the catch is small, but the stock seems to be growing slowly.

A number of marine mammals play a significant role in the ecosystem and of these harp seals

and minke whales, which are important predators on fish in the Barents Sea, are harvested. The populations are large and viable and are harvested in accordance with scientific principles and the recommendations for sustainable harvesting.

The bowhead whale is now endangered, and no longer fulfils its original role as a key plankton-eating species in the Barents Sea. However, at present the activity in the management plan area is not considered to be having an impact on the population of this species.

Population trends up to 2020 for the most important commercial fish stocks such as cod, herring and capelin depend on the extent to which the established principles for sustainable harvesting of living marine resources are followed. Greater knowledge about these species is expected to improve ecosystem-based resource management.

7.6.3.3 Vulnerable and endangered species

If a species is known to be in danger of extinction, or if this is likely to be the case if causal negative factors continue to operate, it is classified on the national red list as endangered or vulnerable (see box 4.5). Norway's most recent red list was compiled in 1998. The only species associated with the marine environment that have been assessed are marine mammals and seabirds, which means that the current red list does not provide a complete picture of the status of the species in Norwegian waters. A revised red list including marine species will be published in 2006.

The current Norwegian red list contains about 20 species of seabirds and marine mammals that are or have been found in the Barents Sea–Lofoten area. The northern right whale is the only species that is classified as extinct. The bowhead whale and the lesser black-backed gull (subspecies *Larus fuscus fuscus*) are listed as “Endangered” and a further five bird species (two of them found on Svalbard) are listed as “Vulnerable”. The remaining species on the Norwegian red list are classified as “Rare”, “Declining, care-demanding”, or “Declining, monitor species”. The categories are explained in box 4.5. In addition to the species on the red list, there are a number of species in the area for which Norway has a special responsibility.

Our knowledge about the vulnerability of marine species indicates that it is mainly birds and mammals that will be threatened by anthropogenic pressures in the Barents Sea–Lofoten area.

An exception is species endemic to certain deep-sea habitats, but we know little about the nature and distribution of such habitats in the management plan area. Recently there have been only sporadic observations of bowhead whales in the northern part of the Barents Sea, but human activity at the present level is not considered to be adding to the critical situation. The lesser black-backed gull (subspecies *Larus fuscus fuscus*) is endangered and has almost disappeared from Norwegian coastal areas. The population has been in decline since the 1970s; the reasons for this are not clear, but the decline is probably due to reduced availability of prey and a poor food supply owing to the decline in herring stocks in the period 1968–86.

The population of common guillemot has declined substantially in the last few decades. We do not know exactly why, but the decline is probably due to a combination of poor food supplies, external pressures and drowning in fishing gear. The Atlantic puffin has also suffered a steep population decline, due mainly to the lack of herring fry in the neighbourhood of their colonies during the period when the herring stock was depleted, which resulted in breeding failure. However, despite the fact that the herring stock recovered many years ago, the puffin population has not grown. Adult mortality has risen in recent years, but the reasons for this are not known. The puffin population on the island of Røst is now only 27 per cent of what it was in 1979. The poor food supplies for both the common guillemot and the puffin are thought to be due to a combination of natural fluctuations and harvesting. However, sustainable management of commercial fish stocks that takes the nutritional needs of seabirds into account is expected to reduce the negative pressure caused by harvesting in the period up to 2020.

A number of species whose numbers had been seriously reduced through harvesting, such as polar bear, walrus and barnacle goose, have now been restored to viable levels, especially in Svalbard and the northern part of the Barents Sea. However, other vulnerable and depleted populations of migratory birds, such as brent goose, have not increased, and this is thought to be due to negative pressures on wintering and migratory areas outside the Barents Sea–Lofoten area.

Major oil spills in the vicinity of important breeding colonies of auks and other seabirds can have serious impacts on many of these species, especially common guillemot and Atlantic puffin,

whose numbers are already severely reduced for other reasons. Status and trends in risk management dealing with environmental damage caused by acute pollution are described in more detail in section 7.5.

The bioaccumulation of long-range transboundary pollutants such as PCBs may have a negative impact on population trends for some species at the top of food chains, such as seagulls, birds of prey and polar bears. Status and trends with regard to pollution are described in more detail in section 7.3.

Anthropogenic climate change may in the long term have serious impacts on already endangered and vulnerable species, and is likely to alter the habitats and food supplies of other species so much that their survival is threatened, especially species that are dependent on drift ice, like polar bear and certain species of seal. However, climate change is not expected to have serious impacts until after 2020.

7.6.3.4 Alien species

The impacts of the introduction and spread of alien species on biodiversity are unpredictable and could be serious. The risk of unintentional introduction of species in the area is mainly related to ballast water exchange and hull fouling, and increases with the growth in ship traffic, especially traffic from areas with a similar marine climate. Climate warming will also increase the probability that alien species transported from waters further south will become established in the Barents Sea–Lofoten area, and if the North West Passage is opened to traffic, this will further increase the risk of alien species from distant regions with a similar marine climate being introduced.



Figure 7.4 Atlantic puffins

Source: Norwegian Polar Institute (Photo: Hallvard Strøm)

Provided that the Ballast Water Convention is ratified by a sufficient number of countries, so that it enters into force and can be implemented at an early enough date, new requirements for ballast water management will become effective during the period 2009–2016. This will reduce the risk of introductions of new alien species. However, this is likely to be outweighed by the increase in the volume of ship traffic, which will in turn increase the risk of introductions through hull fouling. Thus the overall risk level is expected to remain more or less the same. The risk may increase even more if the ban on TBT in anti-fouling systems turns out to lead to greater fouling of hulls. The overall risk of damage from the introduction of new alien species is expected to remain at about the same level as it is today.

Of the alien species that have been deliberately introduced, the red king crab is the one that has spread most widely, and it is continuing to spread. We do not know much about the impacts it may have on ecosystems, but the Institute of Marine Research has started a five-year research programme to investigate these more closely. The red king crab normally lives off sessile and motile benthic species and fish spawn, for example, capelin and lumpsucker. The spread and impact of the king crab can mainly be limited by harvesting.

In 2003 the western boundary of the area where Norway and Russia manage the red king crab stock jointly was drawn at Nordkapp. West of this line Norway has sole responsibility for managing the stock, and in this area fishing is unrestricted. However, no measures have been taken to encourage fishing for this species.

In 2005 a working group was appointed to provide recommendations for management of the red king crab. These will form part of a white paper on management of this alien species, in which the question of harvesting will be discussed.

A rise in the temperature of the Barents Sea will result in an increase in the distribution ranges of species that require higher temperatures, and species from areas further south will be able to spread into the Barents Sea.

In summary, there is a risk that already introduced and new alien species will spread in the Barents Sea–Lofoten area during the period up to 2020. However, it is very difficult to predict what impacts any new species and alien species already present, like the red king crab, are likely to have on the ecosystems in the area. Risks and impacts

can to some extent be reduced by limiting the spread of already introduced species and by taking prompt measures to reduce the risk of new introductions from ballast water. A national, cross-sectoral strategy for alien species, including alien marine organisms, is being drawn up and will be completed in 2006. Measures directed at alien species are outlined in Chapter 10.9.

7.6.4 Conservation of marine habitats

The Government has set the following target for the conservation of marine habitats in the Barents Sea–Lofoten area:

- *A representative network of protected marine areas will be established in Norwegian waters, at the latest by 2012. This will include the southern parts of the Barents Sea–Lofoten area.*

The conservation of a representative selection of marine habitats is important both for maintaining biodiversity and for ensuring that there are certain more or less undisturbed ecosystems for use in research and monitoring. The criteria for an area to be protected are that the marine habitat is representative, endangered or vulnerable, or that the area has characteristic features not found elsewhere. Work on a representative selection of marine habitats in Norwegian coastal waters (national marine protection plan) is well advanced and proposals are expected to be ready for public consultation in 2007, so that protected areas can be established in 2008. In the second phase of the work on the marine protection plan (2007–2012) further areas will be protected and other adjustments made as necessary. The work will be coordinated with the present management plan.

Generally speaking there is a good deal less pressure on marine habitats in the northern part of the Barents Sea and the territorial waters around Svalbard than further south. Protection measures for the territorial waters around Svalbard have ensured that most marine habitats in coastal waters shallower than 100 metres are effectively protected against local pressures.

In the nature reserves on eastern Svalbard, work has begun on protecting certain coastal areas and waters against traffic, especially from cruise tourism. The aim is to safeguard reference areas where human activity has had little impact, particularly on marine mammals and seabirds.

8 Current knowledge and need for knowledge

8.1 Introduction

Management of Norwegian sea areas has to be based as far as possible on knowledge of ecosystem structure and functioning and of how this is affected by human activities. Gaps in our knowledge could result in political objectives and priorities that are decided at random and are not cost-effective. On the other hand, it is not feasible to expect to know everything about such a large sea area in the foreseeable future, in either scientific or administrative and commercial terms. Since knowledge-building is complex and costly, it is important to identify these gaps and the degree of uncertainty of our current knowledge. This will enable us to establish decision-making procedures that take gaps and changes in our knowledge into account.

Knowledge of the Barents Sea–Lofoten area comes from a wide range of activities, for example research, surveys, environmental monitoring,

data collection by other methods and reporting; these are being carried out by many different institutions in a wide range of sectors. In addition to the universities and several university colleges, there are a number of Norwegian government institutions that manage knowledge about the Barents Sea, as shown in the list of examples in box 8.1. The Russian authorities also possess considerable knowledge of the area. The key actors in the knowledge-building efforts include private actors and certain educational and research institutions, both in Norway (for example the University of Tromsø and the Norwegian College of Fishery Science) and in Russia.

There are close links between education, research, surveys, monitoring, management, reporting and other knowledge-related activities in the various institutions. Thus reports based on monitoring and survey data are an important part of knowledge-based management, and enable decision-makers and the public to be kept up to date.

Integrated management of the Barents Sea–Lofoten area requires knowledge from many different sectors and types of activity.

The knowledge base for the present management plan is extensive. Our knowledge about fish stocks is based on over 100 years of research on living marine resources and the marine environment, and we have been transporting goods and passengers by sea for centuries. We also have 40 years' experience of petroleum activity on the Norwegian continental shelf, 25 years' experience of petroleum activity in the management plan area, and data from comprehensive surveys, research and monitoring activity in all these areas. Human activities in the management plan area also involve acquiring knowledge of the natural resources and marine environment. The management plan is a synthesis of our current knowledge about the area. However, there are a number of fields where gaps in our knowledge have been identified and must be filled.

Effective natural resource management and environmental and operational safety for human activities in the Barents Sea make it necessary to monitor factors such as shipping, fisheries, pollu-

Box 8.1 Some Norwegian government institutions responsible for managing knowledge of the Barents Sea

- Norwegian Biodiversity Information Centre
- Directorate for Nature Management
- Directorate of Fisheries
- Norwegian Defence Research Establishment
- Institute of Marine Research
- Norwegian Coastal Administration
- Norwegian Meteorological Institute
- National Institute of Nutrition and Seafood Research
- Geological Survey of Norway
- Norwegian Polar Institute
- Norwegian Petroleum Directorate
- Petroleum Safety Authority Norway
- Norwegian Pollution Control Authority
- Norwegian Radiation Protection Authority
- Governor of Svalbard

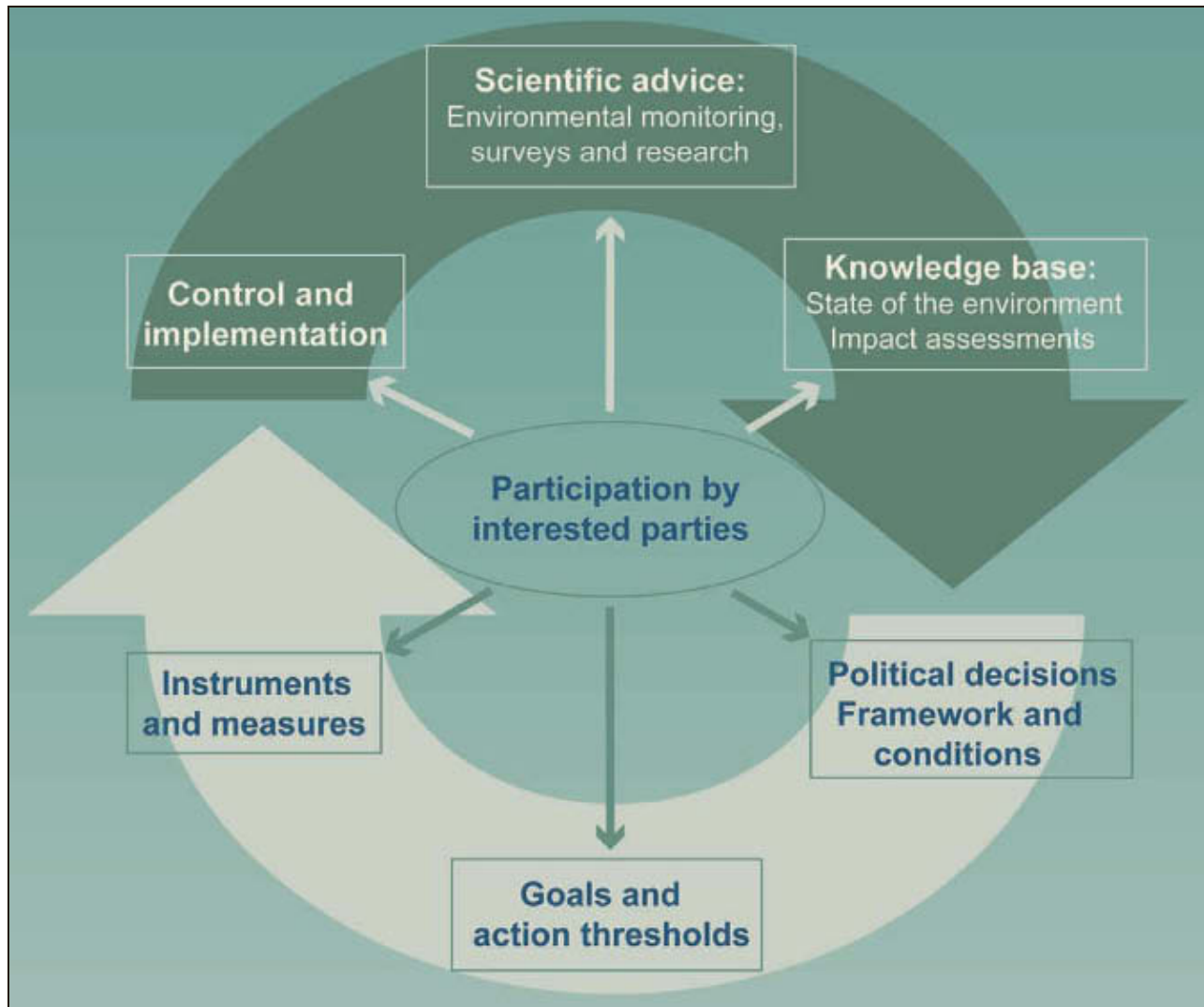


Figure 8.1 The links between knowledge and management

Source: Norwegian Pollution Control Authority

tion and weather conditions in real time and not only later through data capture. Norway has therefore concluded an agreement with Canada on the use of Radarsat, which will ensure that official Norwegian users have access to data from the satellite. The data are used in monitoring oil spills at sea, shipping, wind fields, ice cover and icebergs, and are used by for example the Norwegian Coastal Administration and the Norwegian Coast Guard to supplement data from monitoring stations on land and from ships and aircraft, and by the Norwegian Polar Institute and the Norwegian Meteorological Institute as a basis for ice and iceberg monitoring and for ice forecasts.

This chapter gives an overview of the organisation and collection of knowledge and of the knowledge status in the most important fields covered by the management plan. The focus is on

the main challenges rather than on providing a complete overview.

The question of the need for measures to further improve our knowledge of the Barents Sea–Lofoten area and the priorities for acquiring new knowledge are treated in connection with the evaluation of other measures in Chapters 9 and 10.

8.2 Ecosystem interactions

In its annual report *Marine Resources and Environment*, the Institute of Marine Research gives an overall review of the Barents Sea ecosystem, covering the water column, fish stocks and benthic resources and communities. The information is based on long-term surveys, research and moni-

Box 8.2 Ecosystem surveys of the Barents Sea

The Institute of Marine Research conducts ecosystem surveys of the Barents Sea in cooperation with the Russian marine research institute, PINRO, in Murmansk, which cover the whole of the ice-free area in the Barents Sea. The Institute of Marine Research conducts three surveys a year: in January-March, in June, and in August-September, the last being the most extensive. The results are reported in the Institute's annual report *Marine Resources and Environment*. These data provide the basis for most of the Institute's advice on management of the living marine resources in the Barents Sea, and for its assessment of the state of the environment.

The Institute's research vessels survey the most important components of the ecosystem. The methods used can be broadly classified into continuous observations throughout the survey and sampling at specific stations.



Figure 8.2 Research vessel *G.O. Sars*

Source: Institute of Marine Research

Continuous observations are collected by the following methods:

- sighting surveys of marine mammals and sea-birds,
- use of echo sounding and sonar to observe the biomass in the water column and the topography of the seabed,
- use of instruments for registering the surface temperature, weather conditions, etc.

The following methods are used to collect samples at the sampling stations:

- pelagic trawling for pelagic fish and larvae,
- bottom trawling for benthic fish, shrimps and other benthic organisms,
- when necessary more thorough surveys of benthic organisms with specialised equipment such as video sleds, grabs, and various types of towed gear,
- use of different types of plankton nets to sample plankton,
- water samples for depth profile analysis of nutrients,
- continuous registration of temperature and salinity depth profiles,
- collection of bottom sediment, water and biological material for analysis of environmentally hazardous substances and radioactivity.



Figure 8.3 Sponges (*Geodia* sp) caught by bottom trawling

Source: Institute of Marine Research

Box 8.3 Research and environmental monitoring conducted by the Norwegian Polar Institute in the Barents Sea

The Polar Institute is Norway's most important government institution for management-related research, environmental monitoring and surveys in the Arctic and Antarctic.

In the Barents Sea research and monitoring activities are concentrated on the polar climate, environmentally hazardous substances, biodiversity, climate variations, interactions in the sea ice-land-sea-atmosphere system, and impacts of climate change. The Institute studies the sources

and impacts of pollution and maintains a high level of scientific expertise on polar marine systems. Surveys are conducted either with Institute's own research vessel, the *Lance*, or in cooperation with other institutions on the use of their research vessels. The Institute has its own research station in Ny-Ålesund, which is responsible for the major part of the marine research activities there and plays a leading role in the work of the new marine laboratory.



Figure 8.4 Kings Bay AS runs a leading international climate and environmental research and monitoring station in the Arctic, which is located in Ny-Ålesund. Eleven nations in addition to Norway have their own research stations in Ny-Ålesund, and in 2005 Kings Bay opened the Arctic Marine Laboratory, the world's most northerly marine laboratory. Research at the laboratory is concentrated on the marine ecosystem in Kongsfjorden and surrounding waters and oceanographic studies of the West-Spitsbergen Current (a branch of the Gulf Stream).

Source: Norwegian Polar Institute (photo: Inger Lise Næss)

toring, and sums up what we know today about ecosystem interactions. Among the main sources of our information are the annual ecosystem surveys of the Barents Sea conducted by the Institute of Marine Research.

A working group under the national programme for surveying and monitoring biodiversity has proposed a system for monitoring marine biodiversity in the coastal zone, and a similar system is being developed for sea areas.

The recently established Norwegian Biodiver-

sity Information Centre will be a knowledge bank for biodiversity in Norway and an easily accessible source of information on Norwegian species and their populations and habitats (see <http://www.artsdatabanken.no>).

The website www.havovervakning.no (English site under construction) provides access to all institutions that conduct environmental monitoring in the Barents Sea. Another project entitled MONBASE (MONitoring the BARENTS Sea Environment), which involves cooperation between

the Institute of Marine Research, the Meteorological Institute and NERSC (Nansen Environmental and Remote Sensing Center), is being set up to develop an operational service and forecasts of tides, temperature salinity, nutrient distribution and plankton blooms in the Barents Sea. There are also other reporting mechanisms, one of which is the environmental monitoring programme for Svalbard and Jan Mayen (MOSJ), which collates and interprets data from Svalbard, Jan Mayen and surrounding waters. The Norwegian Polar Institute has the main responsibility for MOSJ, but data are also made available by a number of other institutions (<http://miljo.npolar.no/mosj/start.htm>).

MAREANO is a cross-sectoral programme involving surveys and basic research on physical, biological and chemical conditions on the seabed and systematic organisation of the information in an areal database for Norwegian coastal and marine areas. The database is regularly updated and can be accessed from the MAREANO website.

Operators in the petroleum sector on the Norwegian continental shelf conduct comprehensive surveys and environmental monitoring in accordance with the conditions in discharge permits issued by the Norwegian Pollution Control Authority.

Although our general knowledge of the ecosystem in the Barents Sea is fairly comprehensive, we need to know more about interactions between species in the food chain. So far studies of the ecology of the area have been concentrated on a small number of species. Since the commercial species are intensively harvested, it is essential to find out more about the diet of the most important species and about fluctuations during the year and from year to year. We need more knowledge about energy flow and interactions between species if we are to develop a sound management regime.

We still know little about the impacts of human activity on the various parts of the ecosystem. Researchers have only just begun to study the combined effects of different pressures on species.

Another area where gaps in our knowledge have been identified is the importance and function of the marginal ice zone, for example for the plankton biomass and timing of spring bloom. The horizontal distribution of Atlantic and Arctic water is a vital element in the ecosystem and must be monitored, particularly in view of the progression of climate change.

8.3 Individual species

8.3.1 Fish

Extensive research and fishing activities have given us a good deal of knowledge about the commercial fish stocks in the Barents Sea and their distribution and characteristics, especially with regard to cod, capelin, herring, haddock and saithe. In consultation with the Norwegian and Russian fisheries authorities, the Norwegian Directorate of Fisheries draws up fisheries statistics, which, together with the survey data from the Institute of Marine Research and PINRO, are used as input data for the annual stock estimates. The official catch statistics provide figures for landed catches, and do not include catches from illegal, unreported and unregulated (IUU) fishing, discarded fish, ghost fishing, etc. The knowledge base can be improved by quantifying the unregistered mortality, but this would require extra resources.

Data on non-commercial fish species have been collected during the regular surveys in the Barents Sea over the last 20–30 years, but little has been analysed. Analyses would require extensive resources.

8.3.2 Marine mammals

Extensive knowledge has gradually been built up that enables scientists to estimate the size of the stocks of certain marine species (minke whale, harp seal, polar bear) in the area. However, the estimates for some species are uncertain, and no systematic surveys are being carried out. The data for most of the species are not good enough for smaller-scale changes in population trends to be registered, and our knowledge of the distribution, state of the stock and demography of these species is not adequate as a basis for sound management.

8.3.3 Seabirds

Too little is known about variations in seabird populations in the management plan area. Monitoring the life histories and population trends of seabirds is essential if we are to discover the causes of observed population changes. This is being addressed by the SEAPOP (Seabird Population Management and Petroleum Operations) programme, which is intended to improve knowledge of seabirds through studies of distribution and population size, and thus provide a basis for dis-

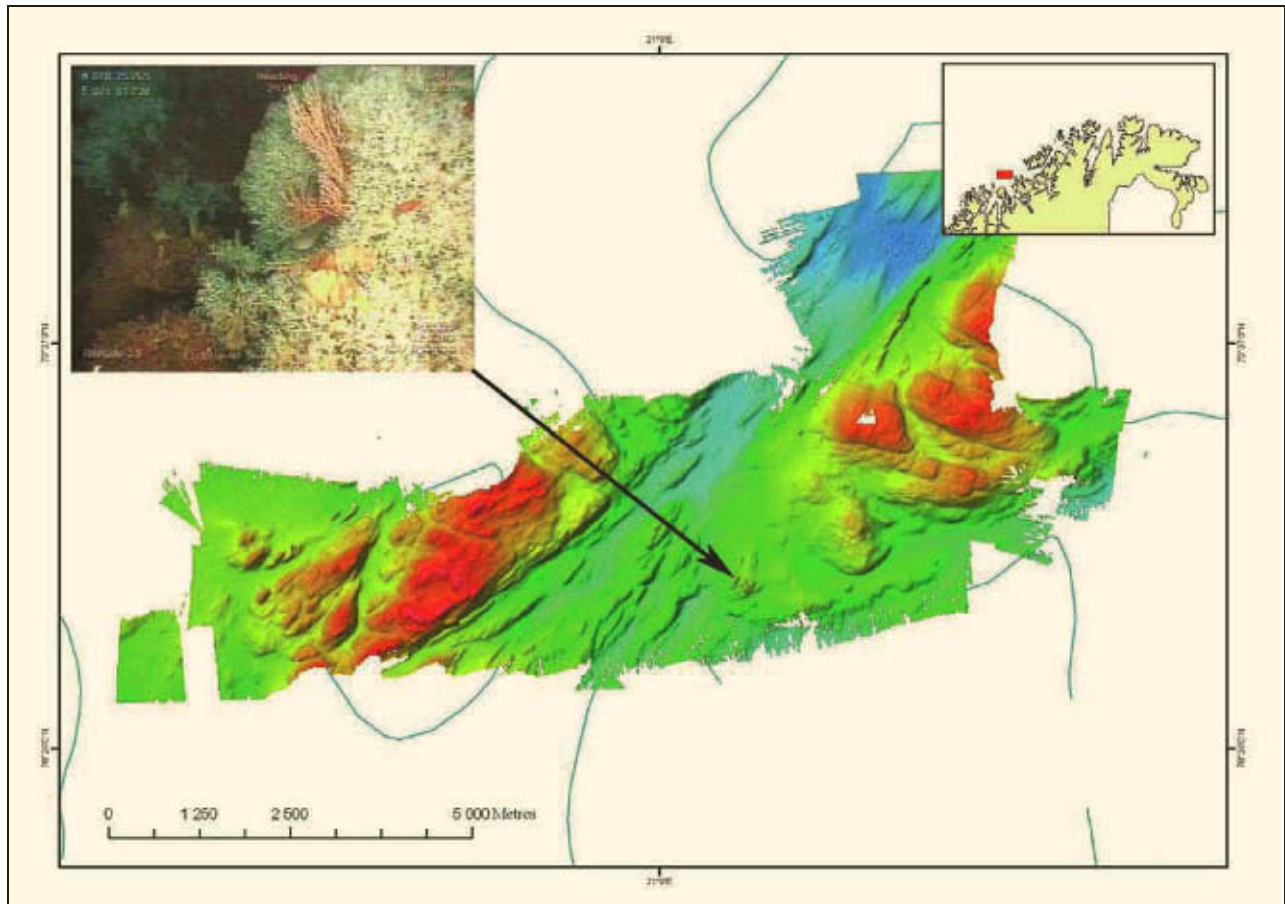


Figure 8.5 Surveys are revealing increasing numbers of coral reefs. Recently a reef was discovered in LoppHAVet, off west Finnmark.

Source: Institute of Marine Research

tinguishing between natural variations and anthropogenic impacts. A new web-based mapping tool for seabirds in Norway is being established to make it easier to access up-to-date information on these birds.

8.3.4 Corals and other benthic fauna

We know very little about the underwater landscape, ecosystems and biodiversity of the seabed in the management plan area, and about the state and distribution of seabed habitats such as coral reefs, sponge communities and deep-sea mountains, their vulnerability, their ecological functions and the biodiversity they harbour.

MAREANO is a cross-sectoral programme involving surveys and research on physical, biological and chemical conditions on the seabed and systematising the information in an areal database for Norwegian coastal and marine areas. The database is kept up to date and can be accessed from the MAREANO website.

MAREANO was established in 2005 and the focus is mainly on the High North, i.e. the southern part of the Barents Sea from Lofoten northwards to the Russian border. It is a cooperation project involving the Institute of Marine Research, the Geological Survey of Norway and the Norwegian Mapping Authority. These three institutions, the Directorate of Nature Management and the Directorate of Fisheries are also members of the programme's steering group, which reports to an interministerial steering group (consisting of the Ministry of Fisheries and Coastal Affairs, the Ministry of the Environment, the Ministry of Trade and Industry and the Ministry of Petroleum and Energy). Other institutions such as the Petroleum Directorate, the Directorate of Fisheries, the Norwegian Defence Research Establishment, the Norwegian Pollution Control Authority and the Norwegian Polar Institute are consulted when necessary.

The Institute of Marine Research also conducts surveys of the seabed at certain sampling stations during its surveys in the Barents Sea.

8.3.5 Alien species

No systematic approach has been adopted to gathering knowledge about alien species in the management plan area, about the nature and level of the risks or about the actual species involved. No methods have been developed for registering introduction of alien species, and there is little likelihood that the presence of a newly introduced species will be registered before it has become established. A cross-sectoral strategy for alien species is currently being developed and will be completed in the course of 2006. The strategy will set out principles, goals and action plans for preventing the introduction of species and containing the spread of alien species. It will contain measures for improving the knowledge base, and general and sector-specific measures targeted at particular species, including alien marine species. There is a special need for more knowledge concerning the impacts of the red king crab on the ecosystem, and the Institute of Marine Research has started a five-year research programme for this purpose. A separate white paper will be drawn up by the Ministry of Fisheries and Coastal Affairs concerning management of the king crab. The Norwegian Biodiversity Information Centre is compiling a list of alien species that according to evaluations based on the precautionary principle are particularly undesirable in Norwegian ecosystems. The list will be completed in the course of 2006.

8.4 Pollution

8.4.1 Introduction

In this white paper the term pollution refers particularly to oil pollution/hydrocarbons, radionuclides and environmentally hazardous substances. The most dangerous substances are persistent organic compounds such as PCBS that accumulate in food chains, alkyl phenols and heavy metals like mercury and cadmium. Eutrophication is not considered a problem in the Barents Sea-Lofoten area. There is a great deal of discussion about ocean acidification resulting from rising CO₂ emissions, but our knowledge in this field is limited. Through its membership of OSPAR, Norway has initiated efforts to increase knowledge about the impacts of ocean acidification, especially for calcifying organisms, and a report on this topic was produced by the Directorate for Nature Management in early 2006. Improving

knowledge of the impacts of acidification is an international task.

It is important to distinguish between knowledge of pollution levels and inputs in the management plan area on the one hand and knowledge of the impacts of pollution on the other. The need for more knowledge of the inputs and/or impacts of pollutants is especially great in cases where the concentration of such pollutants exceeds certain levels, but in order to determine these levels we must know the background levels of naturally occurring substances.

There is also a great need to be able to document the levels of pollutants in fish and other seafood. The international market for fish and seafood is particularly interested in this information.

8.4.2 Levels and inputs

Surveys by the Institute of Marine Research in the Barents Sea in 2004 showed that the background levels of oil components in seawater are very low. The levels of radioactivity in seawater as determined by caesium measurements were also very much lower than those found in areas further south. Knowledge of background values has improved, and more information is being collected in accordance with Norway's obligations under the OSPAR Convention.

The Institute of Marine Research monitors the levels of certain organic pollutants and radioactivity in organisms. Analyses of oil components in fish have been more sporadic, but the levels have been found to be generally very low (see Chapter 5). The National Institute of Nutrition and Seafood Research has collected a good deal of data on organic pollutants, including dioxins and brominated flame retardants, which also indicate low levels. However, information regarding pollution levels in fish has not been systematised, and the already established time series should be maintained.

Over the last 10–15 years the Institute of Marine Research has carried out studies of pollutants in bottom sediment in the Barents Sea, partly in connection with the work of the Arctic Council. Pollution levels are generally low, but we know little about the background levels. We have extensive knowledge of local pollution levels in the neighbourhood of oil installations (and of exploratory drilling operations), which is derived from the monitoring programmes that oil companies are required to carry out.

Only sporadic measurements have been made of the levels of environmentally hazardous sub-

stances in seabirds and marine mammals at the top of food chains. The levels that have been found are disturbingly high, but there are indications that the concentrations of certain substances like PCBs and cadmium are decreasing or levelling out. However, the lack of systematic data collection in this field makes it impossible to determine trends with any certainty.

There is very little knowledge concerning the total inputs of environmentally hazardous substances in the Barents Sea and how much originates from the various sources. Nor do we know much about the total quantities of pollutants entering the area through long-range transport. There is an air monitoring station in Svalbard (at Ny-Ålesund) and one on the Norwegian mainland, but their data do not provide the necessary information. Sporadic studies of inputs have been made under AMAP (the Arctic Monitoring and Assessment Programme), but the field is complex, and investigating the sources of these pollutants in more detail will require substantial resources. Inputs from the petroleum industry, however, are known, since production licences contain requirements governing releases and reporting. These requirements are also imposed on exploratory drilling operations.

Data and information from reports on releases from petroleum operations for the past eight years have been collected in a database (Environment Web), which has been developed by the industry in cooperation with the Norwegian authorities. The results of monitoring activities are put into a separate database (MOD).

The quantities of copper and TBT released from anti-fouling systems for ships have been surveyed and estimated. Inputs of TBT will decrease as the IMO decision to prohibit anti-fouling systems containing TBT takes effect. Data on illegal releases of environmentally hazardous substances are sporadic, but the discharges are assumed to be inconsiderable. Reports of oil slicks are received every year, and most slicks are assumed to be illegal discharges from ships. The frequency of such discharges is assumed to be proportional to the volume of traffic, but the results of the models used to calculate the volume of discharges are uncertain.

Although extensive documentation is required before a substance is considered a candidate for regulation, in many cases demonstrating the presence of an environmentally hazardous substance in living organisms is sufficient to elicit international action. However, the lack of knowledge about



Figure 8.6 Glaucous gull on Bjørnøya being sampled to test for PCBs

Source: Norwegian Polar Institute (photo: Hallvard Strøm)

trends in levels and inputs of pollutants makes it difficult to assess the effects of specific measures. Furthermore, our current knowledge of levels and inputs of pollutants is mainly confined to certain environmentally hazardous substances that are well known and are now being produced and used in decreasing quantities, as in the case of PCBs. We know considerably less about substances that have more recently come into widespread use, such as PFOS and brominated flame retardants. Thus the authorities have no overview of inputs of important substances like brominated flame retardants in the management plan area. Since many of these substances can be transported over long distances, tend to bioaccumulate and are not readily biodegradable, this gap in our knowledge is serious.

8.4.3 Impacts of pollution

Although a great deal of international work is being done by private actors and the public autho-

rities on risk assessment for various substances, there is a general lack of knowledge of the impacts of pollution on the ecosystem and on individual species. In particular, we know too little about the combined impacts of different substances. The EU is in the process of adopting a new regulatory framework for the registration, evaluation and authorisation of chemicals (REACH), which will improve our knowledge in this field.

A system for classifying chemicals used in the petroleum industry in terms of their acute toxicity, biodegradability and tendency to bioaccumulate has been established through OSPAR. However, the tests on which the classification is based are not fully adapted to conditions in the Arctic, for example with respect to the species tested; thus there is still uncertainty regarding the impacts of the tested chemicals.

The greatest effects of the high concentrations of persistent organic pollutants (POPs) in sea-birds and marine mammals in the management plan area are likely to be behavioural abnormalities, disruption of the immune system and reduced reproductive capacity, but we know little about these impacts. AMAP has produced a number of reports on these problems, but no systematic knowledge development is taking place in this field.

In response to the uncertainty regarding the long-term impacts of the large volumes of dissolved oil components in discharges of produced water from petroleum operations, the Research Council of Norway established a research programme to address this problem (PROOF). However, the issue is not particularly relevant to the Barents Sea–Lofoten area since the discharge of produced water is not permitted. No studies corresponding to PROOF have been initiated for long-range transboundary pollution.

There is a lack of knowledge about the local impacts of local oil pollution from illegal operational discharges from ships.

All in all there is a considerable need for more knowledge of the impacts of environmentally hazardous chemicals on important species and on the ecosystem in general.

8.5 Waste

We know little about inputs of waste to the Barents Sea–Lofoten area and their impacts, for example litter and effects on living organisms. Waste may originate from ships or land, but waste

from land is not considered to be a great problem in the area.

The factors used to estimate ship-generated waste and discharges of waste into the sea have been established on the basis of investigations reaching as far back as 1977. It can be assumed that stricter international rules concerning waste management on board ships together with improved technology have resulted in reductions in the volume of both generated waste and waste discharges to the sea. A global ban on discharges of plastics and other types of waste has been adopted by IMO (MARPOL 1973/78 Annex V). These changes will naturally mean that the factors used to calculate volumes of waste must be changed, and it can therefore be assumed that for certain categories of waste the volumes are being overestimated. More knowledge will be needed to arrive at more accurate estimates. The provisions of Chapter 20 of the Norwegian Pollution Regulations require ships calling at ports within the EEA to provide notification of the waste on board, including the amount of waste generated, the amount to be delivered to the port reception facilities and the name of the next port at which waste will be delivered. The information must be provided on a specific form, which is delivered to the port authorities before the ship arrives in port. If this information is pooled and systematised we will be able to form a better idea of how waste is managed.

The petroleum industry is required to sort all waste and transport it to land to be handled there.

A pilot project on monitoring marine beach litter is being conducted under the auspices of OSPAR and is scheduled for completion in 2007. The purpose of the project is to survey and analyse the litter on reference beaches in the region in order to obtain information on waste sources, trends and volumes.

A project carried out in the North Sea has shown that the accumulation of plastic waste in the digestive organs of seabirds has resulted in higher mortality.

8.6 Climate and weather conditions

Climate change poses a major long-term challenge in the Barents Sea–Lofoten area, but our knowledge of the impacts of climate change on fish, benthic communities, plankton and other elements of the ecosystem is limited. Building up the knowledge base in this field is vital and requires a



Figure 8.7 Expedition to the marginal ice zone in the Barents Sea

Source: Norwegian Polar Institute (photo: Hallvard Strøm)

comprehensive, long-term effort both at the national and at the international level, which must be started as soon as possible. A detailed description of the general challenges relating to gaps in our knowledge about the climate and anthropogenic climate change would be outside the scope of this white paper, but establishing time series and developing the methodology will certainly be essential steps. A white paper on Norwegian policy for climate change was published in 2002.

The basic data for weather forecasts for the Barents Sea are scarcer than those for other Norwegian sea areas, since the data stored in the Norwegian hindcast data archive are not as detailed for this area as for the other areas. This is a serious difficulty in the light of the new and growing activity in the Barents Sea. Knowledge of temperature, wind and wave height, for example, is important for calculating oil drift trajectories and in the fields of ship construction, the organisation of oil spill response measures and the construction of oil installations. However, more precise forecasts should be possible with current knowledge and technology if more data are collected and higher-resolution models are used.

8.7 Environmental risk associated with acute oil pollution

More than 40 years' experience of petroleum operations on the Norwegian continental shelf has given us extensive knowledge about the risk of acute pollution from this kind of activity. There is also a wide range of risk analysis tools and comprehensive accident statistics for marine trans-

port. Maritime transport and the petroleum industry are both regulated with a view to ensuring that the risk of acute pollution remains low. We do not have enough information to undertake total quantifiable risk assessments for the Barents Sea–Lofoten area, nor does this appear to be necessary, see Chapter 5.7.

However, more knowledge is needed about the adaptation of existing oil response equipment to Arctic conditions, particularly in order to be able to cope with oil spills in ice and response measures in the dark. A number of studies are being made in this field, for example the MARUT (maritime development) initiative, and exercises are carried out regularly by the authorities and the petroleum industry.

The level of uncertainty as regards the causes of oil spills in the Barents Sea–Lofoten area is no higher than for other sea areas.

However, there is no doubt that acute oil pollution from ships and petroleum activities in particularly valuable and vulnerable areas would have greater impacts in the Barents Sea–Lofoten area than in other sea areas, although exactly how much greater these would be is uncertain, mainly for the following reasons:

- lack of knowledge about the current situation, especially for seabirds, and
- lack of knowledge about the impacts on the ecosystem, for example on how long recovery would take and the rate of degradation of oil.

In addition, changes in the situation during the forecast period up to 2020 are likely to affect the scale of spills and the type of oil involved. The Barents Sea is one of the most productive areas in the High North and a substantial proportion of the fish stocks of the Northeast Atlantic spend part of their life cycle in the Barents Sea. The spawning areas of the most important fish stocks in the Barents Sea are along the Norwegian coast, and the eggs and larvae, which are the critical stages in fish life cycles, are transported northwards by the current system to nursery areas in the Barents Sea. At this stage most of a year class is concentrated in one area and carried passively northwards by the current. The rich production along the coast and in the Barents Sea also means that the density of seabirds in these areas is among the highest in the world.

Species diversity is high in cold-water coral reefs and sponge and other benthic communities. Benthic communities are only rarely affected by oil spills because the oil is transported by the

water masses without coming into contact with the seabed. However, if petroleum discoveries are made containing oil types that are not readily soluble, the possibility of an oil spill from an installation reaching the seabed cannot be excluded. Oil may also reach the seabed if a ship is wrecked but does not break up until it sinks to the bottom. The specific weight of crude oil normally causes it to rise rapidly to the surface of the water. (See Chapter 3 for a more detailed description of the seabed.)

Our knowledge of the effects of oil pollution at the individual level is adequate, although, as with other studies of this type, not all the relevant species have been studied. However, we know less about the ecosystem effects, in other words how damage to one component of an ecosystem (such as a fish stock) affects other components (such as seabirds or marine mammals). Priority will be given to further research on ecosystem interactions in general.

Knowledge of the environmental impacts of oil spills is mainly a result of international experience of major shipwrecks. When the Barents Sea South was opened for oil exploration in 1980, the preceding environmental impact assessment was based on experimental studies of the eggs and larvae of commercially important fish species by the Institute of Marine Research. The studies investigated the impact of the water-soluble fraction of crude oil and showed that there were considerable differences in vulnerability between species. Saithe and cod larvae had the lowest tolerance limits, while herring tolerated much higher concentrations of the water-soluble fraction.

More knowledge is particularly needed in the following fields:

- the impacts on ecosystem interactions,
- the geographical distribution of seabirds and marine mammals at different seasons and times of year.

Our knowledge of the drift and spread of oil has improved in recent years and the underlying data are considered to be adequate for use in risk analyses. The same oil spread models are used in connection with petroleum activities and maritime transport.

However, Arctic ecosystems have a number of distinctive features, such as low temperatures and ice formation, that necessitate more research into the spread, degradability and impacts of oil in these ecosystems. The oil type used in modelling oil spread also has a significant effect on the re-

sults, for example on the lifetime of a slick in the sea. Here the level of uncertainty is higher for oil spills from maritime transport than for those from petroleum activities. The weathering properties of oil are known once ordinary production has started, but not during the preceding exploration activities. The oil in a spill from a ship may include various oil types and products which in some cases have unknown properties.

8.8 Other issues

Disturbance of the seabed caused by dredging, dumping, land reclamation or production facilities, pipelines, cables and other installations on the seabed, may destroy environmental assets and remove or destroy underwater cultural heritage. Surveys of the seabed are among the requirements attached to licences for petroleum activities. Marine cultural heritage in the Barents Sea–Lofoten area has not been adequately surveyed or registered by the cultural heritage authorities, knowledge of shipwrecks in the area is piecemeal and random, and there is a need for better surveys. The marine archaeological investigation of certain areas has been given priority in the efforts to meet the challenges to sound management, but these areas do not have protected status; they have been selected as tools for cultural heritage management.

The methodology of ecosystem-based management needs to be further developed, including models for the overall pressure on the ecosystem exerted by activities in the various sectors. There is also a need for a system of environmental quality objectives and for coordinating monitoring and reporting. It would be an advantage to cooperate with other countries on this, for example in OSPAR, the Nordic Council of Ministers and the Arctic Council, and within the framework of Norway's bilateral cooperation with Russia.

Efforts should be made to improve our knowledge of the socio-economic issues relating to the various industries, such as the spillover effects of fisheries, maritime transport and petroleum activities. This is necessary in order to provide the best possible basis for decision-making.

8.9 Summary

Current knowledge of the ecosystem of the Barents Sea and the pressures on it is spread be-

tween a number of different institutions, and neither data collection nor reporting are adequately coordinated. The Institute of Marine Research, the Norwegian Polar Institute and the relevant administrative bodies are today the main institutions involved in monitoring and knowledge-building. Our cooperation with Russia is extensive, but should be strengthened and targeted more specifically at acquiring the necessary knowledge for ecosystem-based management. Among the most important areas for cooperation are fisheries statistics, surveys, environmental monitoring and knowledge of developments and activities on the Russian side that could put pressure on the environment and that will influence what action needs to be taken during the period up to 2020.

We already know a considerable amount about the ecosystem and commercial fish stocks. However, we need to find out more about interaction between organisms and the energy flow in the food chain, especially for non-commercial species. There are serious gaps in our knowledge about seabirds and conditions on the seabed, partly because these resources are not commercially exploited. However, the SEAPOP and MARE-ANO programmes should considerably improve our knowledge in the next few years. We need to know more about weather conditions in the area so that the data can be entered in the hindcast data archive, since the existing rules for the dimensioning of response measures make it necessary to take account of weather conditions.

Our knowledge of pollution levels in seawater and in the organisms in the Barents Sea–Lofoten

area is relatively good, even though it does not cover all substances. Documentation in this field is very important for documenting that fish and other seafood from the Barents Sea is not polluted. However, we do not know enough about trends in the levels of environmentally hazardous substances or their impacts, particularly in marine mammals and seabirds. This makes it difficult for the authorities to assess the impacts of implemented measures and to decide on where new measures are needed.

Very little is known about the risks associated with the introduction of alien species, which makes it difficult to establish a robust management regime that can deal effectively with new introductions. A cross-sectoral national strategy for alien species is being developed and will be completed in the course of 2006. It will set out goals, principles and action plans for preventing the introduction of alien species and containing the spread of those already introduced, and will contain proposals for joint and specific measures for the individual sector and problem organism. Dealing with alien marine organisms will be a central element, and management of the red king crab will be the subject of a separate white paper. These initiatives will make a considerable contribution to improving our knowledge in the field.

Our current knowledge is insufficient for us to use analytical tools and models to estimate the overall environmental pressure on the Barents Sea–Lofoten area. This will make it difficult to establish an integrated management regime for the area and to select the most cost-effective measures.

9 A new approach: integrated, ecosystem-based management

9.1 Introduction

Responsibility for the management of the Barents Sea–Lofoten area is currently divided between several different sectors, and implementing an integrated, ecosystem-based management regime based on the characteristic features of the different areas will require coordination between these sectors. Furthermore, gaps have been identified in our knowledge of a number of aspects of marine ecosystems, and there is also a need for better coordination of environmental monitoring programmes and for performance monitoring across sectors. The Government considers that meeting these requirements will call for new measures. The further implementation of the measures outlined in the present management plan will be considered in the annual budget propositions, in the light of the budget situation.

The Government also wishes to strengthen our cooperation with Russia. Taken together, these measures will form a sound basis for the integrated, ecosystem-based management of the Barents Sea–Lofoten area. They will also be supplemented by the Government's overall measures for addressing the main challenges relating to pollution and the maintenance of biodiversity discussed in Chapter 10. The question of co-existence between industries discussed in Chapter 6 is also relevant here.

9.2 A sounder foundation for the management regime

The Government will:

- establish an *advisory group on monitoring* of the Barents Sea to assist in the coordination of the system proposed by the Government for monitoring the state of the environment.

The group will be headed by the Institute of Marine Research and its activities will be conducted in line with the current division of expertise between sectors. It will have a broad membership, with representatives from the relevant public institutions with responsibility for and

expertise in the various sectors, and if necessary from other institutions involved in research and monitoring activities in the area, like the Directorate for Nature Management, the Directorate of Fisheries, the Institute of Marine Research, the Coastal Administration, the Norwegian Meteorological Institute, the Norwegian Institute for Nature Research, the Norwegian Polar Institute, the Norwegian Petroleum Directorate, the Norwegian Pollution Control Authority, the Norwegian Radiation Protection Authority, the Governor of Svalbard, the Petroleum Safety Authority Norway and the Norwegian Maritime Directorate. The Advisory Group will be responsible for coordinating the implementation of the monitoring system for the Barents Sea–Lofoten area under the management plan, and will produce annual reports systematising and interpreting the results on the basis of the indicators, reference values and action thresholds to be used in the system (see section 9.5).

The Government will:

- establish a *forum on environmental risk management* focusing on acute pollution in the area, which will provide valuable input to environmental risk assessments.

The forum will be headed by the Coastal Administration and have a broad membership, including representatives from the Norwegian Pollution Control Authority, the Norwegian Petroleum Directorate, the Maritime Directorate, the Directorate for Nature Management and other appropriate public institutions. The forum will also draw on expertise from other sources as necessary. The purpose of the forum is to provide better information on risk trends in the area, especially as regards acute oil pollution. This will improve risk management both across and within sectors and enable sectors to exchange information, particularly about risk factors. Other tasks will be to further develop the monitoring of risk trends and to coordinate monitoring activities applicable to risk management, especially in relation to maritime transport. Interest groups will be involved in the process as appropriate. The forum will com-

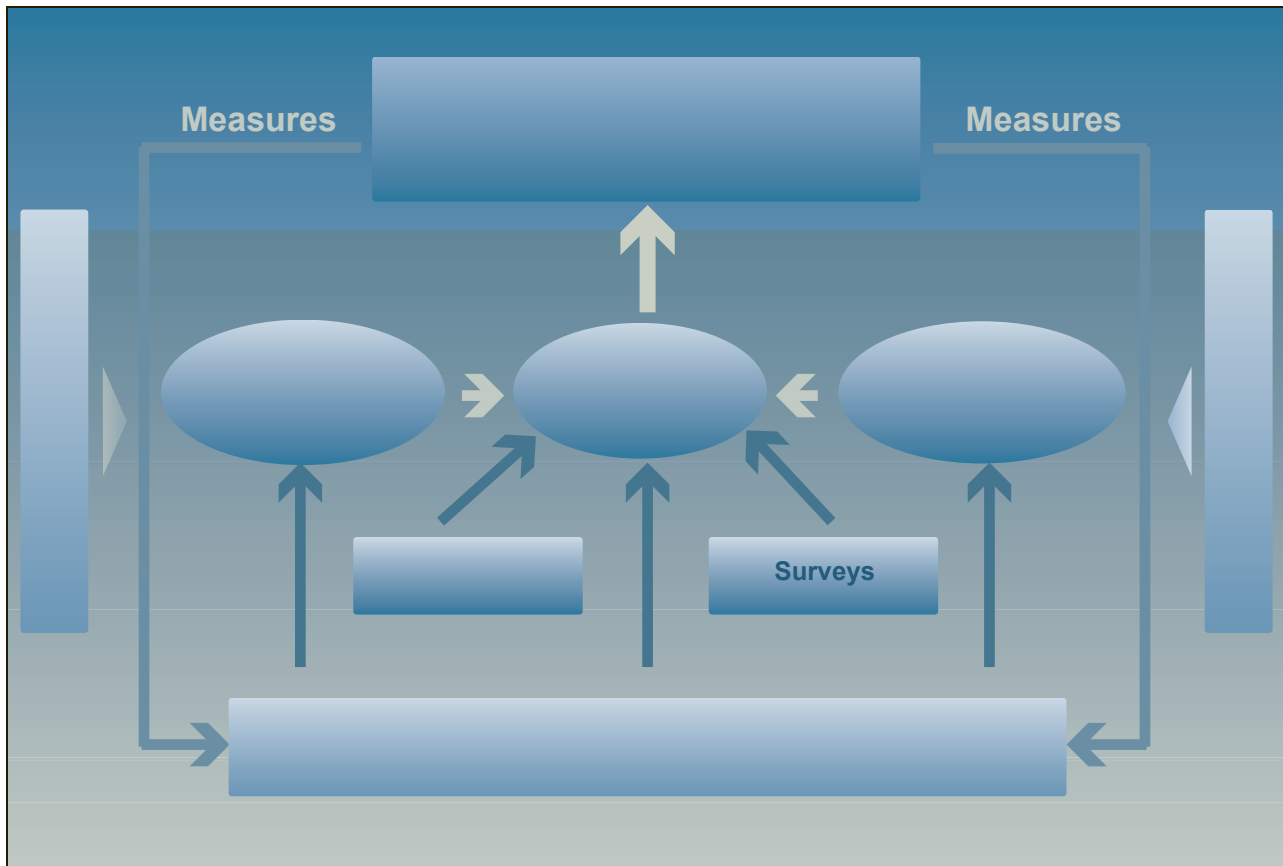


Figure 9.1 Overview of the elements of the system for implementing the management plan

*FM = Ministry of Fisheries and Coastal Affairs, PEM = Ministry of Petroleum and Energy, LIM = Ministry of Labour and Social Inclusion, MFA = Ministry of Foreign Affairs

Source: Norwegian Pollution Control Authority

pile a report on its activities, for the first time in 2010 and after this at regular intervals. Among the recipients of the report will be the forum described in the next paragraph, which will be responsible for the scientific aspects of the management plan, so that the information can be used in the overall follow-up to the plan.

The Government will:

- establish a *management forum* responsible for the coordination and overall implementation of the scientific aspects of ecosystem-based management of the Barents Sea–Lofoten area. The forum will be established and headed by the Norwegian Polar Institute.

The Norwegian Polar Institute will be responsible for ensuring that status reports are compiled on the results obtained through research, monitoring, surveys and other scientific activities relevant to the goals of the management plan. The first report

is to be submitted in 2010 and after this at regular intervals. The reports are to be compiled in close cooperation with the Institute of Marine Research, as head of the Advisory Group on Monitoring of the Barents Sea, and the Coastal Administration, as head of the Forum on Environmental Risk Management. The Management Forum will work in consultation with the administrative bodies involved and will draw on the work of the Advisory Group, the Forum on Environmental Risk Management and international bodies. The reports will be submitted to the Ministries of the Environment, Fisheries and Coastal Affairs, Petroleum and Energy, Trade and Industry, Labour and Social Inclusion, and Foreign Affairs. The Ministry of the Environment will be responsible for coordinating government control of the work and administrative follow-up of the reports, while the appropriate ministries and their subordinate agencies will be responsible for implementing the measures.

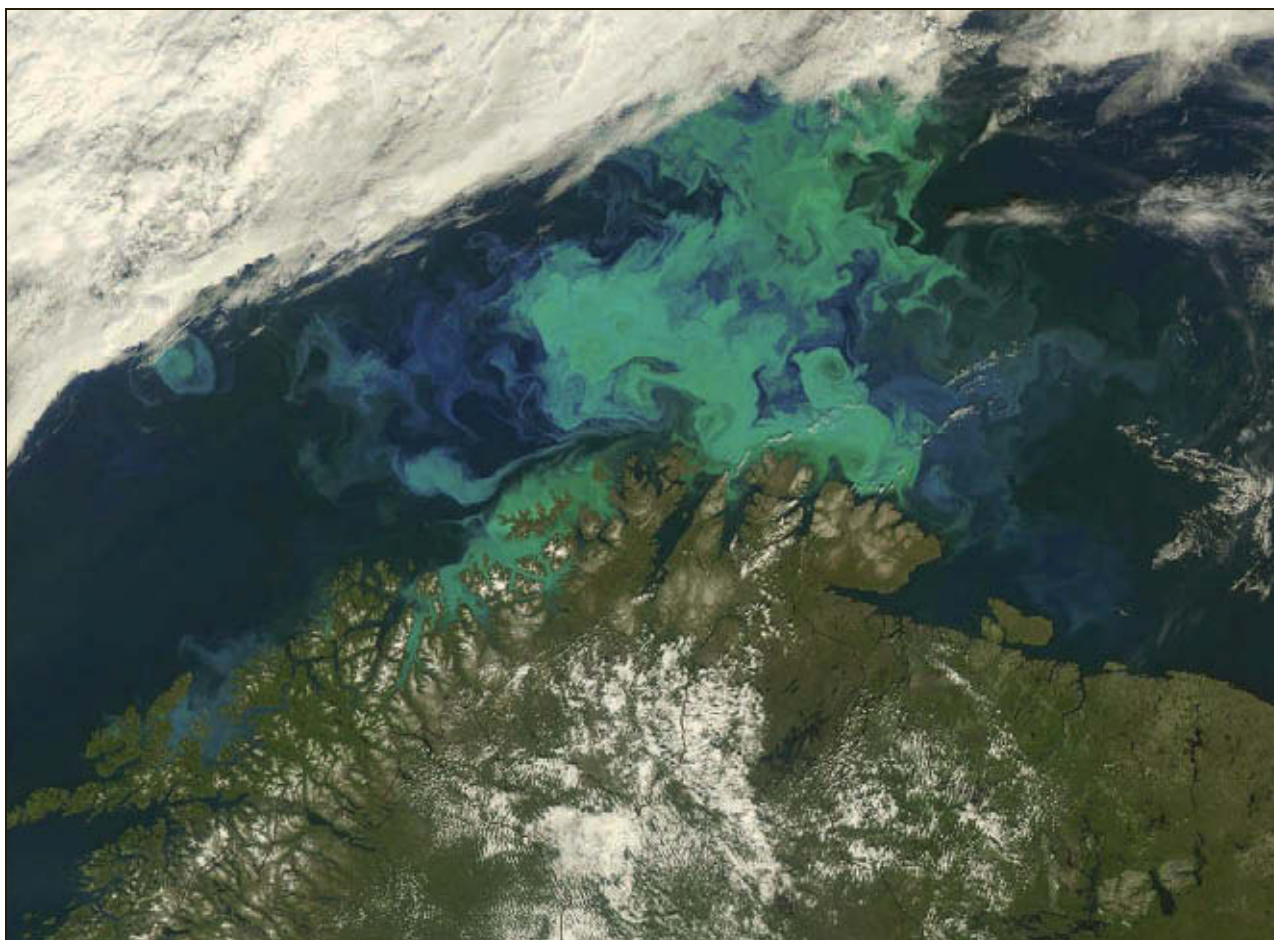


Figure 9.2 Satellite image showing bloom of the alga *Emiliana huxleyi* in July 2003

Source: NASA

9.3 Closer integration of interest groups

The Government will:

- establish a *reference group* for the work on the ecosystem-based management regime that represents the various interests involved, including business and industry, environmental organisations and Sami interest groups.

The Reference Group will be given the opportunity, through meetings with the bodies responsible for implementing the management plan and in other appropriate ways, to express its views on the implementation of the plan.

9.4 Updating the management plan

The Government will:

- assess the need for following up and updating the management plan on a regular basis.

- assess the overall need for new measures to achieve the goals of the plan, based on the status reports to be submitted from 2010 onwards.

New measures will be considered as soon as the reports are available. On the basis of the overall needs identified through these assessments, a process will be started well before 2020 with a view to completing an updated version of the whole management plan in 2020 with a time frame up to 2040.

9.5 An integrated system for monitoring the state of the ecosystem

The Government will:

- introduce a more integrated monitoring system, with indicators, reference values and action thresholds, for the Barents Sea–Lofoten area, including closer monitoring of pollution levels in the marine ecosystems.

Box 9.1 Elements of the monitoring system

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 the 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 favourable.

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 great that new measures must be considered.

9.5.1 Introduction

Chapter 7 sets out the goals of the management plan for the Barents Sea–Lofoten area. Ecosystem-based management of human activity in this area must be based on regular assessments of trends in ecosystems in relation to these goals. Through a system for monitoring ecological quality, the management authorities will be warned of changes that require action. However, it is only possible to take necessary and appropriate measures on the basis of information that clearly distinguishes between anthropogenic pressures and changes that occur independently of human activity. The Government will therefore establish an integrated monitoring system that will give the

competent authorities a better operational tool for managing activity in the area. This is in line with the work being done in OSPAR and the EU.

9.5.2 Elements of the monitoring system

To make it possible to monitor ecological quality in the Barents Sea–Lofoten area, it is essential to choose indicators that are representative, establish reference values for the indicators and determine the action thresholds at which new measures should be considered (see box 9.1 for an explanation of these terms).

The only pressures on an ecosystem over which we have any influence are those caused by human activity. But in order to distinguish between the effects of human activity and natural fluctuations in an ecosystem it is essential to monitor a large number of factors that are fundamental to the state and functioning of the ecosystem, for example temperature, salinity, water transport, extent of the sea ice, nutrient distribution, and the occurrence and production of phytoplankton and zooplankton. There are naturally no action thresholds for these indicators. Monitoring of these variables also provides information on which to base predictions of changes in production conditions, which in turn will affect the harvesting of marine resources.

Indicators are largely chosen on the basis of their relevance to ecosystem management, their relevance in relation to Norway's international obligations, and whether they are feasible in practice, in addition to their role in the ecosystem. Examples of indicators are the population trend for common guillemot and level of pollutants in polar bears.

The reference values for the various indicators are as far as possible determined on the basis of scientific advice, and will be further refined as our knowledge increases. For example, precautionary reference points for spawning stocks are used as reference values for pressure on fish stocks. The reference values for pollutant levels in polar bears are zero for anthropogenic substances and natural background levels for other substances.

There is already a great deal of monitoring activity in the Barents Sea–Lofoten area and ways of expanding or making better use of existing programmes should be considered. New indicators to be introduced under the monitoring system will as far as possible be based on existing long time series and be quantifiable. In areas where it is possible to set action thresholds, the indicators must

be able to show the impact of any remedial measures. In the above example of pollutants in polar bears, the action threshold for anthropogenic pollutants is any value above zero. As well as maintaining long time series, the monitoring system for marine ecosystems must also be dynamic and flexible enough to be changed and updated in the light of new knowledge. Since the proposal presented in this white paper is for a first-generation system, the Advisory Group on Monitoring of the Barents Sea described in section 9.2 above will have a central role in its implementation and further development. Indicators for which new funds are required for development or monitoring are marked “new” or “under development” in the table in Appendix 3.

The proposed action thresholds for the various environmental pressures are not intended as measures of performance. They indicate that the state of a particular indicator is such that the authorities should consider taking remedial measures.

9.5.3 Monitoring of selected indicators in the Barents Sea–Lofoten area

An overview of the proposed indicators for monitoring environmental quality is given in Appendix 3, Table 3.1. Action thresholds are given for indicators that reflect anthropogenic pressures.

Although human activity in the area has little impact on changes in the physical and chemical ecosystem variables or on blooms of phytoplankton and zooplankton, it is important to monitor these variables systematically. Most of the indicators listed in Table 3.1 have been chosen because long time series are already available for them and because they are already being systematically monitored.

The objective of managing biodiversity in the Barents Sea–Lofoten area is to maintain the diversity (in terms of habitats, species and genetic material) and productivity of the ecosystem (see Chapter 7). Maintaining biodiversity is also essential for the sustainable management of the harvestable resources, and the fish resources in the area are being extensively monitored. The indicators with action thresholds warn of changes in the biological parts of the ecosystems that are a direct result of pressures from human activity in the area or of long-range transboundary pollution.

9.5.4 Monitoring of pollutants

Pollution indicators and action thresholds have been chosen with a view to measuring performance in relation to pollution and food safety

goals. The choice of indicators is determined by their role in the ecosystem, whether they are feasible in practice, and their relevance to ecosystem management and in relation to Norway's international obligations. Trends for certain commercial species are also being monitored in order to assess their quality as food for human consumption. In the event of a major oil spill it is essential that a basic monitoring system is already in place so that the long-term effects can be monitored and assessed.

Figure 3.1 in Appendix 3 lists current and proposed pollution indicators and recommended sample types. Long time series should be built up for monitoring pollutants. The final choice of indicators is to be decided by the Advisory Group on Monitoring the Barents Sea described in section 9.2 above.

9.5.5 Implementation

As far as possible, the integrated monitoring system will be built on existing and planned monitoring programmes and be in line with Norway's international obligations. This will ensure that existing time series can be continued and that future research and monitoring needs are taken into account in the ongoing development of the management plan. New monitoring programmes should as far as possible be carried out within the framework of existing programmes. It is not possible for a system for monitoring ecological quality to monitor all the important populations. Special programmes are needed for this, such as the Seabird Population Management and Petroleum Operations (SEAPOPOP) and the ecosystem surveys carried out by the Institute of Marine Research. Revision of the system and inclusion of further indicators to ensure integrated, ecosystem-based management of the area will be considered in the light of the reports to be submitted in 2010. The Advisory Group on Monitoring of the Barents Sea will ensure that the monitoring system is coordinated as necessary with other, corresponding monitoring programmes in other sea areas, in the coastal zone and in freshwater. The Government will initiate new monitoring programmes if this is necessary to complete the reporting required by the monitoring system and will in general continue and strengthen existing monitoring, especially of hazardous substances, at all levels in marine ecosystems. It will also be necessary to review the integrated air, sea and land monitoring programme for the Arctic.

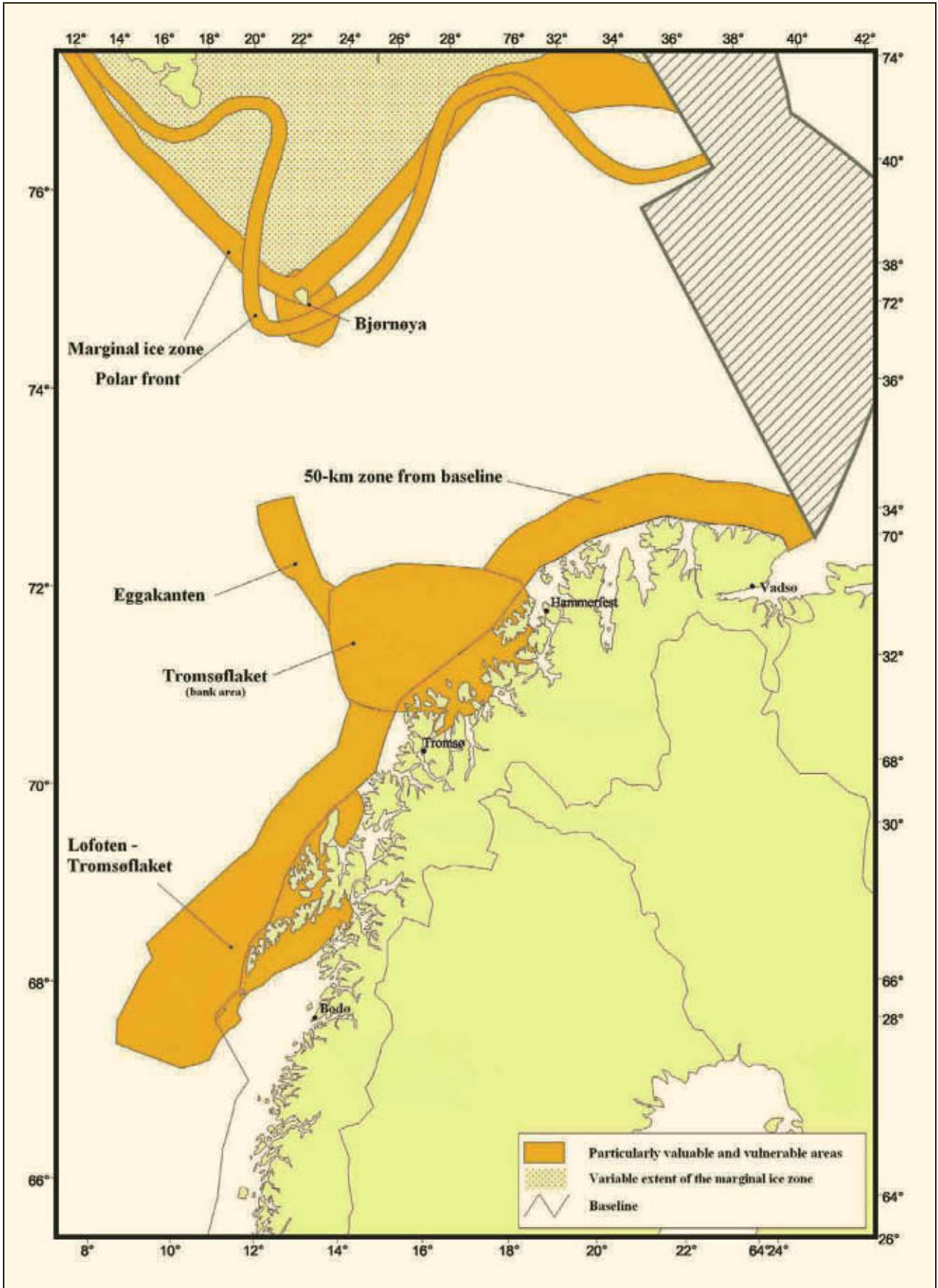


Figure 9.3 Particularly valuable and vulnerable areas

Source: Ministry of the Environment

9.6 Management based on the characteristics of different areas

Management of the Barents Sea–Lofoten area will be based on the assessments carried out during the preparation of this management plan. This means that the adopted measures and activities will be adapted to conditions in different areas, including the areas that have been identified in Chapter 3 as particularly valuable and vulnerable.

In these areas, special caution will be required and special considerations will apply to the assessment of standards for and restrictions on activities. Conditions for petroleum activities, fishing and maritime transport in these areas will be determined within the framework outlined in Chapter 10.

In connection with the work on a national marine protection plan, it has been proposed to establish marine protected areas in the Barents Sea–Lofoten area, for example to facilitate research and monitoring.

9.7 Better surveys

The Government will:

- through the MAREANO programme for developing a marine areal database for Norwegian waters, seek to ensure that the seabed and its biological, physical and chemical environment in the southern part of the Barents Sea, from the Lofoten Islands to the Russian border, is surveyed by 2010.
- facilitate the long-term expansion of the knowledge base relating to seabird populations through SEAPOP, the Seabird Population Management and Petroleum Operations. This will mean that sectors whose activities put pressure on the marine environment, and consequently on seabird populations, will be provided with a better basis for implementing the necessary measures.
- initiate a general survey of hazardous substances in the ecosystem.
- further develop surveys of risk trends in the Barents Sea–Lofoten area.

9.8 Expanding research activity

The Government will:

- increase support for research on factors that are important for the implementation of the management plan.

Research in this field will be coordinated with programmes under the Government's research and development initiative *Barents 2020* and with Norway's research cooperation with Russia. This applies to the research programmes *Havet og kysten* (on the oceans and coastal areas), NORKLIMA (on climate change and impacts in Norway) and *Biologisk mangfold* (on biological diversity). The main goal of *Havet og kysten* is to promote innovative research on the marine environment of high international quality. It has several sub-programmes dealing for example with pressures on ecosystems and management and conflict resolution, that will be useful when addressing issues raised in the management plan. NORKLIMA is focusing on the impacts of climate change on society. Climate change is likely to have a considerable impact on the ecosystem in the Barents Sea and thus on transport and business development in the management plan area. The Government attaches great importance to following climate trends.

These research programmes are administered by the Research Council of Norway, and have a 10-year time frame. Steps will be taken to ensure that the research programmes include all the topics and issues where more knowledge is needed for achieving the objectives of the present plan, especially with respect to the overall level of pressure on the environment and the determination of action thresholds for the various indicators, which is necessary for effective integrated monitoring. The research will include studies of the impacts of pollution on species and organisms and the impacts of the introduction of alien species.

The Government considers it important to continue and strengthen research programmes focusing on technologies developed for the sustainable utilisation of the resources in the area. The programmes include *Petromaks*, (a programme for the optimal management of petroleum resources) and *Maroff*, (for maritime activities and offshore operations), which are under the auspices of the Research Council, and *Maritim utvikling* (for maritime development), under Innovation Norway. Technological research is important for knowledge development in this field, and should be closely coordinated with other management-related research. We will emphasise the importance of certifying new technologies with respect to their impact on the environment.

The Government has set ambitious goals for Norwegian research, and will strengthen re-

search efforts, as indicated by our goal of increasing investment in research to 3 per cent of GDP by 2010. The national research policy priorities – internationalisation; basic research with an emphasis on science; energy and environment; oceans; and food – are all highly relevant to the implementation of the management plan. This is further underlined by the national action plan for climate research that is being developed and by the strategic priority the Government is giving to the High North, especially to expanding the knowledge base and intensifying cooperation with Russia. Coordinated action is needed for the Government to achieve its goals, and it has launched several initiatives to coordinate research in the field of energy and environment.

Further follow-up will be regularly assessed in future budget proposals.

9.9 Assessing the impact of elevated CO₂ levels

The Government will:

- consider further evaluations of the impacts of elevated CO₂ levels on the ocean and the atmosphere, including acidification of the ocean, climate change, and impacts on business activity, distribution of fish species and changes in ocean currents.

9.10 Exchange of information and experience

The Government will:

- ensure by 2008 that the exchange of information and experience concerning the scientific and operational aspects of the plan is more closely coordinated through the further development of existing IT tools. The Norwegian Polar Institute and the Institute of Marine Research will, in consultation with other agencies such as the National Institute of Nutrition and Seafood Research and the Geological Survey of Norway, compile a report as a basis for decision-making.

As far as possible and appropriate, the recommendations should be based on further development of already established IT systems. The views of the Reference Group will be taken into account.

When compiling their reports on the results of research, monitoring, surveys and other activities

relating to the management plan, the Norwegian Polar Institute and the Institute of Marine Research should also develop information material that is suitable for a wider public, including for teaching purposes, drawing in addition on the annual reports on marine resources and the environment from the Institute of Marine Research. They should also seek to ensure that the information is translated into Russian to make it accessible to the Russian authorities and interest groups.

9.11 Enhancing international cooperation, especially with Russia

The Government will:

- present a more general strategy for management and environmental cooperation in the High North.
- in its dialogues on the High North with like-minded countries, foster understanding of Norway's integrated approach to sustainable management of the resources in the Barents Sea and discuss other countries' experience of integrated resource management.
- propose to other coastal states in the North Atlantic Area that environmental standards should be developed for international waters, and raise awareness of the importance of sustainable management of the marine resources in the Barents Sea. Norway will place considerable emphasis on this issue when it assumes the chairmanship of the Arctic Council in October 2006.

The Government will give priority to cooperation with Russia at every level and in every field. The Government will:

- develop broad, long-term cooperation on marine environment issues through the working group on the marine environment under the Joint Norwegian-Russian Commission on Environmental Protection.
- enhance cooperation with Russia on ecosystem-based management of the Barents Sea and seek to establish common management principles and environmental standards.
- seek to ensure that an assessment of the state of the environment for the whole of the Barents Sea is carried out in cooperation with Russia.
- work to standardise and harmonise Norwegian and Russian environmental monitoring in the Barents Sea; this will include continuing to

- assist Russia in introducing OSPAR standards, which will facilitate Russia's entry into the OSPAR cooperation in the long term.
- enhance cooperation with Russia on ecosystem-based management of the Barents Sea, for example by obtaining more information on Russia's marine environmental management.
 - enhance cooperation with Russia on competence-building and the exchange of experience concerning activities that put pressure on the environment in the Barents Sea.
 - continue the development of ecosystem-based management of marine living resources in our bilateral cooperation with Russia, in accordance with a clear, recognised jurisdiction basis, with a particular emphasis on enhancing the scientific credibility, efficiency and international legitimacy of the management regime. Strive for openness with regard to research, and effective measures to combat illegal, unreported and unregulated fishing (IUU fishing).
 - further develop our bilateral energy cooperation with Russia at government level and between private companies, emphasising our experience of cooperation with our neighbouring countries in the North Sea.
- through high national environmental standards and an active High North policy, seek to ensure that Norwegian companies are also able to play a role in future oil and gas extraction in the Russian part of the Barents Sea; this will be a means of ensuring that the projects comply with the highest possible environmental and safety standards.
 - continue and strengthen cooperation between the Norwegian and Russian authorities on joint measures to ensure a high standard of safety and strict environmental standards for petroleum activity in the Barents Sea.
 - cooperate on oil spill response.
 - finalise the Memorandum of Understanding between Norway and Russia on cooperation to enhance maritime safety on the sea routes of the Norwegian and Barents Seas.
 - finalise the Barents VTMIS (Vessel Traffic Management and Information System) for the vessel traffic service centres in Vardø and Murmansk, thus ensuring joint Norwegian-Russian surveillance of maritime transport in the northern areas.
 - enhance our meteorological cooperation with Russia.

10 Measures to prevent and reduce pollution and to safeguard biodiversity

10.1 Introduction

As indicated earlier in this white paper, the state of the environment in the Barents Sea–Lofoten area is generally good. It is the Government's opinion, based on existing knowledge, that the main tasks in the period between now and 2020, in addition to those relating to long-range transboundary pollution, will be to deal with the risk of acute oil pollution in the Barents Sea–Lofoten area and further develop the different elements of an ecosystem-based management regime.

This chapter looks at the main steps the Government intends to take to deal with these tasks. The sectoral authorities are responsible for facilitating the implementation of the measures described here. Further follow-up of the measures will be regularly assessed in future budget proposals, in the light of the budgetary situation.

The measures presented here are intended as a supplement to the new approach to integrated ecosystem-based management of resources outlined in Chapter 9, which includes knowledge-building through monitoring, surveys and research. This is essential for preventing pollution and safeguarding biodiversity. Reference is also made to the importance of coexistence between industries, as discussed in Chapter 6.

Shipping is an international industry. The environmental challenges posed by industry should to a large degree be met through effective environmental measures and regulation under international and global regulatory frameworks.

10.2 Preventing acute oil pollution

The Barents Sea–Lofoten area includes areas which are vulnerable to acute oil pollution. In recent years, there has been a considerable increase in oil transports from Northwestern Russia and a further increase is anticipated in these transports. The level of petroleum activity is also expected to rise. A more detailed assessment of

the risk and of current risk management can be found in Chapter 5.7.

Against this background, the Government will:

- continue its work on maritime safety and oil spill response measures as set out in a recent white paper on maritime safety and the oil spill response system (Report No. 14 (2004–2005) to the Storting). These include:
 - establishing a vessel traffic service centre for North Norway in Vardø to monitor maritime transport from 2007 onwards,
 - cooperating with Russia on the development of a joint monitoring, notification and information system for oil transports and towing operations in the Barents Sea,
 - considering the establishment of AIS (Automatic Identification System) coverage around Svalbard and making the Harbour Act applicable to Svalbard,
 - maintaining adequate emergency tugboat services,
 - initiating the establishment of stockpiles of emergency unloading equipment for bunker oil,
 - further developing and updating the Norwegian Coastal Administration's plans for the use of ports of refuge in keeping with the risk picture,
 - contributing to the development of oil spill response equipment suitable for climatic conditions in the High North,
 - establishing mandatory routing and traffic separation schemes outside territorial waters between Vardø and Røst for traffic that poses a particular environmental risk.

The Government will furthermore:

- increase its focus on building up better and more complete statistics for shipping by systematic compilation of information from existing databases (such as AIS data, the pilot database, satellite tracking data for fishing vessels, data from other satellite-based systems, Safe Sea

Net data, etc.). One purpose is to improve the input data for risk analyses with a view to preventing and detecting acute spills and making it possible to identify the sources.

- cooperate with Russia on the analysis and identification of the types of oil transported by ship along the coast in the area covered by the management plan and evaluate the need to establish a data bank for all these types of oil.
- introduce traffic restrictions in the protected area on Svalbard for ships with heavy bunker oil on board.
- by transferring more responsibility to the business sector within the existing frameworks and legislation, ensure that training modules adapted to the specific environmental and operational conditions in the Barents Sea–Lofoten area are developed.
- strengthen the meteorological observation base.

The Government has already taken the initiative for a new mandatory routing and traffic separation scheme for maritime transport about 30 nautical miles from the coast. It is important that this is implemented as quickly as possible.

Other proposals will be considered by the Government in the ordinary budgetary processes, in the same way as other measures in other priority areas.

The Government also stresses the importance of a cautious approach to the expansion of petroleum activities in the Barents Sea–Lofoten area.

On the basis of an evaluation of the areas that have been identified as particularly valuable and vulnerable (see Chapter 3.2) and an assessment of the risk of acute oil pollution, the Government has decided to establish the following framework for petroleum activities in these areas. This framework will be re-evaluated on the basis of the information available each time the management plan is updated and information from the reports that are to be drawn up from 2010 onwards (see Chapter 9.2). In addition to results from research and surveys, important elements in the evaluation will be experience gained from new activities in the Barents Sea–Lofoten area, including impacts of unintentional releases of pollutants and data obtained from the environmental monitoring system that is to be established (see Chapter 9.5).

1. Bjørnøya

- No petroleum activities will be initiated within a 65-km zone round Bjørnøya.

- The Bjørnøya nature reserve will be expanded to the 12-nautical-mile territorial limit.
2. The marginal ice zone and the polar front
 - No petroleum activities will be initiated in or near the marginal ice zone and the polar front.
 3. Along the coast of Troms and Finnmark to the Russian border
 - No petroleum activities will be initiated within a zone stretching 35 km outwards from the baseline from the Troms II petroleum province along the coast to the Russian border.
 - No new petroleum activities will be initiated in the zone 35–50 km from the baseline, with following exceptions: petroleum activities in areas for which production licences were awarded in the 19th and earlier licensing rounds may be continued; new announcements and licence awards are permitted in predefined areas in mature parts of the shelf (APA area), and there will be openings for development of additional resources in these areas. The question of petroleum activities in the 35–50 km zone will be considered when the management plan is revised in 2010.
 - No exploration drilling will be permitted in oil-bearing formations in the zone 50–65 km from the baseline in the period 1 March – 31 August.
 4. Tromsøflaket bank area
 - The restrictions given above for the coastal zone also apply to Tromsøflaket.
 - No exploration drilling will be permitted in oil-bearing formations on Tromsøflaket outside 65 km from the baseline in the period 1 March – 31 August.
 5. Nordland VII and Troms II petroleum provinces
 - No petroleum activities will be initiated in Nordland VII and Troms II during the current parliamentary period. The question of petroleum activities in these areas will be considered when the management plan is revised in 2010.
 - There is a need to strengthen the knowledge base in these areas. The following programmes will be carried out:
 - The SEAPOP programme (Seabird Population Management and Petroleum Operations) will give priority to surveys in the Lofoten and Vesterålen Islands.

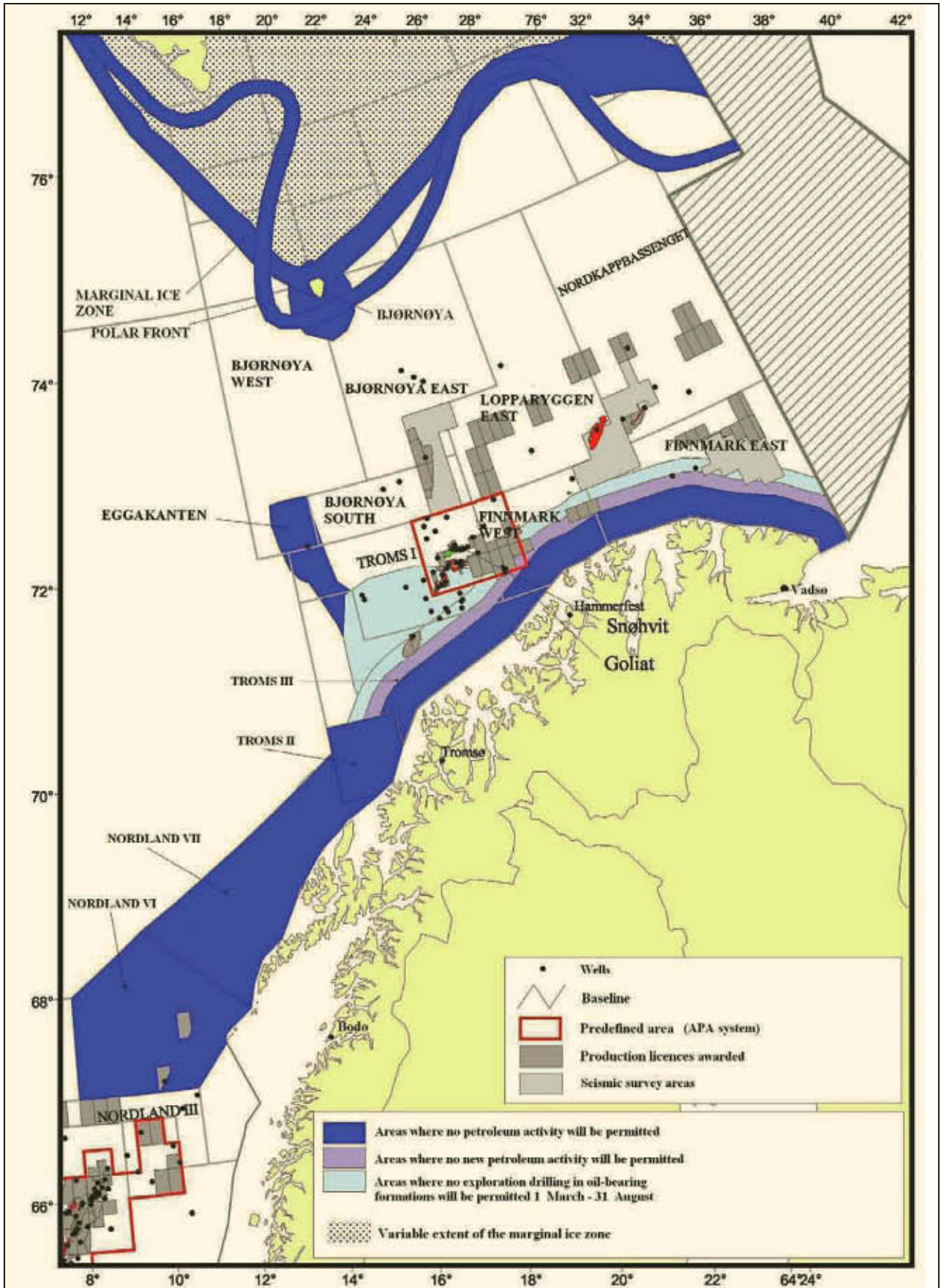


Figure 10.1 Framework for petroleum activities

Source: Ministry of the Environment

- The MAREANO programme to develop a marine areal database for Norwegian waters will give priority to surveys in the Lofoten and Vesterålen Islands.
 - Geological surveys will be carried out in the area under the direction of the Petroleum Directorate. This will include acquisition of seismic data. No impact assessment will be made of the opening up of these areas for petroleum activity during the current parliamentary period.
6. Nordland VI petroleum province
- No petroleum activities will be initiated in Nordland VI during the current parliamentary period.
7. Eggakanten
- No petroleum activities will be initiated in the Eggakanten area (stretching northwards from the Tromsøflaket bank area) during the current parliamentary period.
 - Surveys of the seabed and the distribution of seabirds and geological surveys, will be carried out in this area.
 - The SEAPOP programme (Seabird Population Management and Petroleum Operations) and the MAREANO programme to develop a marine areal database for Norwegian waters will initially give priority to surveys in the Eggakanten area.
8. Other parts of the Barents Sea
- In areas of the southern Barents Sea where no special requirements or restrictions apply in accordance with the points above, no licence-specific conditions will apply apart from the requirement for zero discharges to the sea under normal operating conditions.
 - This means that licence-specific conditions previously laid down, for example on exploration drilling, will no longer apply.
9. Revision
- The management plan will be a rolling plan and it will be updated at regular intervals. The first revision will take place in 2010.

10.3 Reducing long-range transboundary pollution

The assessment of the most important environmental pressures on the sea area has identified long-range transboundary pollution as a major

problem in safeguarding the Barents Sea as a clean and rich sea in the future.

Against this background the Government will:

- give priority to the work of following up the Strategic Approach to International Chemicals Management (SAICM), which has been adopted by the United Nations Environment Programme (UNEP).
- work towards the elimination of mercury releases as far as possible through a binding global convention.
- propose the inclusion of new hazardous substances in international agreements such as the Stockholm Convention on Persistent Organic Pollutants (POPs), as appropriate.
- ensure that efforts to reduce the use and discharge of hazardous substances are given high priority in development cooperation and in cooperation with Russia.
- seek to play an active part in efforts to ensure that the proposed new EU regulatory framework for the Registration, Evaluation and Authorisation of Chemicals (REACH) affords the best possible protection of the environment, consumers and employees.
- propose more persistent organic pollutants for inclusion in the Aarhus Protocol on Persistent Organic Pollutants.
- participate actively in the revision of the Gothenburg Protocol to Abate Acidification, Eutrophication and Ground-level Ozone.
- ensure that marine organisms are taken into consideration in processes related to the development of risk management tools in the OSPAR Commission, the EU and other international fora.

10.4 Other measures to prevent and reduce pollution

The Government will:

- consider establishing an environmental specimen bank for the Barents Sea–Lofoten area to make it possible to re-analyse specimens as better methods of detecting hazardous substances are developed and new substances are found in the environment, and to determine reference values/background levels for new hazardous substances and establish time trends.
- by holding the industries accountable for the pollution they generate, ensure the development of working methods to further reduce the

use and discharge of hazardous substances and the development of less hazardous substances with equally good operational performance.

- strengthen control measures and legal follow-up in cases of illegal discharges/pollution from installations and vessels in the area.
- take the initiative within the framework of the International Maritime Organization (IMO) for the development of better methods, including the development of emission factors, for estimating operational discharges from ships.
- make the Seaworthiness Act applicable to Svalbard and pursuant to the Act, make the regulations on the prevention of pollution from ships applicable to foreign ships in the waters around Svalbard.
- consider whether there are grounds for requesting the IMO to accord the Barents Sea the status of Special Area (SA) under Annex I and Annex V of the Marpol Convention 1973/78, in order to be able to invoke the more stringent rules of the IMO regarding discharges of oil and garbage from ships which apply in Special Areas.
- take the initiative vis-à-vis the IMO on a revision of Annex V on prevention of pollution by garbage from ships with a view to implementing rules with which compliance is easier to control and which take into account the new technologies in the field of waste management.

10.5 Ecosystem-based harvesting of living marine resources

When living marine resources are harvested, part of the annual production is removed from the ecosystems. The environmental pressure thus created is a managed one, which is based on management strategies that follow the principle of sustainable harvesting of marine production. Harvesting can also affect non-commercial species of fish, marine mammals and seabirds.

It is considered extremely important to ensure that the scientific advice underlying the total allowable catches (TACs) determined for each stock is based systematically on ecosystem considerations. Scientific advice is already based on knowledge of important elements of the ecosystems, and the aim is to provide fully ecosystem-based advice as our knowledge expands. Further development of the knowledge base and the methods for ecosystem-based management of resources is still required.

Against this background, the Government will:

- continue the development of an ecosystem-based management regime, in order to ensure an integrated approach to the management of the commercial species and an assessment of how this affects the ecosystem as a whole. This also requires taking into account vulnerable and endangered species and their nutritional needs.
- increase the proportion of commercially exploited stocks that are surveyed, monitored and harvested in accordance with existing management strategies, including management targets.
- set precautionary reference points for all the spawning stocks that are exploited commercially, particularly stocks that are being rebuilt to sustainable levels.
- reinforce control measures to ensure that harvesting takes place in accordance with the TACs.

10.6 Illegal, unreported and unregulated fishing (IUU fishing)

Good management of fish stocks depends on reliable information about how much is being caught and of which species. If researchers and managers lack information about the total catch of a stock, it is difficult to give scientific advice on fish stocks and to achieve sound management of them. There is considerable illegal, unreported and unregulated fishing in the Barents Sea, and this is a threat to sound, sustainable management of its fish stocks. In 2005, it was estimated that IUU fishing for cod alone amounted to 100 000 tonnes. The ongoing unreported, illegal fishing in the Barents Sea puts so much pressure on certain fish stocks that smaller TACs have to be set for legal fishing.

The Government will therefore work to strengthen management of the fish resources in the Barents Sea, and in particular to bring illegal, unreported and unregulated fishing to a halt. The most important measures will be to:

- work towards arrangements that will make it impossible for fish caught during IUU fishing to be sold or landed in any part of the world,
- cooperate more closely with fisheries authorities in other countries, particularly Russia and the EU,
- seek to conclude agreements on fisheries control with countries with which no such agreements exist,

- effectively follow up and investigate cases of IUU fishing,
- strengthen overall efforts in this field (grants to the Directorate of Fisheries and the Norwegian Coast Guard have been increased for this purpose),
- set up a special task force in the Directorate of Fisheries with the responsibility for uncovering economic crime.

10.7 Unintentional pressures on the benthic fauna

Trawling with heavy bottom gear can cause damage to the seabed and result in changes in benthic communities. Gear such as gill nets and long-lining gear can also become entangled in coral reefs and other benthic communities. An assessment of the scale and significance of such pressures is dependent on reliable information about conditions on the seabed and how the different fisheries affect the benthic communities.

Implementation of the MAREANO programme will ensure systematic surveying of the Barents seabed. Along with surveys carried out by the Institute of Marine Research, this will help to provide a basis for determining whether there are areas which should be closed to certain types of fishing gear.

Special provisions have been laid down in the Regulations relating to sea-water fisheries (section 66) to protect coral reefs from damage resulting from fisheries activities. They lay down that special care must be exercised near known coral reefs and prohibit the use of bottom gear on and near specified reefs (including Røstrevet). Deliberate damage to and destruction of known coral reefs during fishing operations is also prohibited.

Against this background, the Government will:

- continue systematic surveys of the seabed under the MAREANO programme with a view to full implementation of this programme in the Barents Sea–Lofoten area by 2010,
- through ecosystem surveys, initiate systematic monitoring of the benthic fauna in the Barents Sea,
- survey the Tromsøflaket bank area in order to identify sponge communities,
- compare the sponge communities on Tromsøflaket with similar communities elsewhere with a view to possible protection,

- ensure satisfactory protection of coral reefs in the Barents Sea–Lofoten area, for example by establishing a cross-sectoral national action plan for coral reefs,
- continue the work of surveying coral reefs and providing adequate safeguards for new reefs that are discovered, and regularly provide the fishing fleet and other operators with updated information on new coral reefs,
- further develop gear that is towed along the seabed in order to reduce bycatches and destruction of the benthic fauna.

10.8 Unintentional bycatches of seabirds

There has been a steep fall in the numbers of some species of seabirds in recent decades. Several of them are included in the list of endangered and vulnerable species. Moreover, Norway has a special responsibility for maintaining the populations of some of these species, as a significant proportion spend part or all of the year in Norwegian waters. Bycatches and a poor food supply are two environmental pressures that can be linked to the fisheries. However, the knowledge base is incomplete and it is difficult to quantify the impact on seabirds. The state of the seabird populations is part of the scientific basis for the advice the fisheries authorities receive from the International Council for the Exploration of the Sea (ICES). This advice is now being gradually reorganised on the basis of a more integrated ecosystem approach. In the time ahead, it will therefore be necessary to give more attention than previously to the sustainability of the whole ecosystem, which includes seabirds. Scattered information about bycatches of various species is available, for example, from longline fisheries and some gill-net fisheries. The problem of bycatches of seabirds has been reduced considerably since drift netting for salmon was prohibited some years ago.

Nonetheless, at certain times and in certain areas, there are relatively large bycatches of diving seabirds in gill nets. Such bycatches have for instance been reported from the spring cod fishery in shallow waters near land and from the lumpsucker fishery. The seabirds dive down to eat fish in the gill nets and can easily become entangled and drown. More knowledge and greater awareness about where and when such bycatches are most likely is therefore needed.

The northern fulmar was previously the species that was most vulnerable to longlining gear, although this did not constitute a threat to the population. A bird-scaring device called a “*kjal-keskrema*” has been developed and this has proved very effective in stopping fulmars from trying to take the bait when longlines are being set.

Fishermen endeavour as far as possible to avoid bycatches of seabirds, because bycatches hinder efficient fishing and also pose an ethical problem. Considerable efforts are being made to reduce this problem in the fisheries.

Better documentation of the bycatch problem will provide more reliable knowledge about where and when bycatches occur. This information is important for an assessment of whether further measures are needed and the choice of measures.

Activities outside the areas covered by the management plan are also of importance for trends in seabird populations.

Against this background, the Government will:

- contribute to long-term build-up of the knowledge base on seabird populations through the SEAPOP seabird monitoring programme. This will give the various sectors which affect the marine environment, including seabirds, a better basis for implementing any necessary measures.
- assess the need for regulatory measures in the fisheries in line with up-to-date information on the distribution of seabirds (where and when) and on their need for protection.
- make suitable arrangements to obtain better documentation of the bycatch problem.

In the light of new knowledge, the Government will assess the need for restrictions on gear to reduce bycatches of vulnerable seabirds in certain areas and during certain periods. The Government will also take steps to reduce bycatches of seabirds through the development and adaptation of suitable gear. In this context, the Government will consider making it mandatory to implement measures that have proved effective in reducing bycatches (such as the “*kjal-keskrema*” bird-scaring device used in longlining).

10.9 Introduction of alien species

The introduction of alien species is a problem, because we do not know what ecological and economic impacts they may have on an ecosystem

or on society. The spread of alien species in an ecosystem may lead to the displacement of native species. In different parts of the world, there have been examples of alien, opportunist species that have become dominant and threatened an entire natural ecosystem. The examples we know of are mainly from enclosed and semi-enclosed aquatic ecosystems. Nonetheless, it is important to address this issue with reference to our own waters.

Shipping is a possible route for the introduction of new species. Steps have been taken at international level through the International Maritime Organization to prevent the introduction of alien species. For example, rules have been established for ballast water exchange. Hull fouling can lead to the introduction of alien species to new areas. It is therefore a paradox that the most effective anti-fouling preparations also represent an undesirable source of pollution. Work is therefore underway to find solutions to both problems.

Against this background the Government will:

- play a part in ensuring that the international rules on the introduction of alien species are complied with and strengthened.
- take steps to improve knowledge of alien species and the risks associated with their introduction through a cross-sectoral national strategy for alien species that is currently under preparation with a view to completion in the course of 2006.
- ratify the Ballast Water Convention and provide the necessary legal basis for taking measures to implement it.
- implement national measures to fulfil the provisions of the Convention: this will include an assessment of whether it is necessary to establish special zones for ballast water exchange, taking into consideration transport routes and risks, and the establishment of monitoring and notification routines and emergency response plans where there is a danger of acute exposure.
- contribute to the development of a regional ballast water strategy for the OSPAR area in cooperation with HELCOM.
- in connection with a separate white paper on management of the red king crab, as set out in the budget proposal for 2006 from the Ministry of Fisheries and Coastal Affairs, consider whether a limit should be set north of which unrestricted fishing for red king crab may be introduced.

10.10 Endangered and vulnerable species and habitats

It is the Government's goal to halt the loss of biodiversity by 2010. The most recent white paper on the Government's environmental policy and the state of the environment in Norway (Report No. 21 (2004–2005) to the Storting) proposes measures to achieve this goal. One of these is to draw up action plans for selected habitats, groups of species and species in the period 2005–2010. Such action plans will help to make it possible to implement concrete, targeted measures to improve the situation for endangered and vulnerable species and habitats. An action plan provides background material in the form of information about a species and its distribution and status, a description of any problems and a description of completed and/or ongoing research. It also describes objectives, gaps in our knowledge, measures to be implemented, the resources needed and responsibilities.

When species and habitats are selected for inclusion in the action plans, species and habitats in the High North will also be of interest.

Examples of species and habitats that will be considered are the lesser black-backed gull (subspecies *Larus fuscus fuscus*), common guillemot, bowhead whale, coral reefs and sponge communities. Many of the most important threats have already been identified during the preparation of this management plan. In cases where human activity in the Barents Sea–Lofoten area represents a threat, the individual sectors are responsible for implementing measures in accordance with the relevant action plan. Action plans must therefore be drawn up jointly by the environmental authorities and other sectoral authorities. If the threats can be traced back to long-range transboundary pollution or climate change, Norway will have to work to improve the situation in international fora.

The Government will:

- draw up and implement action plans for selected habitats, groups of species and species in the Barents Sea–Lofoten area in the period up to 2010 as part of its efforts to halt the loss of biodiversity by 2010 (see Report No. 21 (2004–2005) to the Storting).

11 Economic and administrative consequences

11.1 Introduction

The present white paper contains proposals for new working methods, processes for reviewing the current use of instruments in the various sectors, and specific measures. It also indicates topics to be reviewed at a later date. The economic and administrative consequences of the various proposals can be predicted with varying degrees of accuracy, but as the proposals are implemented the consequences for public and private actors will be assessed in the usual way as set out in the Instructions for official studies and reports and the preparation of legislation.

The Government considers it important to improve knowledge about the whole of the management plan area. Knowledge-building is an essential part of the Government's initiative to promote research and development in the High North as set out in the report *Barents 2020*. The aim is to enhance Norway's role as a responsible steward for the northern seas.

The budgetary consequences of the proposed measures will be clarified in the budget process and included in the usual way in the ministries' annual budget proposals. Follow-up and implementation of measures in the years to come will depend on economic developments and the budget situation. The Government will evaluate the measures in the management plan in relation to other priorities in the ordinary budget processes. The following is a preliminary assessment of the economic and administrative consequences of the proposals put forward in this white paper.

11.2 Assessment of measures for integrated ecosystem-based management

11.2.1 Costs

The establishment of the Management Forum, the Advisory Group on Monitoring of the Barents Sea, the Forum on Environmental Risk Management and the Reference Group proposed in the management plan will involve a good deal of work

for the directorates and other institutions concerned. The volume of work will vary over time but will be especially large when the plan is reviewed in 2010. It must be emphasised that these efforts will be part of the established administrative framework and a continuation of existing activity. Thus the additional work is not on balance expected to have financial consequences of any significance. The Government will evaluate measures to improve the communication of information and revert to this question in connection with the annual budget proposals.

The costs relating to the establishment of a system for monitoring the state of the environment, including pollution levels, physical conditions and biodiversity, will be studied in more detail in connection with the annual budget proposals.

However, most of the work of establishing a system of indicators and reference values can be done as part of the extensive research and monitoring activity in the management plan area. The Institute of Marine Research currently spends approximately NOK 200 million a year on research and monitoring of the ecosystem in the Barents Sea, and it should be possible to carry out most of the proposed additional activity in connection with the Institute's ecosystem surveys. However, increasing the number of ecosystem components to be monitored and widening the geographical area to be sampled will require additional resources. These have been estimated at NOK 10 to 20 million annually. The question will be reviewed in more detail in connection with the annual budget proposals.

The Government will seek to systematise and improve knowledge about the Barents Sea through the programme to develop a marine areal database for Norwegian waters (MAREANO). The full cost of implementing the programme in the Barents Sea area in the period up to 2010 is estimated at about NOK 250 million, and funds were allocated for commencing these activities in 2005 and 2006. The Government will consider the annual allocations for further implementation in connection with the annual budget proposals.

Part of the survey of Tromsøflaket can be covered by MAREANO and additional needs will be evaluated in the budget process.

The cost of surveys of environmentally hazardous substances and of establishing the Biodiversity Information Centre will be the subject of a separate study.

The Government's goal of intensified research will require more funding, and allocations will be considered in the budget process. Reference is made to the proposal for a substantial increase in allocations to research in the white paper *Commitment to Research*.

The costs involved in an impact assessment of elevated CO₂ levels in the sea and the atmosphere will be considered in connection with the budget process.

Enhancing cooperation with Russia on the marine environment will entail cost increases within the framework of the bilateral environmental cooperation, which will be considered in connection with the budget process.

Implementation of the specific measures will depend on economic developments and the budget situation.

11.2.2 Benefits

The proposed measures will improve integrated ecosystem-based management of the Barents Sea–Lofoten area in various ways. The more extensive monitoring activity resulting from closer coordination will provide for an early response to changes in the ecosystem, which will be essential in the light of the expected increase in activity in the area. More extensive monitoring will also improve the underlying data for sustainable management. Better data on pollution will be important for monitoring trends and documenting the status of seafood and will provide a better basis for the international efforts to reduce releases

The proposed measures will strengthen Norway's compliance with its international obligations under the Convention on the Law of the Sea, the Convention on Biological Diversity and its Marine and Coastal Diversity programme, the Johannesburg Declaration on Sustainable Development, the Malawi Principles, the UN Fish Stocks Agreement and the OSPAR Convention. This means that Norway will be taking measures in advance of the adoption of the proposed EU Marine Strategy Directive. In its impact assessments, the European Commission has pointed to the substantial socioeconomic benefits that will result

from implementing a more integrated approach to management.

11.2.3 Administrative consequences

The measures proposed in this management plan will call for closer cooperation between agencies, but no changes will be made in the formal organisational structure. The measures will also call for closer general coordination between research and management.

11.3 Measures for preventing and reducing pollution

11.3.1 Costs

There is a considerable need for measures to reduce future risks of damage to the environment resulting from acute pollution related to maritime transport. Unless action is taken, the growing volume of oil tanker traffic along the coast will increase the risks to the environment, including in the management plan area. The work on the present plan has confirmed the importance of the measures outlined in a white paper on maritime safety and the oil spill response system, which was published in 2005. Additional measures are proposed in the present plan, including the establishment of a forum on environmental risk management and building up better and more complete statistics for shipping by systematic compilation of information from existing databases. As shown in the above-mentioned white paper, the measures needed to avoid an increase in environmental risks cannot be met within the existing budget framework, and further funding will be considered in connection with the budget process over the next few years.

The cost of establishing a data bank for the types of oil transported by ships along the coast and a system for storing tissue samples will be considered separately. When the costs have been estimated, the Government will if necessary consider allocations for setting up the data bank and storage system in connection with the annual budgets.

The costs of strengthening the meteorological observation base will be considered separately in connection with the budget process.

11.3.2 Benefits

Implementing the proposed measures should pre-

vent the growing volume of oil transports along the coast from increasing the risks to the environment, especially in the geographical area of the management plan. This will reduce the risk of pollution, safeguard Norway's position as supplier of clean food and avoid the cost of clean-up operations.

11.4 Other measures

11.4.1 Costs

Measures to ensure the further development of an ecosystem-based management regime will result in higher costs. Such measures include for example monitoring of stocks on a larger scale, ecosystem studies, and development of better fishing gear.

Strengthening the management regime for fisheries resources in the area, especially the efforts to combat IUU fishing (cf. Chapter 10.6), is also likely to increase costs. The budgetary consequences will be studied further and the Government will consider this question in connection with the budget proposals.

11.4.2 Benefits

A systematic strategy for ecosystem-based management will prevent damage to habitats with slow-growing organisms such as corals and sponges, and habitats with a high prevalence of endemic species, which is among the main challenges to marine environmental policy. Sustainable harvesting must take into account other important elements of the ecosystem, such as benthic communities.

Measures to reduce bycatches of seabirds will

ensure that Norway fulfils its international obligations and will allow population trends in seabirds to be monitored more closely and used as indicators of the state of the ecosystem.

11.4.3 Administrative consequences

The above measures are not expected to have administrative consequences of any significance.

11.5 Regional and local consequences

By establishing stable framework conditions over time, the measures in this plan will promote growth in the fisheries, maritime transport, tourism and petroleum industries in North Norway. The plan will encourage competence-building in the region with regard to the Barents Sea, and strengthen the cooperation with Russia on integrated management of the sea area. The research, monitoring and survey activities emphasised in the plan will result in knowledge-building at regional and local levels. The measures are not expected to have specific consequences for the Sami population.

The Ministry of the Environment

h e r e b y r e c o m m e n d s :

that the Recommendation from the Ministry of the Environment concerning integrated management of the marine environment of the Barents Sea and the sea areas off the Lofoten Islands dated 31 March 2006 should be submitted to the Storting.

Appendix 1**Abbreviations**

ACIA	Arctic Climate Impact Assessment	NEAFC	North East Atlantic Fisheries Commission
AIS	Automatic Identification System	o.e.	oil equivalent
AMAP	Arctic Monitoring and Assessment Programme	OSPAR	Commission for the Protection of the Marine Environment of the North-East Atlantic
CBD	Convention on Biological Diversity	PCBs	Polychlorinated biphenyls
DDT	Dichloro-diphenyl-trichloroethane	PFOS	Perfluorooctyl sulphonate
HELCOM	Helsinki Commission	PINRO	N. M. Knipovich Polar Research Institute of Marine Fisheries and Oceanography, Russia
ICES	International Council for the Exploration of the Sea	POPs	Persistent organic pollutants
IMO	International Maritime Organization	PROOF	Langtidsvirkninger av utslipp til sjø fra petroleumsvirksomheten (PROgram for OljeForurensning) (Norwegian research programme on the long-term effects of discharges to the sea from petroleum activities)
IPCC	Intergovernmental Panel on Climate Change	PSSA	Particularly Sensitive Sea Area
IUU	Illegal, unreported and unregulated fishing	REACH	Registration, Evaluation and Authorisation of Chemicals
IWC	International Whaling Commission	SA	Special Area (under MARPOL)
LME	Large marine ecosystem	SAICM	Strategic Approach to International Chemicals Management
LRIT	Long-range vessel identification and tracking	SEAPOP	Seabird Population Management and Petroleum Operations
LRTAP	Long-range transboundary air pollution	SOLAS	International Convention for the Safety of Life at Sea
MAREANO	Marin arealdatabase for norske kyst- og havområder (programme to develop a marine areal database for Norwegian waters)	TBT	Tributyl tin
MARPOL	International Convention for the Prevention of Pollution from Ships	UNEP	United Nations Environment Programme
MONBASE	MONitoring the BArents Sea Environment	UNESCO	United Nations Educational, Scientific and Cultural Organization
NAFO	Northwest Atlantic Fisheries Organization	VTMIS	Vessel Traffic Management and Information System
NAMMCO	North Atlantic Marine Mammal Commission		

Appendix 2

**Studies and reports drawn up as
a basis for the management plan and available at
<http://odin.dep.no/md/norsk/tema/svalbard/barents/bn.html>**

Table 2.1

<i>Date</i>	<i>Title</i>	<i>Published by</i>
<i>Scientific basis</i>		
May 2003	Identification of particularly valuable areas in the Barents Sea–Lofoten area	Institute of Marine Research Norwegian Polar Institute
April 2003	Fauna and flora of the littoral zone in the Barents Sea–Lofoten area – occurrence and distribution	Alpha Miljørådgivning
April 2003	Maritime transport in the Barents Sea–Lofoten area	Institute of Transport Economics Norwegian Coastal Administration
March 2003	The environment and natural resources in the Barents Sea–Lofoten area: supplement	Norwegian Polar Institute Institute of Marine Research
March 2003	Social conditions in North Norway	Agenda Utredning & Utvikling AS
February 2003	Particularly valuable areas for seabirds in the Barents Sea–Lofoten area	Norwegian Institute for Nature Research
December 2002	The aquaculture industry in Finnmark, Troms and the Lofoten region of Nordland	Directorate of Fisheries
November 2002	The fisheries in the Barents Sea–Lofoten area	Directorate of Fisheries Norwegian Fishermen's Association Norwegian Coastal Fishermen's Organisation Norwegian Raw Fish Organisation Norges Sildesalgslag
October 2002	The environment and natural resources in the Barents Sea–Lofoten area	Norwegian Polar Institute Institute of Marine Research
<i>Impacts of external pressures</i>		
June 2004	Assessment of the impacts of external pressures – climate change, pollution and other pressures from sources outside the Norwegian part of the Barents Sea	Norwegian Polar Institute
October 2003	Prescribed study programme	Norwegian Polar Institute
October 2003	Summary of comments received on the proposed study programme	Norwegian Polar Institute

Table 2.1

<i>Date</i>	<i>Title</i>	<i>Published by</i>
October 2003	Proposed study programme	Directorate for Nature Management Directorate for Cultural Heritage Norwegian Pollution Control Authority Norwegian Radiation Protection Authority
<i>Impacts of the fisheries</i>		
June 2004	Assessment of the impacts of the fisheries on the Barents Sea–Lofoten area	Directorate of Fisheries
November 2003	Prescribed study programme	Directorate of Fisheries
November 2003	Summary of comments received on the proposed study programme	Directorate of Fisheries
<i>Impacts of maritime transport</i>		
November 2005	Quantities of waste generated and discharges to the sea from shipping in the Barents Sea–Lofoten area	Det Norske Veritas
June 2004	Assessment of the impacts of maritime transport in the Barents Sea–Lofoten area	Norwegian Coastal Administration
November 2003	Prescribed study programme	Norwegian Coastal Administration
November 2003	Summary of comments received on the proposed study programme	Norwegian Coastal Administration
March 2003	Proposed study programme	Norwegian Coastal Administration
<i>Impacts of year-round petroleum activities</i>		
July 2003	Impact assessment of year-round petroleum activities in the Lofoten–Barents area – summary	Ministry of Petroleum and Energy
January 2003	Prescribed study programme	Ministry of Petroleum and Energy
June 2002	Proposed study programme	Ministry of Petroleum and Energy
<i>Risk and risk management</i>		
January 2006	Frequency of oil spills in the Barents Sea	Det Norske Veritas
October 2005	Management of the risk of acute oil pollution	Norwegian Coastal Administration Norwegian Pollution Control Authority Petroleum Safety Authority Norway Norwegian Petroleum Directorate Norwegian Maritime Directorate
June 2005	Risk indicators for overall environmental risk analysis in the Barents Sea	Det Norske Veritas
<i>Cross-sectoral reports</i>		
October 2005	Proposed indicators and environmental quality objectives for the Barents Sea	Institute of Marine Research Norwegian Polar Institute

Table 2.1

<i>Date</i>	<i>Title</i>	<i>Published by</i>
April 2005	Proposed management targets for the Barents Sea–Lofoten area	Directorate for Nature Management Directorate of Fisheries Institute of Marine Research Norwegian Coastal Administration Norwegian Polar Institute Norwegian Petroleum Directorate Norwegian Maritime Directorate Norwegian Pollution Control Authority Norwegian Radiation Protection Authority
April 2005	Vulnerable areas and conflicts of interest	Directorate for Nature Management Directorate of Fisheries Institute of Marine Research Norwegian Coastal Administration Norwegian Polar Institute Norwegian Petroleum Directorate Norwegian Maritime Directorate Norwegian Pollution Control Authority Norwegian Radiation Protection Authority
April 2005	Impacts of overall pressures on the Barents Sea–Lofoten area	Directorate for Nature Management Directorate of Fisheries Institute of Marine Research Norwegian Coastal Administration Norwegian Polar Institute Norwegian Petroleum Directorate Norwegian Maritime Directorate Norwegian Pollution Control Authority Norwegian Radiation Protection Authority
September 2005	Knowledge needs identified for the Barents Sea	Directorate for Nature Management Directorate of Fisheries Institute of Marine Research Norwegian Coastal Administration Norwegian Polar Institute Norwegian Petroleum Directorate Norwegian Maritime Directorate Norwegian Pollution Control Authority Norwegian Radiation Protection Authority

Appendix 3**Elements of the monitoring system for environmental quality**

Table 3.1 Proposed set of indicators

Indicator	Reference value	Action threshold
Ocean climate		
Extent of ice cover in the Barents Sea	Mean ice cover in summer and winter for the last 10 years	
Temperature, salinity and nutrients along fixed transects	Mean distribution in summer and winter, last 10 years	
Transport of Atlantic water into the Barents Sea	Mean distribution in summer and winter, last 10 years	
The marginal ice zone		
Phytoplankton biomass in the marginal ice zone (<i>Indicator under development</i>)	Average values, last 10 years	
Phytoplankton		
Timing of spring bloom (<i>Indicator under development</i>)		
Phytoplankton biomass expressed as quantity of chlorophyll a	Average values, last 10 years	
Species composition*	Historical data	
Zooplankton		
Zooplankton biomass	Mean distribution in summer and winter, last 10 years	
Species composition*	Historical data	
Fish stocks that are not harvested		
Biomass and distribution of juvenile herring**	Historical data	
Biomass and distribution of blue whiting	Historical data	
Fish stocks that are harvested		
Spawning stock of cod	Precautionary reference point	Estimated spawning stock is below the precautionary reference point

Table 3.1 Proposed set of indicators

Indicator	Reference value	Action threshold
Spawning stock of capelin	Precautionary reference point	Estimated spawning stock is below the precautionary reference point
Spawning stocks of fish stocks that are being rebuilt to sustainable levels*** <i>(Indicator under development)</i>	Precautionary reference point	Estimated spawning stock is below the precautionary reference point
Benthic organisms		
Species composition and quantity of benthic organisms and fish taken during research bottom trawling	Historical data	
Distribution of coral reefs and sponge communities****	Distribution and state of known sites	Significant rise in the extent of damage or reduction in distribution in areas that are monitored
Occurrence of red king crab	Distribution of red king crab	Spread of red king crab to new areas
Seabirds and marine mammals		
Spatial distribution of seabird and marine mammal communities <i>(Indicator under development)</i>	Average population numbers, last 10 years, and historical data	
Population trend for common guillemot	Average population numbers, last 10 years, and historical data	Viable population level when population is below this: or a population decrease of 20 % or more in five years, or failed breeding five years in a row
Population trend for Atlantic puffin	Average population numbers, last 10 years, and historical data	Viable population level when population is below this: or a population decrease of 20 % or more in five years, or failed breeding five years in a row
Population trend for Brünnich's guillemot	Average population numbers, last 10 years, and historical data	Viable population level when population is below this: or a population decrease of 20 % or more in five years, or failed breeding five years in a row
Bycatch of common porpoise <i>(Indicator under development)</i>	Average for the past five years	
Alien species		
Records of alien species	Historical data	Alien species recorded during monitoring

Table 3.1 Proposed set of indicators

Indicator	Reference value	Action threshold
Vulnerable and endangered species		
Vulnerable and endangered species***** (Indicator under development)	Viable population level and historical data on population levels	Population of selected species is below the level considered to be viable
Pollutants (see figure 3.1)		
Pollutants in fish, polar bears, seabirds, marine mammals and benthic animals (Indicator under development)	Natural background level	Rise in pollutant concentrations continuing for specified number of years, or sudden large rise from one sample to the next in an area, to above natural background level
Pollutants in sediments	Natural background level	Rise in pollutant concentrations continuing for specified number of years, or sudden large rise from one sample to the next in an area, to above natural background level
Litter along the shoreline (Indicator under development)	No litter	Unacceptable amounts of litter on shoreline
Levels of radioactivity in seaweed along the coast	Natural background level	Rise in radioactivity continuing for specified number of years, or sudden large rise from one sample to the next in an area, to above natural background level

* Samples for determination of species composition will be taken along the Fugleøya–Bjørnøya transect.

** Juvenile herring mature in the Barents Sea, but are fished in other waters.

*** Precautionary reference points must be determined for species for which they are not available at present.

**** This indicator cannot be used until surveys of coral reefs and sponge communities have been made.

***** Species considered to be vulnerable or endangered in the area are: lesser black-backed gull (subspecies *Larus fuscus fuscus*) (endangered), common guillemot (vulnerable), brent goose (vulnerable in Svalbard), Atlantic puffin (declining, care-demanding) and bowhead whale (endangered).

Pollution indicator	Sediment	Seaweed	Mussels	Shrimps	Capelin	Polar cod	Cod	Brünnich's guillemot	Harp seal	Ringed seal	Polar bear	Atm. inputs
Trace metals	X	X	X	X	X	X	X	X	X	X	X	X
TBT	X		X				X			X	X	
PAHs (oil-related)	X		X	X	X		X		X			X
THC (oil-related)	X						X		X	X		
PCBs	X		X	X	X		X	X	X	X	X	X
Dioxin-like PCBs	X		X	X	X		X	X	X	X	X	
Pesticides:												
DDT	X		X	X	X	X	X	X	X	X	X	X
Toxaphene	X		X		X	X	X	X		X	X	X
Chlordane	X		X	X	X	X	X	X	X	X	X	X
HCH	X		X		X	X	X	X	X	X	X	X
HCB	X		X		X	X	X	X	X	X	X	X
BFR	X		X				X				X	
PFAS	X		X				X				X	
Radioactivity	X	X		X	X		X					

Figure 3.1 Current and proposed pollution indicators, showing current and recommended sample types

Colour-coding in the table:

Green: Monitored regularly.

Blue: Monitored, but not regularly.

Red: Not monitored at present, monitoring recommended.

Unmarked: Not monitored at present, no recommendation made.

Atm. inputs = measurements of atmospheric inputs.

TBT tributyl tin

PAHs polychlorinated aromatic hydrocarbons

THC total hydrocarbon content

PCBs polychlorinated biphenyls

HCH hexachlorocyclohexane (lindane)

HCB hexachlorobenzene

BFR brominated flame retardants

PFSA perfluoroalkyl substances