12 Issues of Environmental Monitoring and Management in the Arctic

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Introduction

Environmental management is a complex exercise in exploiting natural resources and safeguarding the environment. This chapter scrutinizes and compares the systems applied in environmental monitoring and management in two Arctic countries, Russia and Norway, exemplified by the joint management of the Barents Sea. The historical development and current content of environmental management routines and practices, and the adequacy of the systems are discussed. Norway and Russia have been sharing and exploiting the marine resources of the Barents Sea for centuries, and joint environmental monitoring and management systems related primarily to rich fisheries have gradually evolved (Wienerroither et al., 2011; Eriksen, 2014). This corresponds to the Sustainable Development Goal (SDG) 14 Life Below Water framework of the UN 2030 Agenda and is a good example of how bilateral and international cooperation can be built and contribute to achieving SDGs.

In the early 1990s, Norwegian-Russian and circumpolar collaboration in general took a major step forward and a new paradigm of Arctic cooperation rapidly emerged. The novel openness in the Arctic, with military threats being downplayed and cooperation on resource management, environmental protection, and nature conservation led to the establishment of several international initiatives and platforms. As early as in June 1991, the first ministerial conference including all eight Arctic countries, along with three indigenous people's organizations, was held in Rovaniemi in Finland. This conference adopted the Arctic Environmental Protection Strategy (AEPS) (Arctic Environment, 1991). The five basic objectives of AEPS were formulated as:

1 to protect the Arctic ecosystem, including humans;
2 to provide for the protection, enhancement, and restoration of environmental quality and the sustainable utilization of natural resources, including their use by local populations and indigenous peoples in the Arctic;
3 to recognize and, to the extent possible, to seek to accommodate the traditional and cultural needs, values, and practices of the indigenous peoples as determined by themselves, related to the protection of the Arctic environment;

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4 to regularly review the state of the Arctic environment;
5 to identify, reduce, and, as a final goal, eliminate pollution.

The Norwegian-Russian cooperation had, prior to 1991, primarily dealt with managing fishery resources and establishing agreements on catch quotas. In the early 1990s, this cooperation was broadening and extended to include environmental monitoring and ecosystem management.

The 1991 AEPS initiative gradually evolved into today's Arctic Council (AC). The content and mandate for the AC are provided for in the Declaration on the Establishment of the AC signed in Ottawa, Canada in 1996. The AC is today the most prominent cooperation arena for the eight Arctic nations and representatives from the indigenous people's associations. The work is carried out in permanent working groups, currently six, addressing key issues in the management of the Arctic. The working groups are the Arctic monitoring and assessment program (AMAP), the Protection of the Arctic Marine Environment (PAME), the Conservation of Arctic Flora and Fauna (CAFF), the Emergency Prevention, Preparedness, and Response, the Sustainable Development Working Group, and the Arctic Contaminants Action Program.

The inclusion on the agenda of global climate change issues in the late 1990s and early 2000s, the increased pressure for hydrocarbon exploration in Russian and Norwegian Barents Sea, and the 2011 agreement on the delimitation of the formerly disputed area, all highlight the need for strengthened bilateral cooperation. However, Norway and Russia have so far not developed a jointly approved management plan for the Barents Sea, and today the principles of sustainable development and the ecosystem approach in management are implemented differently in the two countries while referring to the same international frameworks and goals.

Environmental monitoring in the Arctic

Environmental monitoring in the Arctic is a complex and diverse issue. Arctic and non-Arctic states, international organizations, industrial companies, and non-governmental organizations (NGOs) develop strategies and plans reflecting the issues of climate change, industrial developments, environmental and social risks, and impacts in the High North. The AC is now the leading intergovernmental forum promoting cooperation, coordination, and interaction among the Arctic states and other stakeholders on common Arctic issues, focusing on sustainable development and environmental protection.

The coordination of environmental monitoring activities under the AC is organized through its working groups. AMAP in its monitoring activities focuses on abiotic ecosystem components to assess the status of the Arctic region with respect to pollution and climate change issues. CAFF elaborates frameworks and guidelines for biodiversity and habitats monitoring in the Arctic.

AMAP designs its coordinated monitoring program and guidelines, bases its work on national and international monitoring network and research programs, and aims to harmonize this work. AMAP's assessments are based on information and results from monitoring and research work that generates a large amount of data. To optimize the work for gaining access to, processing, reviewing, analyzing, and storing the data, they have established a number of thematic data centers located at the expert institutes and organizations, such as the International Council for the Exploration of the Sea, the Norwegian Institute for Air Research, and the Norwegian Radiation and Nuclear Safety Authority. These centers also conduct data handling work for other international monitoring programs and facilitate harmonized data processing and reporting.

The Circumpolar Biodiversity Monitoring Program (CBMP) of CAFF is intended to harmonize and integrate efforts to monitor living resources. The CBMP is carried out by an international network of scientists, governments, indigenous peoples' organizations, and nature conservation groups. The program organizes its activities around the major ecosystems of the Arctic: marine, freshwater, terrestrial, and coastal. For each of these ecosystems, international steering and expert groups have been established to lead monitoring efforts and develop the biodiversity monitoring plans to guide these efforts. The CBMP emphasizes data management through the Arctic Biodiversity Data Service, capacity building, reporting, and integration of Arctic monitoring as well as communication, education, and outreach. The Arctic Marine Biodiversity Monitoring Plan of 2011 is the first of four pan-Arctic biodiversity monitoring plans developed by the CBMP to improve the ability to detect and understand the causes of long-term change in the composition, structure, and function of Arctic ecosystems. The Arctic Biodiversity Monitoring Plan for Freshwater Ecosystems came out in 2012, for terrestrial in 2013, and the fourth and final one for coastal ecosystems in 2019. All four Arctic monitoring plans of the CBMP apply an integrated ecosystem-based approach to monitoring. The ecosystem-based approach integrates information on land, water, and living resources, and lends itself to monitoring many aspects of an ecosystem within a geographic region (Gill et al., 2011).

AMAP is coordinated with and complements the CBMP managed by the CAFF, and both programs contribute to the Sustaining Arctic Observing Networks (SAON).

SAON is a joint initiative of the AC and the International Arctic Science Committee established in 2011 that aims to strengthen multinational engagement in pan-Arctic observing. SAON's ten-year strategy (2018–2028) addresses present and future Arctic observation needs. It sets priorities to fulfill the network's mission to facilitate, coordinate, and advocate for coordinated international pan-Arctic observations and mobilizes the support needed to sustain them. SAON itself has no part in the research, observations, or funding of these efforts; however, it encourages and promotes collaboration among ongoing observation networks and systems (SAON, 2018).

Ecosystem-based approach in Arctic environmental monitoring and management

The AC has developed a strategy for stimulating the ecosystem-based management of the Arctic Seas specified in the 2004 Arctic Marine Strategy Plan. The PAME working group of the AC applies a definition of Large Marine Ecosystems (LMEs) by ecological criteria, including bathymetry, hydrography, productivity, and tropically linked populations. PAME has identified 18 LMEs in the Arctic, each with unique features needing attention in a management plan. The Council has also developed guidelines for applying ecosystem-based management in a pan-Arctic perspective (Hoel, 2009; Skjoldal and Mundy, 2013).

Several of the Arctic LMEs fall entirely within the Exclusive Economic Zone (EEZ) of one single country, for example, LME 6, 7, and 8, are located entirely in the Russian EEZ. Some LMEs are shared among two or more Arctic coastal states. The Barents Sea LME is shared between Norway and Russia (Figure 12.1) (Skjoldal and Mundy, 2013; Matishov et al., 2003).

Managing Arctic ecosystems requires clear targets defining what ecosystem services are to be obtained and what impacts are to be tolerated. It requires input data of good spatial and temporal coverage and quality. Based on this, threshold values for selected indicators are specified. Threshold values are to be accompanied by definitions of trends or specific values which will trigger appropriate actions. Understanding the sensitivity and vulnerability of the ecosystem to any

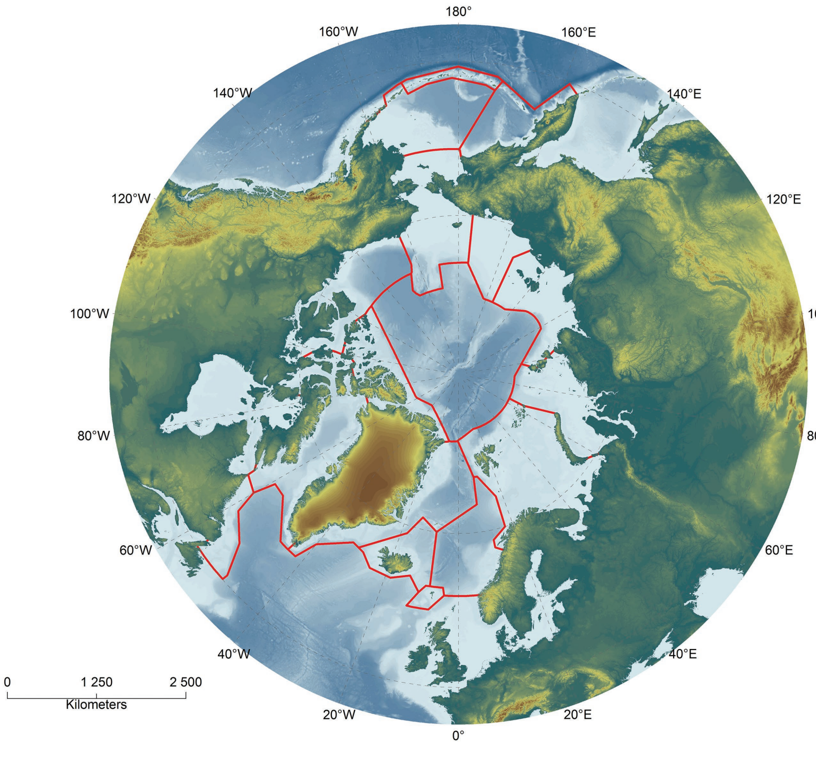

Figure 12.1 Large Marine Ecosystems in the Arctic.
Source: Skjoldal and Mundy (2013).

kind of pressure is essential. Thus, the key objectives are the collection of data to obtain knowledge and from knowledge to generate understanding, which again is turned into management.

Collecting monitoring data

Environmental monitoring is the process of collecting data on environmental variables, with the intrinsic intent to actually enforce measures. In the Barents Sea, collection of monitoring data has historically been directed at monitoring harvestable fish stocks. Data are collected through surveys or through information supplied by the commercial fisheries. Fishery research institutes – IMR in Norway and PINRO in Russia – have since 2003 undertaken coordinated ecosystem surveys, providing an annual picture of the Barents Sea. Combined summer and winter surveys generate insight into annual variations in the ecosystems and commercial fish populations (Mehl et al., 2013; Eriksen, 2014).

The extensive data gathering related to fisheries management in the Barents Sea has since 1998 been supplemented by the seabed and sediment monitoring carried out on behalf of the petroleum industry. Thus, a new commercial interest entering the Barents Sea triggered the collection of targeted data for monitoring this activity.

Environmental studies in the Barents Sea are carried out by national (Norwegian, Russian) and international public and private institutes, generating data for scientific and management purposes.

Provision of data and information for ecosystem-based management in the Arctic

Research is a curiosity-driven process, intrinsically including the risk of not delivering the evidence or conclusions requested by the party doing the management and commissioning the research. However, science is a key to achieving a basic understanding and a solid, unbiased, quality assured and reliable knowledge base.

Research addresses the nonroutine questions and issues relevant to ecosystem-based monitoring and management. This is done through sampling in the field, supplemented by experiments and analyses. Based on research, models are developed and verified through time series of data. Technological methods for data gathering and surveillance have improved rapidly in recent decades, enabling researchers to accumulate vast amounts of data on a number of previously nonmeasurable parameters. These include the atmospheric composition over the North Pole, counts of bacteria in samples from deep Arctic ice cores, and photographs from the bottom of the Polar Ocean – topics unmeasurable and beyond mapping capabilities just a few decades ago.

Not all areas of the Arctic are as accessible and amenable to monitoring and research as the Barents Sea. Despite satellites passing over the Polar regions and measuring, recording, and accumulating data day and night year-round, Arctic indigenous, local, and traditional key knowledge is disappearing with a generally more remote relationship to nature. Knowledge accumulated through generations is losing relevance as climate changes and traditional lifestyles in remote areas and settlements decline. Indigenous and traditional knowledge is not peer reviewed, it is not necessarily available online, but in many instances, it can be of more local significance than any other sources of information.

Indicators for environmental monitoring in the Barents Sea

Indicators for environmental monitoring in Norway

To monitor natural development and from the effects of actions by various actors, Norway defined a set of 40 indicators in the first ecosystem-based management plan for the Barents Sea issued in 2006 (Table 12.1). Data on each indicator are collected through several institutions regularly surveying the Barents Sea, supplemented by data from research and mapping projects.

The list of indicators is revised and adjusted regularly, but in order to maintain time series – monitoring is, after all, related to gaining knowledge on changes over time – one should be careful of excluding any chosen indicator from the list. The latest revision of the Management Plan (April 2020) presents an updated indicators list (Meld. St. 20, 2019–2020).

Indicators for environmental monitoring in the Russian Arctic Seas

In 2015, the Ministry of Nature Resources and Environment of Russia approved the list of species – indicators of the sustainable state of the Arctic marine ecosystems (Ministry of Nature Resources and Environment, 2015). The list includes 61 taxa – 22 of flora and 39 of fauna. Groups and examples of indicator species are presented in Table 12.2.

In 2020, Rosneft, the Russian oil major, published the first scientific report of its kind, Species – Biological Indicators of the Status of the Marine Arctic Ecosystems (Mokievskiy et al., 2020) – in the companies' series of environmental atlases of the Russian seas. The report summarizes existing knowledge on 61

Table 12.1 Original indicators for environmental monitoring in the Norwegian part of the Barents Sea (2006) and indicators included in the 2020 update

Theme	*Indicator*
Ocean climate	Distribution of ice in the Barents Sea
	Temperature, salinity, and nutrients at fixed transects
	Inflow of Atlantic water into the Barents Sea
Phytoplankton	Species composition
	Biomass and production expressed as chlorophyll
	Timing of the spring bloom
Zooplankton	Species composition
	Biomass

Non-harvested fish stocks	Blue whiting biomass and distribution
	Young herring biomass and distribution
Commercial fish stocks	Population of mature capelin
	Spawning stock biomass of North-East Atlantic cod
	Spawning stock biomass of Greenland halibut
	Spawning stock biomass of redfish
	Spawning stock biomass of beaked redfish
Benthic organisms	Species composition and number of benthic animals in research trawls
	Distribution of coral reefs, Gorgonaceans, and marine sponges
	Distribution of red king crab
Seabirds and mammals	Spatial distribution of seabird communities
	Population development in puffin
	Population development in common guillemot
	Population development in Brünnich's guillemot
	Population development in black-legged kittiwake
	Spatial distribution of whales
	Bycatch of harbor porpoise (excluded from 2020 list)
Introduced species	Introduced species (only king crab monitored regularly)
Vulnerable and threatened species	Red-listed species and habitat types
Contamination	Intertidal waste accumulation (in Svalbard, specified in 2020 list)
	Atmospheric contribution of contaminants
	Riverine contribution of contaminants
	Contaminants in sediments
	Contaminants in macroalgae (radioactivity, specified in 2020 list)
	Contaminants in blue mussels
	Contaminants in shrimp
	Contaminants in cod
	Contaminants in capelin
	Contaminants in polar cod
	Contaminants in seabirds (Brünnich's guillemot)
	Contaminants in ringed seal
	Contaminants in polar bear
Human activity	Fish mortality (included in 2020 list)

Table 12.2 Species of flora and fauna – indicators of the sustainable state of marine ecosystems of the Russian Arctic

	Category	*Species*
I	Seaweed, algae, plants	Twenty-two species
	• Brown algae	• Six species
	• Red algae	• Two species
	• Green algae	• Four species
	• Diatoms	• Six species
	• Dinophytic algae	• Three species
	• Vascular plants	• One species
II	Invertebrates	Eighteen species
	• Ascidians	• One species
	• Chaetognatha	• One species

	Category	*Species*
	• Polychaete	• Two species
	• Echinoderm	• Three species
	• Molluscs	• Five species
	• Crustacean	• Six species
III	Vertebrates	Twenty-one species
	• Fish	• Six species (e.g., polar cod, navaga, three-spined stickleback)
	• Birds	• Ten species (e.g., common eider, ivory gull, Brünich's guillemot, black-legged kittiwake)
	• Mammals	• Five species (Polar bear, walrus, ringed seal, beluga whale, bowhead whale)

Source: Created by authors based on Ministry of Nature Resources and Environment (2015).

indicator species in the Russian Arctic Seas, including the Barents, Kara, Laptev, East-Siberian, and Chukchi seas.

Joint Norwegian-Russian indicators for environmental monitoring

Norwegian-Russian cooperation in fisheries management has since the 1960s included environmental monitoring and several annual surveys. The results of this work have been published in joint reports and papers, including the regularly updated joint environmental status report for the Barents Sea (e.g., Aanes et al., 2009, 2016). Research institutes and environmental authorities from both countries have also been working under the Joint Norwegian-Russian Environmental Commission toward the harmonization of environmental monitoring tools and the development of joint indicators. From 2002 to 2011, several bilateral projects on the harmonization of monitoring tools were carried out. The basis was the Convention for the Protection of the Marine Environment of the North-East Atlantic Joint Assessment Monitoring Program/Coordinated Environmental Monitoring Program guidelines.

In 2005, the Marine working group of the Joint Norwegian-Russian Environmental Commission launched the project on Ecosystem Based Joint Monitoring of the Barents Sea. In 2015, the bilateral project group proposed the set of 22 joint indicators for environmental monitoring (see Table 12.3), including 11 indicators originating from the Norwegian-Russian fishery cooperation and ecosystem surveys by IMR and PINRO and 11 new indicators in a bilateral context (Korneev et al., 2015a). The work on joint indicators development is ongoing within the Action Plan of the Norwegian-Russian bilateral Environmental Commission.

Integrated management plans of Norway

In the last 15 years, Norway has managed the marine offshore areas following the ecosystem-based management principle. In Report No. 12 to the Norwegian Parliament (*Storting*) (2001–2002) – Protecting the Richness of the Seas – the

Table 12.3 The 22 proposed joint indicators and information regarding monitoring in Russia and Norway and status of ongoing monitoring in Russia and Norway (Yes* means monitoring of not all parameters/sub-parameters included in the existing monitoring programs)

Indicator	*Monitoring*	
	Russia	*Norway*
Sea ice cover in the Barents Sea	Yes*	Yes*
Meteorological conditions	Yes	Yes
Oceanographic conditions	Yes*	Yes*
Water masses properties and volume transport in the Barents Sea	Yes*	Yes*
Ocean acidification and ocean CO2 uptake	No	Yes*
Phytoplankton diversity, abundance, and biomass	Yes*	Yes
Zooplankton diversity, abundance, and biomass	Yes	Yes
Benthos diversity, abundance, and biomass	Yes*	Yes*
Microbe biomass and diversity	No	No
Sea ice biota, diversity, and abundance	No	No
Fish and shrimp biomass	Yes*	Yes*
Fishing pressure	No	Yes*
Introduced species	Yes*	Yes*
Seabird communities/assemblages at sea	Yes*	Yes*
Population development and demography of seabirds	Yes*	Yes
Dynamics of ice-associated marine mammals	Yes*	Yes
Vulnerable and endangered species	Yes	Yes*
Pollution levels in the physical environment	Yes*	Yes*
Contaminants levels in the biota	Yes*	Yes*
Bottom substrate	Yes	No
Demersal fauna biodiversity	Yes	Yes

Source: Korneev et al. (2015a), adopted by the authors.

concept of the ecosystem-based management of Norwegian Sea areas was introduced following the international 'Malawi principles' of the UN Convention on Biological Diversity (CBD, 1998). The aim was to establish three management plans, covering all Norwegian Sea areas, one for the Barents Sea, including Lofoten, one for the Norwegian Sea, and one for the North Sea.

The Integrated Management Plan for the Barents Sea and Lofoten was established in 2006 (Report No. 8 to the *Storting* 2005–2006). The first plan for the Norwegian Sea was approved in 2009 and the management plan for the North Sea was composed in 2013. The first update of the Barents Sea-Lofoten management plan was released in 2011 and the second update was issued in 2015.

Originally, all three management plans were to be fully updated every four years, but new data and information were not generated at a pace justifying the use of resources to implement such frequent updates. The current approach is that the management plans are revised every eighth year, and minor adjustments are made every fourth year (updates), and that all three plans are reviewed simultaneously. In April 2020, the first complete management plan covering all Norwegian Sea areas was published (Meld. St. 20, 2019–2020).

Two advisory groups have been established to develop the scientific basis for the marine management plans: the Forum for Integrated Marine Management and the Advisory Group on Monitoring.

Particularly valuable and vulnerable areas

Particularly valuable and vulnerable areas (SVO – in Norwegian *Særlig Verdifulle og Sårbare Områder*) are geographically defined areas which, on the basis of scientific assessments, have been identified as areas of significant importance for biological diversity and production within and often also outside the area (Eriksen et al., 2021).

For the assessment of valuable and vulnerable areas, that is, areas that are important as living areas for species at different times of the year in Norwegian waters, the Norwegian Environment Agency applies seven CBD scientific criteria for ecologically or biologically significant areas (EBSAs). Areas are defined as valuable according to the spatial and temporal distributions of certain species and life stages of fish, seabirds, marine mammals, and habitat types. In addition, several larger areas are defined as particularly valuable and vulnerable, based on their importance for biological diversity and production, and where disturbance could potentially cause long-lasting or irreversible damage. Detailed descriptions of the criteria, methodology, and documentation used to define valuable areas are provided for fish, seabirds, marine mammals, and habitat types. In the maps presented in the Norwegian Environment Agency's web portal, fish, seabirds, and marine mammals are determined on a monthly basis, whereas habitat types (particularly valuable areas) stay the same throughout the year.

A number of particularly valuable and vulnerable areas have been identified in the Barents Sea – Lofoten area. In the border area between Norway and Russia, these include 50 kilometers of coastal zones along Troms and Finnmark counties and a sea area north of the ice edge (Figure 12.2).

According to the integrated management plan, the designation of areas as particularly valuable and vulnerable does not have any direct effect on the form of restrictions on commercial activities, but indicates that these are areas requiring special caution. They have been used as a basis for setting an overall framework for activities, to make activities in such areas subject to special requirements using the current legislation. Such requirements may apply to the whole or part of a particularly valuable and vulnerable area and must be considered on a case-by-case basis for specific activities. For example, petroleum activities are not to be implemented or initiated in these areas, and additional seasonal limitations on exploratory drilling in the Barents Sea have been established for extended coastal areas along Troms and Finnmark counties and around Bjørnøya (Figure 12.3).

Ice edge – marginal ice zone: an example of an SVO

A marginal ice zone (MIZ) has been defined as an SVO in all versions of the Norwegian integrated management plans for the Barents Sea-Lofoten area. This SVO includes the sea areas that are most important for biological production and diversity related to the ice edge zone as a natural phenomenon. For the purposes of the management

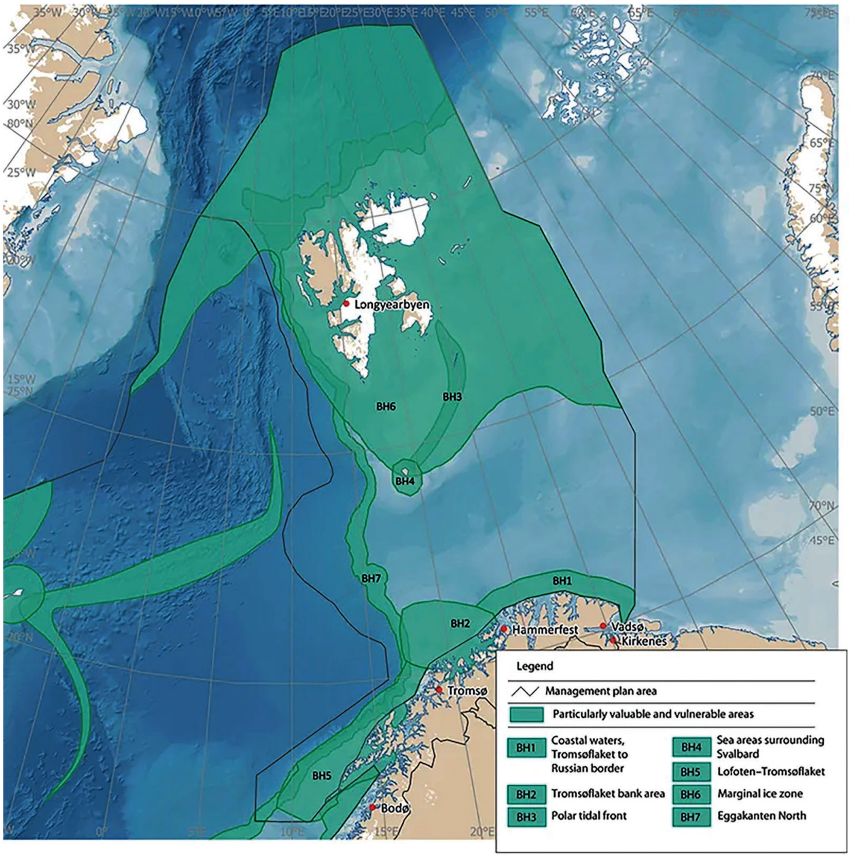

Figure 12.2 Particularly valuable and vulnerable areas (SVO) in the Norwegian part of the Barents Sea according to the integrated management plan.
Source: Meld. St. 20 (2019–2020).

plan, MIZ as a particularly valuable and vulnerable area has been delimited using statistical methods of expressing satellite observations of variations in sea ice extent throughout the year for a series of years. MIZ, as an SVO in the management plans issued in 2006, 2011, and 2015, was based on ice data for a recent observations period spanning a series of years (over 20 years) and the delimitation of the ice edge was set where sea ice occurred on 30% of the days in April (30% ice frequency).

The Forum for Integrated Marine Management has recommended that mapping MIZ should continue based on the presence of sea ice in April using the latest available 30 years' time series with satellite observations of ice cover extent. However, delimitation of the MIZ as an SVO was adjusted in terms of ice frequency from 30% to 15% of the days in April, thereby extending this particularly valuable and vulnerable area. This limit can be updated in the later versions of the management plans (Meld. St. 20, 2019–2020).

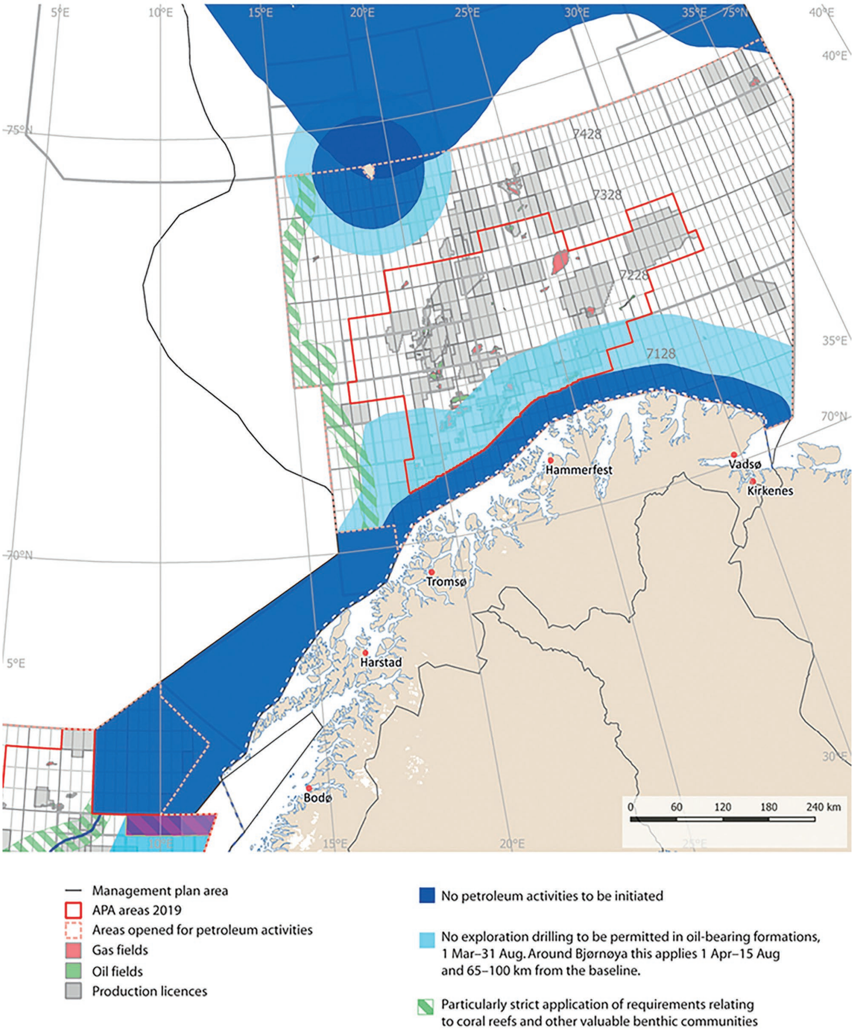

Figure 12.3 Petroleum license areas in the Barents Sea by 2020 and particularly valuable and vulnerable areas (SVO) with associated limitations in petroleum activities.

Source: Meld. St. 20 (2019–2020).

Integrated management plans of Russia

There is so far no approved integrated management plan for the Russian part of the Barents Sea. The Russian authorities have initiated the process of developing an integrated management plan for marine nature resources for the Russian part of the Barents Sea, launching research projects and processes of elaboration of relevant laws and regulations. Research institutes and consortia, tasked with the elaboration of concepts and drafts of the integrated management plan, have used international experiences and criteria, for example, LME concept, the International Union for Conservation of Nature (IUCN) and CBD EBSA criteria, for mapping environmental values and ecologically valuable areas in the Barents Sea (Bambulyak et al., 2021).

In 2013, the Zubov State Oceanographic Institute (SOI) in Moscow, at the behest of the Ministry of Economic Development of Russia, published a report on results of their research work on the elaboration of the methodology of marine spatial planning (MSP) and a comprehensive (integrated) management plan of marine nature use management in the Barents Sea, taking into account international experience and best practices of transborder resource utilization (Zemlyanov, 2013). The research team led by SOI used the LME concept to define borders for MSP in the Barents Sea, and referred to three basic publications, among them to the Norwegian Integrated Management Plan for the Barents Sea-Lofoten area 2005–2006.

In 2015, Sevmorgeo from St Petersburg, assigned by the Ministry of Natural Resources and Environment of Russia, issued a report called project of a plan for the comprehensive (integrated) management of marine nature use for the Russian part of the Barents Sea based on an ecosystem approach (Korneev, 2015b). The authors concluded that the UN Educational, Scientific and Cultural Organization (UNESCO) Intergovernmental Oceanographic Commission (IOC) Manual and Guide on MSP was a basic international document to be followed for developing the integrated management plan for Russian seas and pointed out that the Norwegian Integrated Management Plan for the Barents Sea-Lofoten area provided a good platform for MSP in the Russian part of the Barents Sea.

In 2016, the Ministry of Natural Resources and Environment of Russia presented the pilot project of the integrated management of nature resources use in the Russian part of the Barents Sea prepared on the basis of the report issued by Sevmorgeo. The UNESCO IOC MSP Manual and Guide and the Norwegian Integrated Management Plan for the Barents Sea-Lofoten area were used for setting aims and compiling this pilot project (Figure 12.4).

The plan for the pilot project implementation included elaboration and approval of the Federal Law on Marine Spatial Planning. The concept of the Law was elaborated by the Ministry of Regional Development of Russia. The Ministry of Regional Development was abolished in 2014 and responsibility for elaboration of the Law transferred to the Ministry of Economic Development of Russia. Activities related to the elaboration and implementation of the pilot project of the integrated management plan for the Russian part of the Barents Sea are currently coordinated by the State Commission on the Development of the Arctic.

Particularly valuable and vulnerable areas in Russia

SOI in their 2013 report proposed to define and map existing and planned special nature protected areas, areas of spawning, feeding, and fishing of aquatic resources as valued nature areas for MSP within the LME of the Barents Sea. Giving protection priority to key identified areas with high seasonal concentrations of birds and marine mammals has also been proposed (Zemlyanov, 2013).

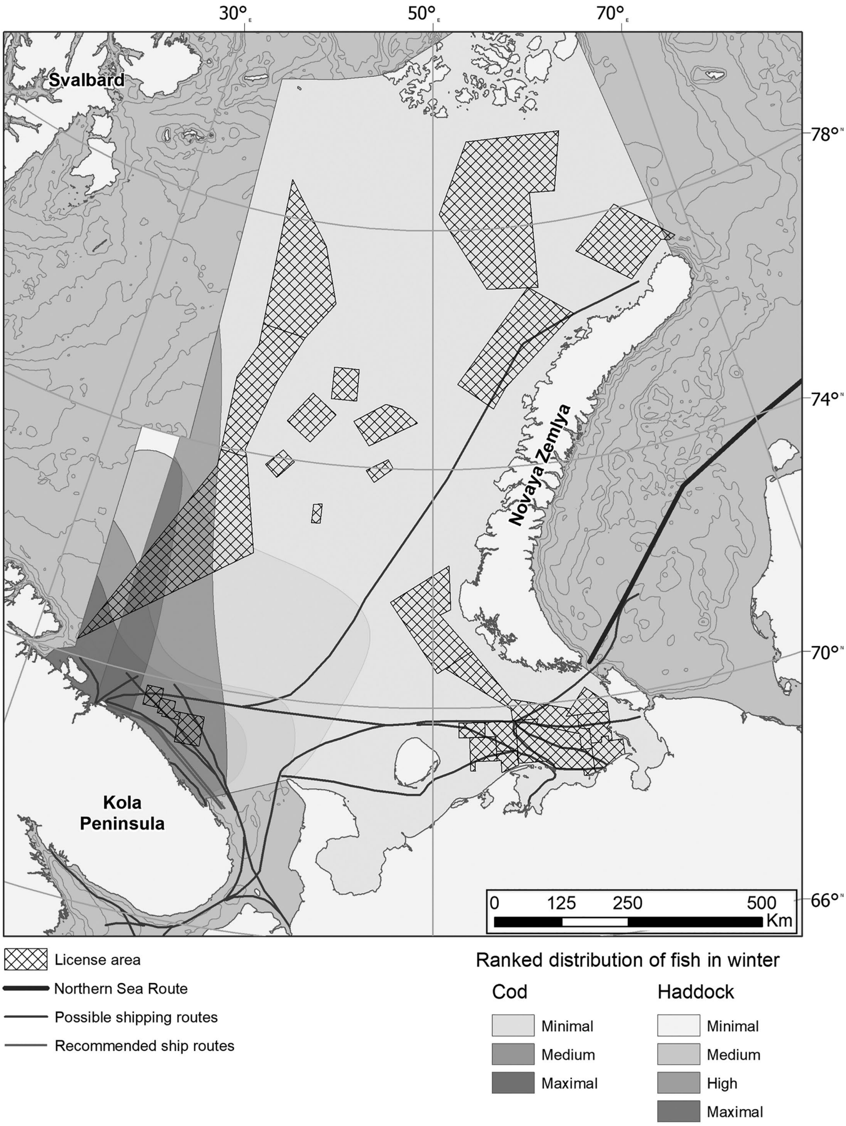

Figure 12.4 Areas of possible conflict of interests of fishery, shipping, and petroleum industries in the Barents Sea for the first quarter according to the 2015 project of an integrated management plan for the Russian part of the Barents Sea.

Source: Korneev (2015b), adopted by MMBI.

The research team led by Sevmorgeo defined and mapped biological or ecological values and valuable and vulnerable areas using CBD EBSA (Korneev, 2015b). Maps with visual presentations of the spatial and seasonal distribution of biotic components were created from monitoring data. The biotic components of the Barents Sea and their values were assessed and mapped for the four seasons

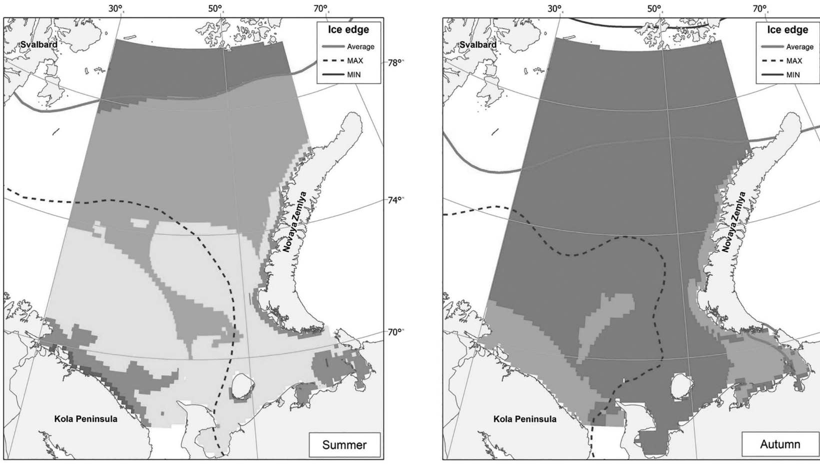

Figure 12.5 Example of the maps of integral vulnerability of the Barents Sea ecosystems to oil spills in summer (left) and autumn (right). Values of vulnerability are ranged from maximum to minimum.

Source: Shavykin and Ilyin (2009).

(winter, spring, summer, autumn) with ranks (from 0 to 3) in the respective units. The authors of the report suggested using mapping of (integral) vulnerability to specific impact (e.g. oil pollution) or integrated impact of human activity in addition to mapping biological values in the MSP process (see examples in Figure 12.5). This approach resembles those used in the Norwegian integrated management plans for defining particularly valuable and vulnerable areas (SVO).

Ice edges or MIZ were not proposed as particularly valuable and vulnerable areas in the abovementioned projects of the integrated management plans for the Russian part of the Barents Sea (Zemlyanov, 2013; Korneev, 2015b).

Integrated management plan for the Barents Sea – the Norwegian-Russian perspective

The integrated management plan for the Barents Sea-Lofoten area was introduced in Norway in 2006 and has been updated three times, including the recent update released in 2020. Russia is still in the process of developing and introducing an integrated management plan, including the elaboration and approval of norms and regulations. Despite the differences in the management plans' status on the two sides of the border, it is important to note that both the Norwegian and Russian integrated management plans and/or plan proposals are built on the same international approach for MSP with ecosystem-based management principles and the application of CBD EBSA criteria. Moreover, the Norwegian plan was used as one of the key reference documents for drafting the Russian 2015 plan (Korneev, 2015b; Aune et al., 2017). We also perceive certain differences in the possible practical implementation of international principles and criteria regarding the management of petroleum activities and in the definition of particularly valuable and vulnerable areas in the Barents Sea in Norway and Russia, initially those related to MIZ and ice-covered waters.

While it is unclear when the integrated management plan for the Barents Sea will be introduced in Russia, we find a good basis for developing practical cooperation on environmental monitoring, impact, and risk assessment, and also on the implementation of up-to-date and harmonized tools across the border.

Conclusions

The Arctic basin, including most of the bordering epicontinental seas, except the Barents Sea, has so far been difficult to access. It holds few commercially attractive fish resources and has not yet been the target of extractive industries. This may be about to change with growing demand in energy and food resources. The expected receding of the Polar ice cap will make the physical constraints on activities in the Arctic Seas less prominent, while with the commercial industries entering the scene in great number, conflicts of interest will inevitably arise and so also the need for management, pursuing common goals, and following mutually agreed rules.

If human resource exploitation is considered the main driver necessitating the development of management, the role of science in providing the needed understanding of Arctic ecosystems should also be emphasized. Even in the relatively well-explored Barents Sea, there are ecosystems of poorly known sensitivity and resilience to man-made stimuli, one example being the MIZ ecosystem with its unique species composition and production properties.

Human impact on the Barents Sea ecosystem through removal of biomass has taken place for centuries. Examples range from the harvesting of whales from the 15th to 17th centuries to the extreme harvesting of capelin in the 1970s and the continuous harvesting of the world's largest cod stock. Managing this type of influence requires large amounts of data and computation capabilities. With new impacts becoming eminent, such contaminations and petroleum activities, the scientifically justified ecosystem-based approach in management becomes vital. A leading role for the AC as an intergovernmental forum and coordination platform is to be encouraged.

The Barents Sea LME can be a driving force for the introduction of ecosystem-based management in a pan-Arctic perspective. Norway and Russia share and manage biological fisheries and other resources in the Barents Sea and carry out industrial activities, including oil and gas exploration and production, which entail environmental impacts and risks in the cross-border context. Two countries manage resources and control industries according to national laws and regulations, following international conventions (e.g., UNCLOS or CBD) and bilateral agreements. Norway and Russia have some similar procedures in managing the offshore petroleum industry, such as environmental impact assessment and monitoring and protecting the marine environment. However, no harmonized system has been established between Norway and Russia in industrial control and environmental protection in the Barents Sea (Bambulyak et al., 2015), and the principles of sustainable development and the ecosystem approach to management are implemented differently in the two countries.

For example, Norway that introduced an integrated management plan for the Barents Sea in 2006 has updated this plan regularly and addressed the issue of establishing a joint coordinated management plan with Russia. In the last ten years, there have been several initiatives in Russia aimed at the elaboration of an integrated plan for natural resources management in the Barents Sea, but no such plan has so far been established.

In Norway and Russia, the oil and gas industry has been moving northwards. In Norway, with its long experience in offshore exploration and production, the northernmost licensed areas are limited to 74°30' N, and certain limitations on petroleum activities have been established for operations in ice-covered waters, defining these as particularly valuable and vulnerable areas. Russia has already gained experience in year-round petroleum operations in areas covered by seasonal ice (e.g., the Varandey terminal and Prirazlomnaya platform in the south-eastern Barents Sea) and has granted licenses for operations above 74°30' N (Bambulyak et al., 2021).

Either an integrated management plan for the Barents Sea needs to be introduced in Russia in the near future or its development and approval will take a long time, so we can expect that oil and gas activities will not be managed in Russia in the same way as in Norway, also when it comes to operations in ice-covered waters. Nevertheless, certain steps can be implemented to contribute to the establishment of more harmonized and coordinated procedures in environmental management, monitoring, impact, and risk control between the two countries. These steps are to be coordinated through the programs and projects of the working groups of the AC and bilateral Norwegian-Russian Fishery and Environmental Commissions. This will also serve to build a better understanding of the Barents Sea ecosystem and support the development of a joint coordinated management plan for the entire Barents Sea that can be promoted and extended to other Arctic areas – LMEs defined by the AC.

December 2021

Ex-post reflections

This chapter was written in 2021 by a team of authors representing Norwegian and Russian environmental research institutes and the secretariat of the AMAP. This chapter describes the status of environmental monitoring and management in the Arctic, focusing on international and interregional cooperation, looking at Norwegian and Russian experiences as an example, and a driving force for circumpolar collaboration. This chapter reflects much of the authors' personal experiences in building up cooperation across borders during the last 30 years. In our conclusions, we looked positively to the future and emphasized the importance of science in providing knowledge about the changing Arctic, developing circumpolar environment monitoring systems, and moving step-by-step toward sustainable and ecosystem-based management.

The year 2022 brought tragic events and dramatic changes. Today, we cannot foresee how environmental monitoring and management in the Arctic can be implemented or what the role of the AC or international and bilateral agreements will be. However, what we can say for sure is that environmental monitoring of the

Arctic, ecosystem-based management of resources, and sustainable development of the circumpolar regions is of ever-growing importance and cannot be implemented without cooperation and trust between countries, institutes, and people.

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