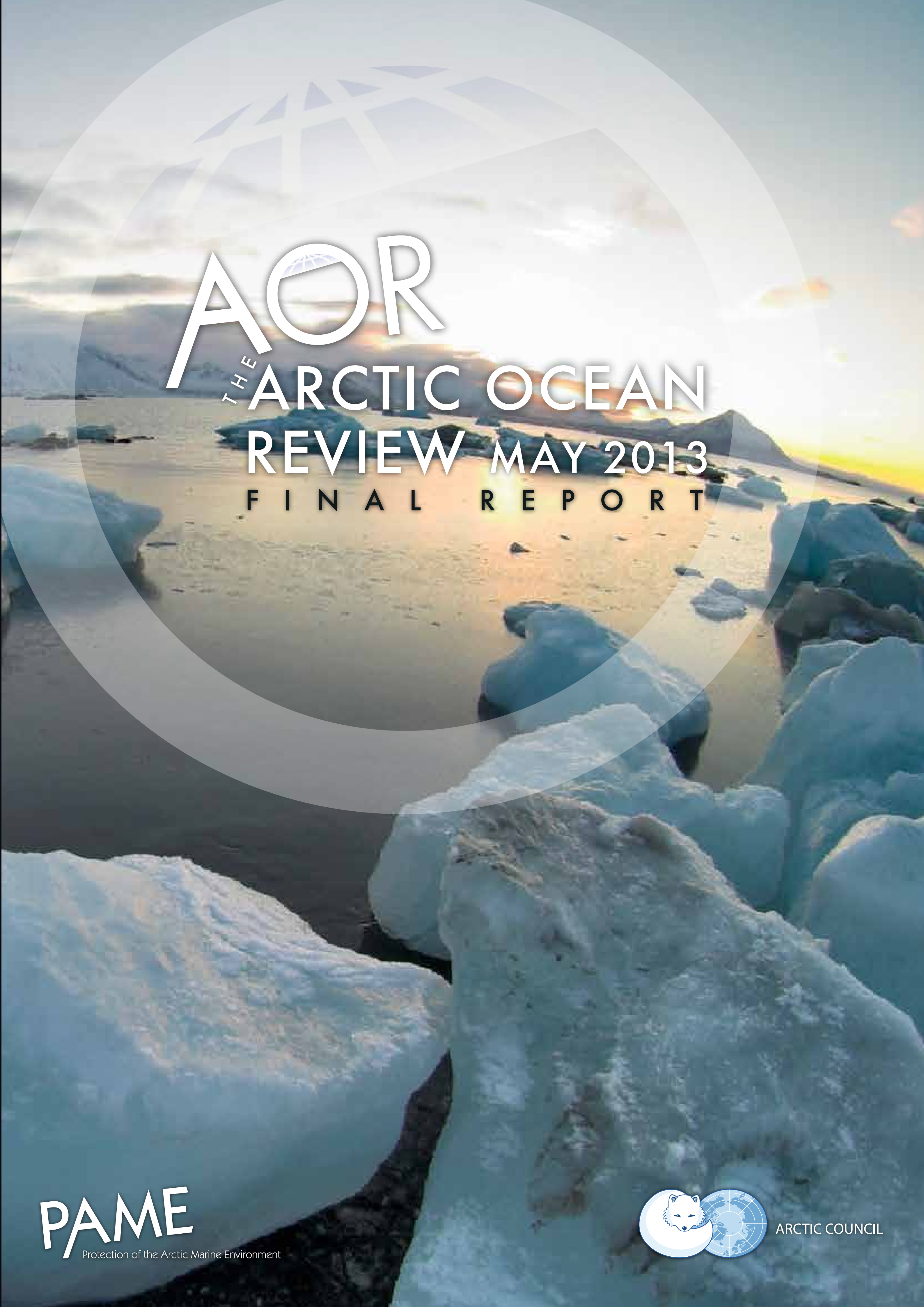


AOR
The Arctic Ocean Review May 2013
Final Report

PAME
Protection of the Arctic Marine Environment

Arctic Council

ARCTIC OCEAN REVIEW PROJECT
2009-2013

Final Report

2011-2013

8th Arctic Council Ministerial Meeting
Kiruna, Sweden
15th of May 2013

Citation
This publication may be cited as:
PAME, The Arctic Ocean Review Project, Final Report, (Phase II 2011-2013), Kiruna May 2013.
Protection of the Arctic Marine Environment (PAME) Secretariat, Akureyri (2013)

Acknowledgements

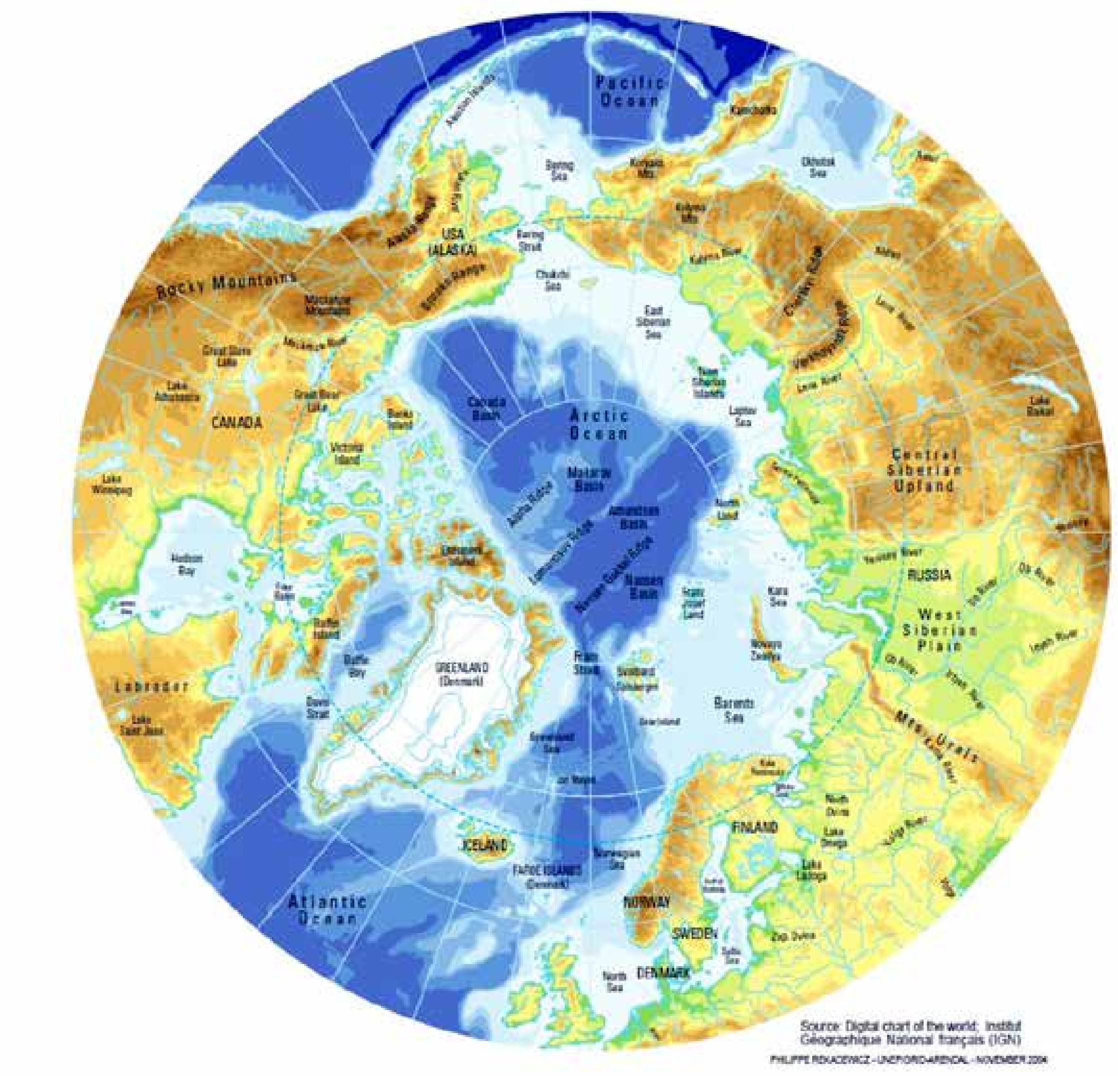
Lead countries
Canada, Iceland, Norway, United States and the Russian Federation.

Acknowledgement of funding and support
We gratefully acknowledge the financial support provided to this project (2011-2013) from the Norwegian Climate and Pollution Agency and the Nordic Council of Ministers. Furthermore, both financial and in-kind support was provided by the lead countries. We would also like to thank all PAME countries, other Arctic Council Working Groups and Permanent Participants to the Arctic Council, and experts for their support and contributions in this work.

CLIMATE AND POLLUTION AGENCY

PAME
Protection of the Arctic Marine Environment

norden
Nordic Council of Ministers



ARCTIC SEAS AND COASTAL AREAS

Table of Contents

Guide to Acronyms, Terms and Abbreviations

ABA	Arctic Biodiversity Assessment
ACAP	Arctic Contaminants Action Program
ACAP	Agreement on the Conservation of Albatrosses and Petrels
ACIA	Arctic Climate Impact Assessment
AEPS	Arctic Environmental Protection Strategy
AFS	International Convention on the Control of Harmful Anti-fouling Systems on Ships
AIS	Automatic Identification Systems
AMAP	Arctic Monitoring and Assessment Programme
AMSA	Arctic Marine Shipping Assessment
AMSP	Arctic Marine Strategic Plan
AO	Arctic Oscillation
AOOGG	Arctic Offshore Oil and Gas Guidelines
AOR	Arctic Ocean Review
AOR-I	Arctic Ocean Review Phase I Report
ARHC	Arctic Regional Hydrographic Commission
ASW	Aboriginal Subsistence Whaling
BAT	Best Available Technology
BEP	Best Environmental Practices
BePOMAr	Best Practices in Ecosystem-based Oceans Management in the Arctic
BFR	Brominated Flame Retardants
BONN	Bonn Agreement for Co-operation in Dealing with Pollution of the North Sea by Oil
BWM	International Convention for the Control and Management of Ships' Ballast Water and Sediments
BWMS	Ballast Water Management Systems
CAFF	Conservation of Arctic Flora and Fauna Working Group
CBD	Convention on Biological Diversity
CBird	Circumpolar Seabird Expert Group
CBMP	Circumpolar Biodiversity Monitoring Program
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CLC	International Convention on Civil Liability for Oil Pollution Damage
CLCS	Commission on the Limits of the Continental Shelf
COLREG	Convention on the International Regulations for Preventing Collisions at Sea
COP	Conference of the Parties
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
EA	Ecosystem Approach
EBM	Ecosystem-based management (EBM is also used in this Report as shorthand for both EBM and EA)
ECDIS	Electronic Chart Display and Information System
ECE	Economic Commission for Europe
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
EPPR	Emergency Prevention, Preparedness and Response Working Group
FAO	Food and Agriculture Organization
FUND	International Convention on the Establishment of an International Fund for Compensation of Oil Pollution Damage
GAIRS	Generally Accepted International Rules and Standards
GHG	Greenhouse Gases
GMDSS	Global Maritime Distress Safety System
GOOS	Global Ocean Observing System
GPA	Global Programme of Action for the Protection of the Marine Environment from Land-based Activities
HBCD	Hexabromocyclododecane
HELCOM	Helsinki Commission
HFO	Heavy Fuel Oil
HMS	Highly Migratory Species
HNS	Protocol - Protocol on Preparedness, Response and Co-operation to Pollution Incidents by Hazardous and Noxious Substances
IADC	International Association of Drilling Contractors
IALA	International Association of Marine Aids to Navigation and Lighthouse Authorities
IASC	International Arctic Science Committee
IASSA	International Arctic Sciences Association
ICES	International Council for the Exploration of the Sea
ICRW	International Convention for the Regulation of Whaling
IHO	International Hydrographic Organization
IICWG	International Ice Charting Working Group
IMO	International Maritime Organization
IMSO	International Mobile Satellite Organization
InterAct	International Network for Terrestrial Research and Monitoring in the Arctic
IOC	Intergovernmental Oceanographic Commission
IPY	International Polar Year
IPCC	Intergovernmental Panel on Climate Change
IRF	International Regulators Forum
ISAC	International Study of Arctic Change
ISO	International Organization for Standardization
IUCN	International Union for Conservation of Nature
IWC	International Whaling Commission
JAMP	Joint Assessment and Monitoring Programme (OSPAR)
LME	Large Marine Ecosystem
LRIT	Long Range Identification and Tracking
LRTAP	Convention on Long-range Transboundary Air Pollution
MARPOL	International Convention for the Prevention of Pollution from Ships
MEA	Multilateral Environmental Agreement
MEPC	Marine Environmental Protection Committee of the IMO
METAREAS	Meteorological Areas
MODU	Mobile Offshore Drilling Unit
MOPPR	Arctic Marine Oil Spill Preparedness and Response Agreement
MOU	Memorandum of Understanding
MSR	Marine Scientific Research
NAFO	Northwest Atlantic Fisheries Organization
NAMMCO	North Atlantic Marine Mammal Commission
NAO	North Atlantic Oscillation
NASCO	North Atlantic Salmon Conservation Organization
NAVAREAS	Navigation Areas
NEAFC	North East Atlantic Fisheries Commission
nm	Nautical Miles
NOAA	National Oceanic and Atmospheric Administration
NPAFC	North Pacific Anadromous Fish Commission
OECD	Organisation for Economic Co-operation and Development
OGP	Oil and Gas Producers Association
OIC	Offshore Industry Committee (OSPAR)
OIS	Offshore Industry Strategy (OSPAR)

OPRC	International Convention on Oil Preparedness, Response and Cooperation
OSPAR	Convention for the Protection of the Marine Environment of the North- East Atlantic
PAG	Pacific Arctic Group
PAME	Protection of the Arctic Marine Environment
PBDE	Polybrominated Diphenyl Ethers
PBSG	Polar Bear Specialist Group
PCN	Polychlorinated Naphthalenes
PDA	Pacific Decadal Oscillation
PFCA	Perfluorooctane Sulfonate
PFO	Perfluorocarboxylate
PICES	North Pacific Marine Science Organization
POLREP	Pollution Reporting System
POP	Persistent Organic Pollutants
PSSA	Particularly Sensitive Sea Area
Ramsar	Convention on Wetlands of International Importance
RFMOs/As	Regional Fisheries Management Organizations or Arrangements
ROOS	Regional Ocean Observing System
SAO	Senior Arctic Official
SAON	Sustained Arctic Observing Network
SAR	Search and Rescue
SEA	Strategic Environmental Assessment
SCPAR	Standing Committee of Parliamentarians of the Arctic Region
SDWG	Sustainable Development Working Group
SLCF	Short-lived Climate Forcers
SOLAS	International Convention for the Safety of Life at Sea
STCW	International Convention on Standards of Training, Certification and Watchkeeping for Seafarers
SWIPA	Snow, Water, Ice and Permafrost in the Arctic
TBBPA	Tetrabromobisphenol-A
UN	United Nations
UNCED	United Nations Conference on Environment and Development
UNCLOS	United Nations Convention on the Law of the Sea
UNDRIP	United Nations Declaration on the Rights of Indigenous Peoples
UN ECE	United Nations Economic Commission for Europe
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
UNFSA	United Nations Fish Stocks Agreement
WMO	World Meteorological Organization
WSSD	World Summit on Sustainable Development

Foreword

The Arctic Ocean Review (AOR) was organized as a project under the Protection of the Arctic Marine Environment (PAME) working group of the Arctic Council, reporting to the Senior Arctic Officials (SAOs) of the Arctic Council through PAME.

The AOR is a project of the Arctic Council led by Canada, Iceland, Norway, the Russian Federation and the United States.

The work was reviewed and comments received at the biannual meetings of the PAME Working Group and four expert workshops in Copenhagen in March 2010, Washington D.C. in September 2010, Reykjavik in September 2011 and Halifax in September 2012. Written comments were received from many individuals and organizations. The AOR was carried out in cooperation with other working groups of the Arctic Council. The SAOs provided comments and guidance at their meetings as well.

Descriptions in this AOR Final Report of international law, including as reflected in the 1982 Law of the Sea Convention, as well as other instruments, measures and arrangement are included for the benefit of the reader only and are not intended to constitute interpretations by the Arctic Council, its working groups, or Arctic states.

M. Elfa Jónsdóttir

Executive Summary

Arctic marine areas are vital components in the regulation of global climate and an important source of nutrition, income and cultural identity for Arctic peoples and communities.

Existing and new research and observations indicate sustained alterations in the Arctic, in particular marine ecosystems. As emphasized in many Arctic Council reports and Declarations, the Arctic marine environment continues to experience significant changes, along with numerous accompanying social and economic changes.

In 2012 alone, a new minimum for the extent of Arctic sea ice was set in September, eclipsing the dramatic previous new low set only five years before in 2007; the sea surface temperature on the ice margins continued to exceed the long-term average; the Greenland ice sheet experienced melting over some 97 per cent of its expanse

in a single day; and massive phytoplankton blooms were measured below the Arctic summer sea ice, an indication that biological production may be lower than originally estimated. The reduction in sea ice extent bears emphasis: the last six years, 2007-2012, have produced the “six lowest sea ice minimum extents since satellite observations began in 1979” (Perovich et al. 2012).

Growing interest in the Arctic marine environment with respect to industrial development, shipping, oil and gas activities, commercial fishing, tourism and other marine activities, has an effect on the marine environment itself. These activities also have potential effects on the livelihoods of local inhabitants and indigenous communities, with both positive and negative consequences. Increased activity brings increased risk of adverse impact, whether through incremental or cumulative pressures from additional pollution loads or from acute accidental events.

An extensive framework of international, regional and national instruments, measures and arrangements already applies in Arctic marine areas. The Arctic states are committed to responsible governance for the conservation and sustainable use of the Arctic marine environment, and are taking practical steps to implement and strengthen these instruments, measures and arrangements as access to, and use of, Arctic marine areas increase.

The Arctic Council is an important forum that enables the Arctic states to keep abreast of changing circumstances in Arctic marine areas and to continue to take cooperative action. This cooperation includes collaborative research and assessments, collection and timely exchange of information, scientific data and analyses, and encouraging other competent entities, such as the International Maritime Organization, to strengthen existing instruments and develop new instruments.

Arctic Council Ministers initiated the Arctic Ocean Review (AOR) project in 2009 under the leadership of the PAME working group to provide guidance to the Council on possible ways to strengthen governance, and to achieve desired environmental, economic and socio-cultural outcomes in the Arctic through a cooperative, coordinated and integrated approach to the management of activities in the Arctic marine environment. Consistent with the Arctic Marine Strategic Plan (AMSP 2004), the AOR project constitutes a periodic review of potential opportunities and options to strengthen global and regional instruments, measures and arrangements in order to manage activities in the Arctic marine environment within respective sectors.

The AOR project reviewed instruments, measures and arrangements in two phases. The AOR Phase I Report (AOR-I), tabled with Arctic Council Ministers in 2011, identified international and regional instruments relevant to the management of activities in the Arctic marine environment. Building on the AOR-I, this AOR Final Report, by agreement of the Arctic states, focuses on three cross-cutting themes: *Indigenous Peoples and Cultures (Ch.2), Ecosystem-based Management (Ch. 7) and Arctic Marine Science (Ch.8). In addition, four sectors are examined: Arctic Marine Operations and Shipping (Ch.3), Marine Living Resources (Ch.4), Arctic Offshore Oil and Gas (Ch.5), and Arctic Marine Pollution (Ch.6).* Arctic marine tourism is discussed in Chapter 3 on *Arctic Marine Operations and Shipping*.

These cross-cutting and sectoral chapters analyze some, but not all, instruments to identify opportunities and tools that Arctic states could use to strengthen governance for the conservation and sustainable use of the Arctic marine environment. Each chapter identifies opportunities for consideration of the Arctic Council. While numerous opportunities are identified, these do not necessarily constitute a comprehensive, all-inclusive list. Key recommendations for consideration by the Arctic Council appear in Chapter 9. These recommendations were developed by considering the full range of opportunities for action that appear at the end of each chapter and, from that broader range of opportunities, the selection and modification of the most important and timely actions.

Notably, this AOR Final Report acknowledges the important role that Permanent Participants and other Arctic residents must play to identify and promote effective management models that enable inclusion of traditional and local knowledge, as well as the engagement of Arctic communities in decision-making processes for marine development and sustainable resource management.

In addition, the AOR Final Report recognizes that continued scientific cooperation and coordination are essential components in the effective management of activities in the Arctic marine environment. Increasing linkages among relevant scientific organizations, improving infrastructure and research platforms, and facilitating the gathering and exchange of information under relevant agreements will be necessary to inform ecosystem approaches to management.

Ecosystem-based management (EBM) provides a coordinated and integrated approach, and has been recognized to achieve all four goals of the Arctic Marine

Strategic *Plan (AMSP 2004), namely: reduce and prevent pollution in the Arctic marine environment; conserve Arctic marine biodiversity and ecosystem functions; promote the health and prosperity of all Arctic inhabitants; and advance sustainable Arctic marine resource use.*

The AOR Final Report recognizes that some types of opportunities, for example those related to knowledge development and dissemination, are qualitatively different from actions to amend or create new legal instruments. Similarly, institutional coordination, investments in infrastructure, and improved instrument implementation and compliance efforts, also require qualitatively different processes and means to implement. Highlighting this range of functional options allows policy makers to tailor each opportunity to the problem it is designed to address. The five functional categories observed in this AOR Final Report are:

- Coordination across Institutions
- Cooperation on Knowledge
- Adjusting Existing Instruments
- Improving Implementation and Compliance; and
- Investing in Infrastructure.

five opportunities for cooperative actions recur across chapters:

- Finalizing and implementing the Polar Code;
- Addressing Special, Protected or Critical Areas;
- Better monitoring of the Arctic marine environment;
- Increasing understanding of the Cumulative Effects; and
- Implementing Ecosystem-based Management to address stressors in an integrated manner.

The recommendations of this AOR Final Report are outlined below:

Recommendations

The following recommendations are considered important actions in light of the dynamic changes occurring in the Arctic marine environment.

Chapter 2: Indigenous Peoples and Cultures

(1) The Arctic states in cooperation with the Arctic Council should assist, as appropriate, the Permanent Participants with the documentation of current and historical a) timing and geographical extent of local uses of the marine environment, and b) levels of traditional marine resources harvests, taking into account the differing documentation needs and capacities of Arctic states.

(2) The Arctic states should work with Arctic residents to identify and promote effective models for enabling inclusion of traditional knowledge and input into decision-making processes for marine development and sustainable resource management.

Chapter 3: Arctic Marine Operations and Shipping

(3) The Arctic states should support work at the IMO and other international organizations with recognized competence to promote and advance safe, secure, reliable and environmentally sound shipping, including through: timely completion and implementation of the Polar Code; efforts regarding training requirements for officers and crew of ships operating in polar waters; adoption as appropriate of ship routing and reporting measures (including vessel traffic services); and discussions regarding enhancement of weather and ice forecasting and nautical charts to aid navigation. Arctic states should also encourage ratification to enable entry into force and implementation of the Ballast Water Management Convention and research into ballast water management systems that are effective in colder settings of polar regions.

(4) Arctic states should explore the possibility of developing voluntary guidelines and, if appropriate, best practices in implementing such guidelines for sustainable tourism. Moreover, that the role the cruise industry plays in facilitating tourism in the region and the impacts of this industry on Arctic peoples, ecosystems and the environment should be acknowledged. The Arctic Council should also give consideration towards the development of a broader sustainable tourism initiative.

(5) Arctic states should explore, within an appropriate time after the mandatory Polar Code has been adopted, collaborative approaches to encourage effective implementation of any future related IMO measures for the Arctic, including the possible development at IMO of port state control guidelines and/or initiatives within existing port state arrangements.

(6) Arctic states should support ongoing work at the IMO to address black carbon emissions from international shipping in Arctic waters including considering amendments to MARPOL or other IMO instrument.

(7) Arctic states could consider approaches, including at IMO, to address safety and environmental concerns with respect to other types of vessels that, due to their size, routes, and nature of activity, may not be subject to the Polar Code.

Chapter 4: Marine Living Resources

<u>Part A: Fisheries Resources</u>

(8) Fisheries resources should be managed in accordance with the law of the sea, relevant fisheries agreements and modern principles of fisheries management, including the precautionary and ecosystem approaches, also being mindful of the interests of the indigenous peoples of the Arctic.

(9) Fisheries resources should be managed based on the best scientific knowledge available, and necessary scientific understanding should be enhanced, including on changes in fish stocks.

(10) Fisheries resources in areas beyond national jurisdiction should be managed based on cooperation in accordance with international law to ensure long term sustainability of fish stocks and ecosystems.

<u>Part B: Marine Mammals and Seabirds</u>

(11) The Arctic Council should increase collaboration with IMO, IWC and NAMMCO for information sharing and cooperation between their respective working groups and sub-groups on cetacean-related issues such as ocean noise and ship strikes and consider Ecosystem-based Management (EBM). Additionally, Arctic states should consider taking more proactive efforts in the IMO, IWC and NAMMCO on these issues such as by contributing to the IWC ship strike database.

(12) Arctic states, to the extent practicable, should continue to create and/or share seabird and marine mammal density and distribution maps, including through common databases such as the National Oceanic and Atmospheric Administration (NOAA) CetMap for Cetaceans (http://cetsound.noaa.gov/index.html) and CAFF's CBird online tools for timely tracking of seabird populations (<u>ww.caff.is/seabirds-cbird/seabird-information-network</u>).

(13) Arctic states should advance conservation of Arctic marine ecosystems by considering management measures in ecologically significant areas of the Arctic Ocean that Arctic states might pursue at the IMO, building on the results of the AMSA Recommendation II(D) Report on Specially Designated Arctic Marine Areas.

Chapter 5: Arctic Offshore Oil and Gas

(14) The Arctic Council should urge its members to support, as appropriate, efforts in the ISO and other processes to develop standards relevant to Arctic oil and gas operations.

(15) Arctic states should move toward circumpolar policy harmonization in discrete sectors such as, e.g., environmental monitoring based on existing studies such as the Arctic Council's Arctic Offshore Oil and Gas Guidelines and the EPPR Recommended Prevention Practices report.

(16) Arctic Council should promote interactions with the appropriate international treaty bodies on offshore oil and gas issues that address for example discharges, oil spill preparedness and response, and environmental monitoring. This could include coordinating information exchange on reporting, monitoring, assessment and/or other requirements under relevant entities, encouraging inclusion of science and traditional knowledge, and keeping abreast of Arctic-specific developments relevant to the appropriate instruments.

(17) Arctic states should further engage industry and regulator involvement, as appropriate, in PAME and EPPR initiatives on offshore oil and gas activity by utilizing existing industry forums, or by convening an Arctic-specific oil and gas dialog for industry and contractor groups.

Chapter 6: Arctic Marine Pollution

(18) Arctic states should continue to identify, monitor and assess the combined effects of multiple stressors – inter alia climate change, ocean acidification, shipping, living marine resource use, regional and long-range pollution, and offshore oil and gas exploration and extraction – on Arctic marine species and ecosystems. Support the on-going work under EBM, AMAP and CAFF including the initiative "Adaptation Actions for a Changing Arctic" to achieve this endeavor and strengthen the link between the

current known status and future management of Arctic marine species and ecosystems.

(19) Arctic states should reaffirm the importance of their engagement in the UNFCC to reduce global greenhouse gas emissions as a matter of urgency, recognizing the significant potential threats posed to Arctic marine ecosystems and Arctic biodiversity from climate change and ocean acidification identified by AMAP and CAFF. Arctic states should also increase their leadership role in the study of ocean acidification in Arctic waters

Chapter 7: Ecosystem-based Management in the Arctic

(20) Arctic states should recognize, in accordance with the recommendations from the Arctic Council EBM Expert Group and the PAME lead Ecosystem Approach expert group, the importance of the following elements when implementing marine Ecosystem-based Management in the Arctic Council Working Groups: identification of the ecosystem, description of the ecosystem, setting ecological objectives, assessing the ecosystem, valuing the ecosystem and managing human activities.

(21) The Arctic Council should promote common understanding and the mutual exchange of lessons learned by periodically convening Arctic Council-wide meetings on EBM to:

- share knowledge and experiences with respect to management and science across Large Marine Ecosystems; and
- review information on integrated assessments.

Chapter 8: Arctic Marine Science

(22) The Arctic states should promote coordination and collaboration in providing for access to marine scientific research in their marine areas, and the Arctic states should consider developing an Arctic science instrument, inter alia, to facilitate marine scientific cooperation and promote data sharing

(23) The Arctic Council could consider directing its working groups to collaborate to developing a list of research gaps and priorities, taking into account the knowledge and process needs for the Arctic EBM intersessional document as well as key global and regional instruments.

(24) The Arctic states should improve scientific cooperation and coordination by increasing linkages with relevant organizations, sharing infrastructure and platforms, and facilitating the gathering and exchange of information under relevant agreements. The improvements could be supported by:

- developing a network map that identifies the relationships of research/science organizations and governance organizations to Arctic-relevant instruments;
- building on science, local and traditional knowledge, and other information gathered to fulfill reporting or assessment obligations;
- informing ecosystem based management approaches;
- improving communication between science and policy arms of existing treaties; and, moving toward coordinated assessment, monitoring, and reporting, where appropriate; and
- improving data and information management, interoperability and accessibility through mechanisms such as the Arctic Spatial Data Infrastructure and the Sustained Arctic Operating Network (SAON).

Note to Reader: The descriptions in this report of international law, including as reflected in the 1982 Law of the Sea Convention, as well as other instruments, measures, and arrangements, are not intended to constitute interpretations by the Arctic Council, its working groups, or Arctic states.

M. Elfa Jónsdóttir

Chapter 1 – Introduction

1.1 The Context for the Arctic Ocean Review Phase II Report

The Arctic marine environment is central to life in the circumpolar north, both geographically and in terms of their importance to human and natural ecosystems. This marine area is the smallest and arguably the most remote of the world's ocean systems, but is a vital component in the regulation of global climate, and an important source of nutrition, income and cultural identity for Arctic peoples and communities.

The Arctic Ocean Review (AOR) is a two-phase project initiated by the Arctic Council Ministers in 2009, under the leadership of the Protection of the Arctic Marine Environment (PAME) working group and anchored in the Arctic Marine Strategic Plan (AMSP) adopted by the Council in 2004. The AMSP calls for the Arctic Council, through its members and subsidiary bodies, to periodically review potential opportunities and options to strengthen global and regional instruments and measures for the management of activities in the Arctic marine environment within their respective sectors. (AMSP, Strategic Action 7.3.4).

The Phase I Report (AOR-I): Status, Trends and Compendium of Instruments

The AOR Phase I Report (AOR-I) was submitted to Arctic Council Ministers at their meeting in Nuuk, Greenland, in May 2011. Its introductory chapter reviews the background, objectives, dimensions and scope (see Sidebar 1.1) of the AOR project as a whole, as well as the scope and approach of AOR-I.

Chapter 2 of AOR-I discusses some methods of defining Arctic marine areas and provides information on the geography, ocean circulation, sea ice, ecological features, large marine ecosystems (LMEs), and status and trends of the Arctic marine ecosystems. This geographic discussion appears in full in Appendix 1 of this AOR Final Report. In addition, Chapter 2 of AOR-I provides information on the conservation status of Arctic marine mammals and Arctic birds. Climate change and variability are also examined in the context of climate impacts on the ecosystems as a result of Arctic warming, including ocean acidification and issues relating to the ozone layer and ultraviolet radiation.

Furthermore, Chapter 2 of AOR-I summarizes our understanding of Arctic pollution resulting from persistent organic pollutants (POPs), heavy metals and radioactivity, and discusses the issue of contaminants and human health. It also reviews industrial activities and developments, including Arctic marine shipping, Arctic oil and gas development, Arctic fisheries, Arctic tourism, important land-based activities affecting the Arctic marine environment, as well as other marine activities.

Finally, Chapters 3 and 4 of AOR-I provide a compendium of basic information about existing global and regional instruments and measures that are relevant to the Arctic marine environment. Chapter 5 contains information on integrated ocean management.

The detailed context supplied in AOR-I provides a basis for the more analytical consideration of instruments presented in this AOR Final Report.

The Final Report: Analysis of Instruments

The AOR Final Report, which summarizes Phase II of the AOR, is based on the broad background and context provided in AOR-I. The AOR Final Report updates that information only when necessary to better focus the analytical discussions that are the central concern of this concluding phase of the Arctic Ocean Review and its treatment of regional and global instruments relevant to the Arctic marine environment. The many instruments that exist are largely uncoordinated with each other, and only a few are designed specifically for the Arctic marine environment. All are implemented in the Arctic by the

Sidebar 1.1

Geographic Scope

"In the marine area, the AOR project covers the central Arctic Ocean, and in addition, the surrounding seas: the Bering Sea, the East Siberian Sea, the Chukchi Sea, the Beaufort Sea, the Davis Strait, Baffin Bay and Labrador Sea, the Greenland Sea, the waters around Iceland and the Faroe Islands, and northern parts of the Norwegian Sea, the Barents Sea, the Kara Sea, and the Laptev Sea. The oceans and seas included in this definition comprise an area of … 20 million km^2 and are referred to as the 'Arctic marine environment'. The Baltic Sea is not included here."

AOR-I Report, section 1.3, reproduced in Appendix 1 to this AOR Final Report.

Arctic states themselves and, in many areas, by states outside the region whose actions affect the Arctic marine environment. Implementing these instruments effectively requires the availability of relevant science, as well as traditional knowledge.

In some cases, the relevant instruments are implemented through clusters of regional cooperation that are not centralized in any one entity or program. In other cases, such as shipping, the International Maritime Organization (IMO) regulates this activity globally, including in the Arctic. The Arctic Council, the primary forum for cooperation in the Arctic, addresses many issues relevant to the Arctic marine environment and plays an important role in encouraging implementation of existing global and regional instruments. However, in neither phase of the AOR did PAME's mandate include a review of national implementation of the instruments, and the topic is not covered here.

1.2. Overarching Trends

The Arctic, including its marine areas, continues to experience significant bio-geophysical changes and accompanying increases in human activity since AOR-I was published in 2011. The changes to the natural world, first brought to broad public attention through the 2004 Arctic Climate Impact Assessment (ACIA), have since been accompanied by increases in shipping and related activity documented in the 2009 Arctic Marine Shipping Assessment (AMSA) and other reports. In 2012 alone, a new minimum for the extent of Arctic sea ice was set in September, eclipsing the dramatic previous low set only five years before in 2007; the sea surface temperature on the ice margins continued to exceed the long-term average; the Greenland ice sheet experienced melting over some 97 per cent of its expanse in a single day; and massive phytoplankton blooms were measured below the Arctic summer sea ice, an indication that biological production may be lower than originally estimated (Jeffries et al. 2012). The reduction in sea ice extent bears emphasis: the last six years, 2007-2012, have produced the "six lowest sea ice minimum extents since satellite observations began in 1979" (Perovich et al. 2012).

The effects of these rapid changes point to sustained alterations to the Arctic marine environment. A growing body of scientific research indicates that there are additional multiple threats to, and changes occurring in, global marine systems (e.g., pollution, over-exploitation of marine resources, acidification, hypoxia, and sea level rise), and some of these are now reaching into the Arctic. Nonetheless, the scientific literature indicates that the effects and interactions among these factors are not yet fully understood.

Similarly, the impacts of these threats and changes on Arctic communities and economies are also not yet well understood. As change allows greater access to the waters of the Arctic Ocean, vessel-based human activity there is also increasing. Economic opportunity and advantage drive the search for new transportation options through Arctic marine areas. This increased activity signals a growing perception of the value of Arctic marine resources and ecosystem services. However, the financial and institutional resources are not available to meet all the demands associated with the development of a comprehensive understanding of dynamic Arctic marine systems and the human dimensions within these systems.

1.3 The Structure of the AOR Final Report

This AOR Final Report provides an analysis of some of the key existing instruments relevant to the Arctic marine area. It also identifies a variety of opportunities for further cooperative actions and provides recommendations for consideration by the Arctic Council Ministers.

In light of current and emerging trends and issues, the AOR Final Report is organized by themes and sectors, rather than on the basis of the instruments as presented and compiled in AOR-I.

Two organizing principles run through this AOR Final Report: the centrality of Arctic peoples and cultures, and the importance of ecosystem-based management (EBM), to successfully understand and address change in the Arctic marine environment. Accordingly, Chapter 2 on Indigenous Peoples and Cultures is the first analytic chapter, and Chapter 7 on Ecosystem- based Management is placed near the end to summarize how EBM can be used to address the sectoral concerns analyzed in the intervening chapters.

Chapter 2 on Indigenous Peoples and Cultures leads off the analytic chapters to emphasize that the AOR Final Report is premised on promoting the well-being and interests of the approximately four million people, including indigenous peoples, for whom the Arctic is home and whose interests should be an important consideration in issues relating to the Arctic marine environment. This stage-setting chapter focuses only marginally on international instruments, concentrating instead on small-scale uses of the marine environment, especially those related to social and cultural well-being rather than commercial production. The increase in international action on Arctic matters suggests that Arctic communities are more and more likely to be affected one way or another by those actions. The involvement of local communities is paramount in effective responses to environmental change and to the pressures to develop Arctic resources.

Chapter 3 discusses instruments relevant to Arctic Marine Operations and Shipping, the primary transportation enablers of many, if not most, activities that occur in Arctic marine areas. Ships and marine craft are vital components in private, scientific and commercial transport, including fishing, oil and gas exploration and development, mining development, tourism and many other marine activities.

Chapters 4 through 6 examine instruments related to specific sectors that appear most likely to experience growing levels of interest and activity in the immediate future, namely, Living Marine Resources, Arctic Offshore Oil and Gas, and Pollution. Chapter 4 contains two separate sections: one on Fisheries and one on Marine Mammals and Seabirds.

Chapter 7 explores Ecosystem-based Management (EBM), also known as the ecosystem approach to management (the AOR Final Report uses EBM as shorthand for both terms). EBM provides a conceptual framework for the kind of "cooperative, coordinated and integrated approaches" to the Arctic marine environment called for by Arctic Council Ministers in initiating the AOR in 2009 (AOR-I 2009, section 1.2). As Chapter 7 details, EBM is grounded in international instruments and is currently the subject of an Arctic Council Expert Group that will report in more detail on the utility of this approach in Arctic marine and terrestrial areas.

Chapter 8 examines Arctic Marine Science and its integral role in supporting EBM in many of the sectors covered by the other chapters. Science, including appreciation and use of local and traditional knowledge, is a recurring theme throughout much of the AOR Final Report. Science and the development of knowledge are critical and essential foundations for understanding dynamic Arctic systems and their relationship to Earth systems, as well as for implementing EBM approaches and supporting the instruments discussed throughout the AOR Final Report.

Finally, Chapter 9, Conclusions and Recommendations, draws from the opportunities identified in each chapter and makes recommendations for the Arctic Council Ministers consideration. It organizes (by chapter) the opportunities identified in the preceding chapters to strengthen governance and achieve desired environmental, economic and socio-cultural outcomes in the Arctic through a cooperative, coordinated and integrated approach to the management of activities in the Arctic marine environment. Some opportunities exist for cooperation in knowledge development and dissemination; these are qualitatively different from actions to amend or create new legal instruments. Similarly, institutional coordination, investments in infrastructure, and better instrument implementation and compliance efforts also constitute qualitatively different categories.

Sectoral Trends

Certain activities have understandably increased in the Arctic marine environment since the period covered by AOR-I, 2009-2011. Changes relevant to the chapters on *Indigenous Peoples and Cultures*, *Ecosystem-based Management* and *Arctic Marine Science* are measured less by individual activity levels and more by the gradually developing issues and trends described in those chapters. Activities relevant to the sectoral chapters covered by this AOR Final Report (*Arctic Marine Operations and Shipping*; *Living Marine Resources*; *Arctic Offshore Oil and Gas;* and *Pollution*) are too vast to cover in detail in a report of this scope. However, some major trends can be summarized here.

Arctic shipping activity appears to be increasing as ice loss in the Arctic marine area increases. Transit passages through the Northern Sea Route (NSR) have received much international publicity. While specific numbers are hard to come by (AMSA 2009), destinational traffic relating to onshore and offshore resource activity has also been steadily increasing and cruise ship traffic to the Arctic is similarly on the rise (although these latter numbers remain relatively small). By contrast, supply deliveries to remote communities have remained fairly constant. Chapter 3, *Arctic Marine Operations and Shipping,* provides a more detailed description of this shipping activity.

While interest in energy resources continues, offshore oil and gas production currently occurs at a small number of locations in the Arctic marine region, (e.g., Norway's Snøvhit natural gas fields in the Barents Sea; Russia's Sakhalin Island offshore crude oil production and liquefied natural gas (LNG) infrastructure for the export of natural gas to international markets; and some near-shore oil production in the Alaskan offshore near Prudhoe

Bay). Arctic offshore oil and gas exploration activities have fluctuated in recent years, but Russia and Norway continue to pursue exploration. June 2012 lease sales offered in the Canadian Arctic encompassed approximately 2,239,000 acres (9,061 sq. km.), but no active exploration currently takes place there. More seismic surveys are expected in the Greenland offshore in 2013. Iceland offered a second round of exclusive exploration and production licenses in 2011 on the Northern Dreki Ridge area of the Jan Mayen Ridge. Shell's exploration plans in the U.S. Chukchi and Beaufort Seas in summer 2012 were substantially scaled back to pre-exploratory drilling. Finland and Sweden have no oil or gas activity in the Arctic, although their emergency response practices in the Baltic Sea can inform similar efforts in the Arctic.

Energy supply developments, in particular the "shale gas revolution," will critically affect the economics of new Arctic oil and gas development, which will be highly dependent on the cost of extracting and the market price for these resources. Technological, safety and environmental issues continue to be major concerns. For example, at the 2011 Arctic Council Ministerial Meeting in Nuuk, Ministers mandated a Task Force to develop an international instrument on Arctic marine oil pollution preparedness and response. This instrument is expected to be signed at the 2013 Ministerial.

Trends that relate to living marine resources since the AOR-I vary, depending on the resource in question. As detailed in Chapter 4, *Marine Living Resources*, commercial fishing is still limited in Arctic marine regions. At present, no commercial fishing takes place within the central Arctic Ocean. Some predominantly temperate or subarctic seabird species are spreading northwards, while at least one Arctic species, the ivory gull, is in retreat in Nunavut and Greenland. Chapter 4 details more examples, including seal, walrus, whales and polar bear.

Pollution trends are detailed in Chapter 6 for petroleum hydrocarbons, persistent organic pollutants (POPs), heavy metals such as mercury, lead and cadmium, radionuclides, climate change and ocean acidification, physical disturbances and noise.

As Chapter 8 details, Arctic marine areas have been the subject of coordinated scientific research and cooperation among the Arctic states (and others) for decades, and these collaborative efforts have intensified over the past 20 years. The International Polar Year (IPY) in 2007-2009 is a prime example of a global initiative for joint polar research. A key lesson from IPY is that Arctic marine systems cannot be fully understood simply by reference to science conducted exclusively in Arctic marine areas. Non-Arctic, terrestrial and atmospheric factors are important components in building a better understanding of Arctic marine ecosystems. Furthermore, as indicated in Chapter 2, *Indigenous Peoples and Cultures*, Arctic marine science engages not just western or physical science, but also the social sciences and local and traditional knowledge generally as it relates to the region.

References

AHDR. 2004. Arctic Human Development Report. Stefansson Arctic Institute, Akureyri, Iceland.

AMSA. 2009. Arctic Marine Shipping Assessment 2009 Report. Protection of the Arctic Marine Environment, Ottawa, Canada.

AMSP. 2004. Arctic Council, Arctic Marine Strategic Plan 2004, Protection of the Arctic Marine Environment Secretariat, Akureyri, Iceland.

AOR-I. 2011. Arctic Council, The Arctic Ocean Review, AOR-I (2009-2011), Protection of the Arctic Marine Environment Secretariat, Akureyri, Iceland.

Jeffries, M. O., Richter-Menge J.A., and Overland, J.E., eds., 2012: Arctic Report Card 2012, http://www.arctic.noaa.gov/reportcard.

Perovich, D., Meier, W., Tschudi, M., Gerland, S., Richter-Menge, J. 2012. Sea Ice. Arctic Report Card 2012, http://www.arctic.noaa.gov/reportcard.

M. Elfa Jónsdóttir

Pavel Svoboda

Chapter 2 – Indigenous Peoples and Cultures

2.1 Introduction

The Arctic has approximately four million residents (AHDR 2004), all of whom are potentially affected by how well the instruments that are analyzed in this AOR Final Report function. In addition to the eight states with Arctic territory, more than two dozen indigenous peoples call the Arctic home (ACIA 2005). Most Arctic residents live near the ocean, but only a few of the Arctic's indigenous peoples are truly maritime.

Broadly speaking, the vast majority of instruments analyzed in this AOR Final Report have some effect on those who use the Arctic marine environment, whether for small-scale or commercial activity. Other chapters of this report address commercial-scale activities at sea, and the international and regional instruments that regulate that activity. This chapter focuses on small-scale uses of the marine environment, especially those related to social and cultural well-being rather than economic production. The Saami, Inuit, Dene, Aleut, Koryak, Nents, Dolgan, Nganasan, Entsi, Yukagir, Even and Chukchi peoples, as well as non-indigenous residents of Arctic coastal areas, are the primary practitioners of such small-scale uses (e.g., AHDR 2004, ACIA 2005). Some peoples, including the Athabaskans in Alaska, Yukon and Northwest Territories, make extensive use of marine resources such as salmon (e.g., ADF&G, undated), but access and use saltwater areas from only a few communities. Such uses are important to the overall well-being of the Arctic inhabitants.

The Arctic population increased greatly in the 20th century, especially as mineral and petroleum reserves were discovered and exploited (ACIA 2005). In the final decade of the century, however, the overall population fell, largely due to outmigration from the Russian Arctic as the nation's economy changed radically (e.g., Voinov et al. 2004). Other regions, including Canada's Northwest Territories, Nunavut and northern FennoScandia, experienced smaller declines in population for various social and economic reasons. Relatively high birthrates led to population increases in other regions where economic conditions remained more stable. Today, the overall population of the Arctic appears to be increasing again, particularly in areas of private- or public-sector economic growth.

Arctic coastal peoples have a long history of using fish, marine mammals and seabirds for food, clothing, building materials, trade and other purposes (e.g., McGhee 2005). Small settlements and family camps were spread along coastlines well into the 20th century. The arrival of trading posts, missionaries, government offices and services, and other factors led to the consolidation of populations into fewer, larger communities over the course of many decades, a pattern that persists throughout the Arctic today (e.g., Slezkine 1994, Kulchyski and Tester 2007). While the basic activities of hunting, fishing and gathering have remained intact in many regions, the patterns of these practices have often shifted to reflect greater concentrations of people or changes in diets and dietary preferences (e.g., Hansen et al. 2008).

When considering the interactions of Arctic peoples and the marine environment, three main themes are important: (1) the benefits that people derive from a healthy marine ecosystem, (2) the areas that people use to realize those benefits, and (3) economic development and decision-making in the context of governance of marine ecosystems, particularly in relation to Arctic peoples' patterns of use. As conditions change, adjustment and adaptation will require not just action by Arctic peoples, but cooperation and collaboration with others who use the Arctic Ocean or affect what happens there.

When considering the interactions of Arctic peoples and the marine environment, three main themes are important: (1) the benefits that people derive from a healthy marine ecosystem, (2) the areas that people use to realize those benefits, and (3) economic development and decision-making in the context of governance of marine ecosystems, particularly in relation to Arctic peoples' patterns of use.

First, marine mammals, fish and seabirds can contribute nearly all of some Arctic communities' traditional food production (e.g., ADF&G, undated). For those who live on islands or in areas with few available land animals, the sea is the only real option. For those who do have access to caribou, muskoxen, lake fish, and other terrestrial and freshwater resources, the ocean is nonetheless an important source of food and well-being. These benefits can reach far beyond salt-water areas. For example, a study of Alaska's oceans and watersheds found that only a small handful of places in the state did not make use of anadromous fish (Colt and Huntington 2002),and that even these places often engage in trade with coastal communities, exchanging furs for seal oil or whale maktak (skin and blubber).

The importance of marine species goes well beyond nutrition. Cultural identity is often inextricably bound to the practices of marine hunting and the use of marine products, through rituals, the yearly cycle of events and even the names people give themselves. For example, "Coast Saami" are Saami people who live on the coast and in fjords and rely on fisheries for their main income (e.g., Nielssen 1986), distinct from reindeer herders inland (even if some people practice both livelihoods), and have created a rich landscape of place names that reflect settlement and use patterns, as well as recent events (Brattland and Nilsen 2011). The Greenlandic population is concentrated on the coast, in large part because the interior of the island is solid ice, but also because the productivity of the sea is much greater and more reliable than that of the land. Salmon are central to the art and images of Bering Sea peoples, as are seals and whales farther north. The future of Arctic peoples as distinct cultures with continuity of traditional practices is thus closely linked to the well-being of the Arctic marine environment (AMAP 1998).

Second, the way that people use the Arctic marine environment is an important consideration when discussing the implications of additional human activity. While the consolidation of settlements has focused harvesting activity to some degree, many people still travel great distances to hunt and fish (e.g., AMSA 2009). Seasonal fish camps exist along large stretches of coastline, so that human presence covers a far greater area than the location of permanent towns would indicate. But marine use is not limited to forays along coastlines. In many areas, people travel upwards of 150 kilometers from shore in pursuit of marine mammals (e.g., Bering Straits CRSA 1984). When offshore activities such as oil drilling or commercial shipping are underway, there is a potential for conflict, along with a risk of accidents (AMSA 2009, AMAP 2010). The Arctic is sometimes portrayed as largely uninhabited, with vast stretches of land and sea that have no human presence. While the population is indeed sparse by global standards, the human presence covers a vast extent of Arctic waters (AMSA 2009). The use of marine resources and the significance of that use cannot be separated from the spatial extent of the areas that people use to obtain what the Arctic marine environment provides. The loss of summer sea ice is leading to rapid changes in the Arctic Ocean, as well as in human usage, and further changes in use patterns can be expected.

Third, the economic well-being of Arctic communities depends more and more on non-traditional activities (e.g., Glomsrød and Aslaksen 2006). Public sector expenditures are a major source of income for most Arctic regions. The development of petroleum and mineral resources drives many Arctic economies, with commercial fisheries also playing a major role in some places. While economic development often brings social and cultural dislocation (e.g., AMAP 2010), it can also provide funds to support cultural programs and allow people to preserve their traditional ways. In Canada, for example, the implementation of the Inuvialuit Final Agreement has provided opportunities for territorial park development and tourism activities that feature the culture and heritage of the coastal and marine environments.

Oil production in northern Alaska provides the means for the local government, the North Slope Borough, to offer a high level of services for its residents. Such resources continue to help the Borough support the local bowhead whale hunt as traditional means of subsistence. At the same time, local residents are often ambivalent about the proposed expansion of oil development into the marine environment, as they fear the impacts and risks to marine mammals may outweigh the benefits that local communities will receive. Economic development is thus a factor in the relationship between Arctic peoples and the Arctic marine environment (and other users thereof), but not a one-sided or necessarily decisive factor.

Climate change, too, poses threats to marine ecosystems and those who use them, but may also provide new hunting and fishing opportunities. Arctic peoples have lived through major environmental, social and economic upheavals in past centuries and the present (e.g., Nuttall and Callaghan 2000). Flexibility and adaptation are crucial characteristics that have allowed them to thrive despite high variability and uncertainty. To what extent they still have the ability to adapt and change is a crucial question. Modern governance and the allocation of resource uses often create a highly structured system with little room for adjustment when conditions change, as discussed below. The allocation of salmon catches, for example, can leave little opportunity for increased harvests when other resources fail. The delineation of shipping lanes can separate hunters from hunting areas. An integrated approach to management of Arctic marine resources can be used to help overcome user conflicts.

2.2 Challenges

The Arctic marine environment is changing rapidly. Sea ice loss drives a host of environmental shifts. Resource development alters social and economic conditions, leads to changes in governance, and may also affect the environment and the way people use it. For indigenous peoples seeking to continue their practices of using the resources of Arctic marine ecosystems, these changes pose a major challenge. In seeking to mitigate the impacts of such changes, a secondary challenge is the lack of knowledge about many aspects of life today in the Arctic. The challenges local societies, cultures and peoples face in the Arctic thus fall into two major categories: (1) responding effectively, and (2) gathering the knowledge required to do so.

Responding effectively to change means retaining what is important to you. Bowhead whalers in Savoonga, Alaska, are challenged by greater variability in spring weather during the usual bowhead whale hunt, as well as by changes in sea ice conditions around the island (Noongwook et al. 2007). The loss of ice, however, also allowed them to create a new fall whaling season and sustain the overall harvest level. Similarly, seal hunters in Clyde River, Nunavut, have adjusted in similar ways to changes in sea ice, noting that the effects of sea ice loss are not a simple matter of losing hunting opportunity, but rather a shift from hunting on the ice to hunting by boat at certain times of the year (Gearheard et al. 2006).

In both cases, the regulatory regime left such shifts entirely in the hands of the hunters, so that they were able to adapt themselves, when and as the new opportunities arose. In other cases, communities have not had the ability to change, due to environmental or governance limitations. In such cases, an effective response requires action beyond the affected community. Many, if not most, major changes anticipated in the Arctic marine environment will fall into this category.

A challenge in the preparation of this chapter has been the lack of documentation of local marine use for many areas of the Arctic (cf. AMSA 2009). Without such information, a sound appraisal of the current status is not possible. Instead, we are limited to extrapolation from existing data and reliance on anecdotal or other incomplete pieces of information about large areas of the Arctic.

The challenge to Arctic communities is thus not simply to learn to adjust. They are already doing so, and have done so for as long as they have been in the Arctic. Instead, the challenge is to figure out how to work with institutions of governance, private companies and even other communities, to develop responses that can minimize the negative impacts of environmental and social change, while maximizing any benefits or opportunities that arise. Peoples and communities with the connections and resources that enable them to work in this way may be able to take on this new challenge. Others may lack the time, funding or political standing to engage substantively in discussions about what will take place in their regions. Reading voluminous documents and taking part in multiple meetings far from home can be an onerous burden and detract from the ability to hunt, fish and pursue other important activities. For many, frequent participation of this kind may not be appealing or productive (e.g., Huntington et al. 2012a).

The second aspect of responding to change is to develop the base of knowledge upon which to design and advocate for effective response. Within communities, the base of traditional knowledge of their environment, the species they use, and the ways to remain safe while on the land and sea, are an essential foundation for response (e.g., ACIA 2005, Gearheard et al. 2006, Noongwook et al. 2007). Although rapid environmental change may make some aspects of traditional knowledge out of date or lead to shifting baselines (in which people lose track of how things used to be and thus underestimate how much change has occurred (e.g., Papworth et al. 2009), a basic understanding of how to deal with uncertainty and variability remains relevant. Modern technology such as GPS has improved navigational ability and reduced some forms of risk, but technology cannot substitute for sound judgement (e.g., George et al. 2004). The perpetuation of hard-won understanding will remain important for Arctic peoples as they respond to new challenges.

The availability of traditional knowledge depends on the vitality of local languages. Twenty-one Arctic languages have become extinct since the 1800s, with ten of these extinctions occurring after 1990 (ABA 2013, linguistics chapter). This increasing rate of language extinction could mean that much traditional knowledge may be lost before it can be used.

Advocating effectively outside of one's community requires the dissemination of knowledge and information to the wider world. Some studies on use areas or harvest levels are decades out of date, calling into question the reliability of the data that may be all that is available as the basis for new decisions. While the active participation of Arctic community members at meetings is useful, it does not replace access to documented information that can be shared and applied in many settings. Indeed, a challenge in the preparation of this chapter has been the lack of documentation of local marine use for many areas of the Arctic (cf. AMSA 2009). Without such information, a sound appraisal of the current status is not possible. Instead, we are limited to extrapolation from existing data and reliance on anecdotal or other incomplete pieces of information about large areas of the Arctic. For example, the Bering Strait is a key bottleneck for all marine traffic from the Pacific to the Arctic Ocean, and yet the details of local marine practices, especially in Russia, are not readily available. The Conservation of Arctic Flora and Fauna Working Group (CAFF) seabird harvest index, with its historical comparisons, is a step in the right direction.

The rapid increase in interest in marine shipping, mining, petroleum development, tourism and other activities in Arctic waters makes it possible that, in some areas, decisions may be made before all information is available, but will be based on best available scientific information. As a consequence, shipping lanes or development zones may be delineated without sufficient reference to local use areas, leading at best to losses of hunting and fishing opportunities, and at worst to accidents such as collisions. Thus, there is considerable urgency in conducting appropriate studies of local practices to provide information while there is still time to use it. One example of a precautionary approach that recognizes the lack of scientific information is the 2009 decision by the United States to set a commercial fisheries catch limit of zero for its Arctic waters north of the Bering Strait until adequate science and management is in place (NOAA 2009).

The rapid increase in interest in marine shipping, mining, petroleum development, tourism and other activities in Arctic waters makes it possible that, in some areas, decisions may be made before all information is available, but will be based on best available scientific information.

A final challenge for those who use the Arctic marine environment is the difficulty of predicting what the future holds. Climate change produced a sudden decline in sea ice in 2007 and another in 2012, far faster than models predicted, and these are unlikely to be the last surprises we witness. Changes will produce opportunities as well as impacts, but who will be poised to take advantage of those opportunities, and how will the instruments discussed in this report help or hinder their position? For example, the climate-driven switch to diversify from "cod only" to include shrimp fishing in West Greenland in the 1990s allowed the town of Sisimiut to thrive. However, another community, Paamiut, failed to diversify, missed the window of opportunity and experienced an economic decline that led in turn to a population decline (Hamilton et al. 2003). Another example is the increased coastal erosion in Alaska, which poses challenges that may be difficult to overcome (Huntington et al. 2012b). Careful planning is important in harnessing economic development opportunities for the benefit of local communities, but uncertainty can make it difficult to create sound plans.

2.3 Adaptation to Change: Opportunities and Challenges

Changes in the Arctic marine environment and changes in the way humans use this environment offer both opportunities and challenges. The primary opportunities are economic ones that promise employment and income for individuals, clients and contracts for businesses, and tax revenues and associated monies for local and regional governments. In addition, as noted above, loss of sea ice and the northward movement of some marine species may provide additional possibilities for local hunting and fishing, perhaps counteracting, to some extent, the losses of opportunity that are also associated with changing conditions (cf. Hamilton et al. 2003, ACIA 2005).

Economic development and traditional activities are far from incompatible (e.g., AMAP 2010). While there may be risks and conflicts over use areas or environmental impacts, increases in revenue for individuals and regions can help support traditional activities. For example, the equipment needed to go hunting and fishing is expensive. Snowmobiles and outboard engines typically cost far more in remote northern communities than they do in more densely populated regions, and gasoline may be twice as expensive. Jobs provide the means to purchase hunting trip necessities from today's consolidated settlements. And local and regional governments are able to invest in cultural programs and research needed to advocate effectively for local interests. The trouble is that the connections between industrial-scale resource development and local well-being are not simple and straightforward. The opportunities must be nurtured and pursued.

Realizing the potential local benefits of economic activity in the Arctic calls for attention on several fronts, including local involvement in (1) determining local needs and interests to set appropriate goals, (2) establishing appropriate governance mechanisms to ensure local needs and interests are considered, (3) participating effectively in those governance mechanisms and related instruments, and (4) identifying other relevant opportunities for such involvement.

Determining local needs and interests is not easy. Few communities are unified in their views, and there may be differences of opinion among communities in a region. Nonetheless, the views of local residents are unlikely to be represented well, if at all, in the absence of effective local advocacy. Once again, the simplistic view of a zero-sum outcome between economic development and traditional practices is misguided and potentially harmful. In today's Arctic, jobs and income are necessary to support a decent standard of living (AHDR 2004). The absence of traditional practices leaves little incentive or justification for living in remote locations. The decline in rural population in Scandinavia, Iceland and Greenland (AHDR 2004) may be a sign of the decreasing attractiveness of the lifestyles characteristic of such regions. Indeed, urbanization is a worldwide trend.

The simplistic view of a zero-sum outcome between economic development and traditional practices is misguided and potentially harmful. In today's Arctic, jobs and income are necessary to support a decent standard of living (AHDR 2004). The absence of traditional practices leaves little incentive or justification for living in remote locations.

The Arctic offers several examples of far-reaching local visions that have become reality. The North Slope Borough in northern Alaska began with the desire to harness oil production for local benefits, primarily through revenues from the taxation of oilfield infrastructure. Today's Self-Government in Greenland began with a movement towards self-governance in the 1970s, in part from concerns about European Union fishing fleets operating in Greenland's waters. The territory of Nunavut was created as a result of land claims by Inuit seeking recognition for their occupancy of northern Canada, and followed the earlier Inuvialuit Final Agreement that established several co-management bodies to govern use of land and sea. The Saami Parliaments in Fennoscandia are similarly an outcome of a strong desire to sustain Saami identity and culture.

What these examples have in common is the establishment of governance mechanisms to pursue local needs and interests. None has full control over the affairs of its region, though the Greenland Self-Government has come closest, with only a few aspects of governance remaining under the Danish Parliament. Nonetheless, each has found a unique way to help shape what takes place in its region, and each is responsive to local interests via elections and other forms of participatory governance.

Because none of these bodies have full control over all matters in its territory, each of them also has to work with other levels of government, as well as the private sector and non-government organizations. At this level, local voices may have larger or smaller roles, depending on the systems in place. The North Slope Borough has a local permitting process, but often has to rely on advocating its position with state and federal agencies. In the Inuvialuit Settlement Region in Canada, and in Nunavut, land-claim agreements have established co-management bodies that are responsible for setting local regulations and recommending policies to be enacted by federal agencies (e.g., CAFF 2001). The participation by local residents in such co-management arrangements offers a powerful mechanism for incorporating local views as well as traditional knowledge relevant to the topics under discussion. Similarly, a report from the Norwegian Coastal Fishing Committee resulted in an agreement between the responsible Norwegian Ministry and the Saami Parliament that establishes a right to fish – on certain terms – for residents of Finnmark and other Saami areas allocating an additional cod quota there, and increases participation in decision-making through a local fjord fishing advisory board. The Norwegian Parliament approved the necessary measures in 2012 and the Norwegian Government is establishing that advisory board, a process in which the Saami Parliament will be involved.

An agreement between the responsible Norwegian Ministry of Fisheries and Coastal Affairs and the Saami Parliament establishes a right to fish - on certain terms - for residents of Finnmark and other Saami areas allocating an additional cod quota there, and increases participation in decision-making through a local fjord fishing advisory board.

Subnational instruments, while not a focus of AOR, are important reflections of traditional ecological knowledge and sustainable management practices at the local level. The 1988 Inuvialuit–Inupiat Polar Bear Management Agreement in the Southern Beaufort Sea, a non-legally binding arrangement between indigenous peoples in the United States and Canada, sets the hunting season and other management parameters on both sides of the U.S.-Canada boundary, including the annual sustainable harvest (Brower et al. 2002). Article V(c) of the agreement seeks to assuage concerns that the agreement could conflict with federal or international regimes by specifying that the Inupiat signatories act "solely as representatives of the local traditional user group of the polar bear resource in furthering the consultation, management, and information exchange goals of the International Agreement on the Conservation of Polar Bears." Other types of interactions between national governments and local users are not easily categorized as sub- or international as with the "cooperative agreement between U.S. and Russian governments with all Chukotkan Native coastal communities in the harvest, conservation and sound management of the Pacific walrus" (Alaska Eskimo Walrus Commission, undated).

Arctic affairs are now also a matter of international attention and action. The regulation of shipping in the Bering Strait, for example, requires action by the International Maritime Organization (IMO), because neither Russia nor the U.S. can impose regulations unilaterally on an international strait (AMSA 2009). The rights of indigenous peoples are recognized by ILO Convention 169 and by the United Nations Declaration on the Rights of Indigenous Peoples (e.g., Kleist 2010). The Convention on Biological Diversity, article 8(j), recognizes the deep connection between indigenous peoples and biodiversity. The Arctic Council itself confers "Permanent Participant" status on six indigenous peoples' organizations, an unprecedented level of recognition at an intergovernmental forum. The extent to which such agreements affect domestic actions in the Arctic countries is a matter of national law, but the increase in international action on Arctic matters suggests that Arctic communities are more and more likely to be affected one way or another by those actions.

This is not to say that everything works smoothly. While having effective governance mechanisms in place is necessary, effective participation is also required. Many aspects of economic development, such as the regulations for shipping or for oil and gas, are highly technical and complex. Thousands of pages of documents are generated to address various aspects of decisions to be made. Conflicting information is offered by different interest groups. Sifting through all the material requires not only time but considerable expertise. The burden of reading countless reports and attending a never-ending stream of meetings (often far from home) is a heavy one (Huntington et al. 2012a). One recent effort to relieve such burdens is A Circumpolar-Wide Inuit Response to AMSA, a joint effort of the Inuit Circumpolar Council and the Sustainable Development Working Group (SDWG). This ongoing project involves community-based workshops in which the findings from complex reports, such as the AMSA Report, are communicated to Inuit communities in order to seek their guidance on follow-up work.

Once again, the local revenue streams provide one option for addressing this challenge, harnessing economic development to protect traditional activities. The North Slope Borough, for example, is able to hire highly qualified scientists and lawyers to conduct research, review documents and advocate for the Borough's positions. While many local indigenous residents also play a major role in these activities, the ability to procure expertise can be a big help, both in obtaining needed talent and in allowing local residents the time and freedom to pursue their traditional practices.

To date, however, most attention to Arctic development has focused on individual projects or regions, and has not considered the long-term, cumulative effects of development on the Arctic marine environment and Arctic peoples.

With increasing economic development in many sectors and areas, there is an opportunity for local residents, as well as local and regional organizations, to take the lead in shaping the relationship of that development to traditional culture and activities. The Inuit Circumpolar Council, for example, held an Inuit Leaders Summit on resource development in 2011, outlining basic principles for how such development should be conducted in Inuit regions (ICC 2011). The Yukon River Inter-Tribal Watershed Council spans the length of the Yukon River, through Alaska and the Yukon Territory, addressing water quality issues as well as international aspects of salmon migration and harvest. To date, however, most attention to Arctic development has focused on individual projects or regions, and has not considered the long-term, cumulative effects of development on the Arctic marine environment and Arctic peoples (e.g., USGS 2011). This piecemeal approach has resulted, among other things, in pitting neighboring groups against one another over fishing rights, and in little attention being paid to the total number of vessels likely to transit key areas.

2.4 Opportunities for Cooperative Action

Based on the preceding discussion, the opportunities for cooperative action fall into three categories: (i) documentation of local marine use, (ii) participation in decision making related to local marine use, and (iii) evaluation of effective responses to change, as follows:

(1) The Arctic states in cooperation with the Arctic Council should assist, as appropriate, the Permanent Participants with the documentation of current and historical a) timing and geographical extent of local uses of the marine environment, and b) levels of traditional marine resources harvests, taking into account the differing documentation needs and capacities of Arctic states.

Relatively little current information is available about spatial and temporal patterns of marine uses today in the Arctic. While many results of former studies may remain broadly applicable, they do not reflect intervening changes in technology and behavior. A clearer understanding of current local use patterns allows better identification of how further Arctic development will most likely affect local activities. Documenting current use should consider not just the areas local hunters and fishers use, but also areas where the fish, mammals, and seabirds migrate, to determine which communities may be affected by activities in which areas. Documentation should also assess intensity of use across the overall use area.

Understanding the significance of traditional marine subsistence – as opposed to commercial – harvests is also essential to understanding how new activities may affect Arctic communities. For example, shifts in harvest target species may indicate ecosystem changes. For many communities, harvesting marine resources produces a large amount of food, in addition to sustaining cultures. Because much of the harvest takes place outside the market economy, it can be difficult to assess its contribution to local well-being. Documenting harvest levels and related indicators of social and cultural significance will help fill this gap.

Where possible, documentation of use areas and harvest levels should be compared with past records in order to assess trends as, for example, the CAFF seabird harvest index seeks to do, and should account for differing documentation needs and capacities between Arctic states.

(2) The Arctic states should work with Arctic residents to identify and promote effective models for enabling inclusion of traditional knowledge and input into decision-making processes for marine development and sustainable resource management.

Both the mechanisms and the role of local residents in those mechanisms vary greatly by country in the Arctic, and even within country or by economic sector. While many countries have systems to gather local information and provide opportunities for local comments and other involvement, the effectiveness of these mechanisms is not well understood. Given the amount of time and effort required to participate in most decision-making processes, it is worthwhile to determine how effective that participation has been. Such a consideration could examine both the time and effort that people invest, as well as the degree to which local input and local interests influence the decisions that are made. A comparison of experiences across the Arctic will help identify and share practices that are effective.

Further, it can be difficult to compare economic benefits expressed in indicators such as money and jobs with non-market activities such as traditional hunting and fishing. Nonetheless, decisions concerning the Arctic marine environment implicitly or explicitly make such comparisons. Determining how these comparisons are done and identifying ways to better capture the importance of non-market values could better reflect local interests in decision-making processes.

(3) The Arctic states should seek to reduce and mitigate the various threats to traditional activities, separately and cumulatively.

Climate change and many sectoral activities described in this AOR Final Report appear to pose substantial threats to the well-being of Arctic peoples and their communities. At the same time, few analyses have attempted to compare the significance of the different threats or to determine how the cumulative threats can be addressed collectively. An evaluation of these threats should also consider the relative benefits from different activities, allowing a more comprehensive assessment of the future for Arctic communities, and identifying actions to best manage existing and further development.

(4) The Arctic states should, as appropriate, support indigenous peoples' efforts to identify and promote successful strategies that Arctic communities have developed for perpetuating traditional activities while engaging in new opportunities.

Arctic communities have been responding to variability and change for as long as there have been Arctic communities. A great deal of experience exists for finding appropriate responses or avoiding inappropriate ones. The specific environmental, economic and political settings of different communities and Arctic states in general, will obviously play a major role in determining what works in each case, but there are also likely to be many common elements, or simply a common inspiration to seek the best ways of managing the challenges and opportunities ahead. It should also be kept in mind that opportunity, freedom and choice in moving between traditional activities and participation in the modern labor market are also essential for Arctic populations and communities. In fact, current economic realities have made modern activities just as important as traditional activities to secure livelihood and income for a large proportion of the Arctic population and indigenous peoples. Allowing Arctic community leaders and others to share ideas and learn from one another offers the chance both to benefit from experiences elsewhere and to identify opportunities for collective action for common goals.

References

ACIA. 2005. Arctic Climate Impact Assessment. Cambridge University Press, Cambridge.

ADF&G (Alaska Department of Fish and Game). Undated. Community Subsistence Information System. http://www.adfg.alaska.gov/sb/CSIS/

AEWC (Alaska Eskimo Walrus Commission).Undated. http://www.kawerak.org/servicedivisions/nrd/ewc/

AHDR. 2004. Arctic Human Development Report. Stefansson Arctic Institute, Akureyri, Iceland.

AMAP. 1998. The AMAP Assessment Report: Arctic pollution issues. Oslo: Arctic Monitoring and Assessment Programme (AMAP).

AMAP. 2010. Assessment 2007: Oil and gas activities in the Arctic – effects and potential effects. Oslo: Arctic Monitoring and Assessment Programme (AMAP).

AMSA. 2009. Arctic Marine Shipping Assessment 2009 Report. Protection of the Arctic Marine Environment (PAME), Ottawa, Canada.

Bering Straits CRSA (Coastal Resource Service Area). 1984. Bering Straits CRSA, Volume 1 – Resource Inventory. Northern Resource Management, Anchorage, Alaska.

Brattland, C., and Nilsen, S. 2011. Reclaiming indigenous seascapes. Sami place names in Norwegian sea charts. Journal of Polar Geography 34 (4): 275-297.

C.D. Brower, Carpenter, A., Branigan, M.L., Calvert, W., Evans, T., Fischbach A.S., Nagy, J.A., Schliebe, S., and Stirling, I. et al. 2002. The Polar Bear Management Agreement for the Southern Beaufort Sea: An Evaluation of the First Ten Years of a Unique Conservation Agreement, Arctic 55(4): 362-372.

CAFF (Conservation of Arctic Flora and Fauna). 2001. Arctic flora and fauna: status and conservation. Helsinki: Edita.

Colt, S., and Huntington, H.P. 2002. Oceans, watersheds, and humans: facts, myths, and realities. The Status of Alaska's Oceans and Watersheds 2002. Anchorage, Alaska: Exxon Valdez Oil Spill Trustee Council. p. 109-117.

Downie, D.L., and Fenge, T., eds. 2003. Northern lights against POPs: combating toxic threats in the Arctic. Montreal: McGill-Queen's University Press.

FAO. 2005. FAO fishery country profile–the Kingdom of Norway. http://www.fao.org/fi/fcp/en/NOR/profile.htm

Gearheard, S., Matumeak, W., Angutikjuaq I., Maslanik, J., Huntington, H.P., Leavitt, J., Matumeak Kagak, D., Tigullaraq, G., and Barry, R.G. 2006. It's not that simple: a collaborative comparison of sea ice environments, their uses, observed changes, and adaptations in Barrow, Alaska, USA, and Clyde River, Nunavut, Canada. Ambio 35(4):203-211.

George, J.C., Huntington, H.P., Brewster, K., Eicken, H., Norton, D.W., and Glenn, R. 2004. Observations on shorefast ice failures in Arctic Alaska and the responses of the Inupiat hunting community. Arctic 57(4): 363-374.

Glomsrød, S., and Aslaksen, I. 2006. The economy of the North. Oslo: Statistics Norway.

Hamilton, L.C., Brown, B.C., and Rasmussen, R.O. 2003. West Greenland's cod-to-shrimp transition: local dimensions of climatic change. Arctic 56(3): 271–282.

Huntington, H.P., Lynge, A., Stotts, J., Hartsig, A., Porta, L., and Debicki, C. 2012a. Less ice, more talk: the benefits and burdens for Arctic communities of consultations concerning development activities. Carbon and Climate Law Review 1/2012:33-46.

Huntington, H.P., Goodstein, E., and Euskirchen, E. 2012b. Towards a tipping point in responding to change: rising costs, fewer options for arctic and global societies. Ambio, 41:66-74.

Hansen, J.C., Deutch, B., and Odland, J.Ø. 2008. Dietary transition and contaminants in the Arctic: emphasis on Greenland. Circumpolar Health Supplements 2008:2.

ICC (Inuit Circumpolar Council). 2011. A circumpolar Inuit declaration on resource development principles in Inuit Nunaat. ICC: Ottawa. http://www.iccalaska.org/servlet/content/declarations.html

Kleist, K. 2010. Changes and challenges in Greenland. http://uk.nanoq.gl/Emner/News/News_from_Government/2010/05/TheCircle_Changes_Challenges.aspx

Kulchyski, P., and F.J. Tester. 2007. Kiumajut (talking back): game management and Inuit rights 1900-1970. Vancouver: University of British Columbia Press,

McGhee, R. 2005. The last imaginary place: a human history of the Arctic world. Oxford: Oxford University Press.

Nielssen A.R. 1986. The economic adaptation among the Coast Sami population in Finnmark c.1700. Acta Borealia 3(1): 21-41

NOAA (National Oceanic and Atmospheric Administration). 2009. U.S. Arctic Fishery Management Plan (August 2009). http://www.fakr.noaa.gov/npfmc/fmp/arctic/Arctic FMP.pdf

Noongwook, G., the Native Village of Savoonga, the Native Village of Gambell, Huntington, H.P., and George, J.C. 2007. Traditional knowledge of the bowhead whale (Balaena mysticetus) around St. Lawrence Island, Alaska. Arctic 60(1):47-54.

Nuttall, M., and Callaghan, T.V. 2000. The Arctic: environment, people, policy. Amsterdam: Harwood Academic Publishers.

Papworth, S.K., Rist, J., Coad, L. and Milner-Gilland, E.J. 2009. Evidence for shifting baseline syndrome in conservation. Conservation Letters 2: 93–100.

Slezkine, Y. 1994. Arctic mirrors: Russia and the small peoples of the North. Ithaca, NY: Cornell University Press.

USGS (United States Geological Survey). 2011. An Evaluation of the Science Needs to Inform Decisions on Outer Continental Shelf Energy Development in the Chukchi and Beaufort Seas, Alaska. Circular 1370. http://pubs.usgs.gov/circ/1370/pdf/circ1370.pdf

Voinov, A., Bromley, L., Kirk, E., Korchak, A., Farley, J., Moiseenko, T., Krasovskaya, T., Makarova, Z., Megorski, V., Selin, V., Kharitonova, G., and Edson, R. 2004. Understanding human and ecosystem dynamics in the Kola Arctic: a participatory integrated study. Arctic 57(4): 375–38

M. Elfa Jónsdóttir

Chapter 3 – Arctic Marine Operations and Shipping

3.1 Introduction

3.1.1. The character and scope of marine operations in the Arctic

Arctic marine operations have been increasing as natural resource development and economic ties between the Arctic and the global economy expand. These in turn are associated with potential effects of global warming and with development in technology and science, two trends that are expected to continue in the near future. With the retreat of Arctic sea ice, greater marine access and potentially longer seasons of navigation and operation are also expected.

This emerging maritime Arctic is characterized by:

- new marine systems supporting offshore hydrocarbon exploration and resource development;
- expanding marine tourism;
- summer marine transportation routes that support hard minerals and mining operations, and modest but growing levels of trans-Arctic cargo movement;
- more scientific voyages in the central Arctic Ocean;
- potential increases in fishing in coastal waters such as Baffin Bay/Davis Strait;
- a general increase in the summer presence of a wide variety and sizes of vessels around the Arctic basin; and
- other related developments.

The recognition of two key aspects of marine operations in the Arctic is critical to the context of this chapter. First, the 'Arctic marine environment' as understood for the purposes of this AOR Final Report encompasses an area broader than the Arctic Ocean, and includes numerous regional marine areas such as the Bering Sea. A complete list of those regions appears in Chapter 1, Sidebar 1.1 and in Appendix 1. Some of these areas are seasonally ice-covered and others are ice-free. Second, Arctic shipping is understood to include a wide range of vessels from icebreakers, tankers, offshore support vessels, container ships, fishing vessels, bulk carriers, ferries, tug-barges and cruise ships, to government ships, research vessels and more. This range is consistent with the Arctic Council's Arctic Marine Shipping Assessment (AMSA 2009).

3.1.2. Documenting the scope of Arctic marine operations and building on AMSA

Properly addressing the issues of maritime safety and marine environmental protection requires a comprehensive and holistic perspective on all vessel traffic within each large marine ecosystem (LME) of the Arctic marine environment. Such an approach calls for regional databases of Arctic indigenous marine use, and a spatial understanding of ecologically and culturally significant or sensitive areas. An additional complex challenge is accounting for the numerous fishing vessels in Arctic waters and their impacts on the Arctic marine environment. The fishing activities of many of these vessels are under the jurisdiction of the Arctic states where they operate.

The Arctic Council's AMSA, conducted between 2004-2009 under the working group for the Protection of the Arctic Marine Environment (PAME) in cooperation with other Arctic Council working groups, provides a framework for action with 17 recommendations arranged under three key themes: I) Enhancing Arctic Marine Safety, II) Protecting Arctic People and the Environment, and III) Building the Arctic Marine Infrastructure (AMSA 2009). The AMSA recommendations were negotiated and consensus was reached by the eight Arctic states, resulting in an effective document for further policy development. AMSA can be viewed as a strategic guide for a host of stakeholders and actors, as a baseline of information that can be updated as traffic and regional marine use change, and as an overall Arctic Council policy document.

AMSA recommended that the Arctic states identify common interests and work within relevant international maritime organizations to enhance the Arctic as a region, by requiring new attention and action to advance the safety and address the environmental impacts of Arctic marine shipping. As will be seen in section 3.3.5, several of the Arctic states have taken the lead at the International Maritime Organization (IMO) to develop a mandatory code for ships operating in polar waters (Polar Code). This is a complex process that involves the global maritime community and includes key sectors of the maritime industry operating today in the Arctic marine environment, such as bulk carriers, tankers and passenger vessels.

The Arctic community has an insufficient but increasing amount of information on Arctic ship traffic, and the location of ecologically and culturally significant areas. For example, AMSA Recommendation IIA calls for the Arctic states to consider conducting surveys to identify gaps in knowledge regarding the patterns of indigenous marine use. In response to AMSA Recommendation IIC, the Sustainable Development Working Group (SDWG), Arctic Monitoring and Assessment Programme (AMAP) and Conservation of Arctic Flora and Fauna Working Group (CAFF) identified many areas of heightened ecological and cultural significance. This response to AMSA IIC dealt adequately with ecological areas. However, the information available on areas of heightened cultural significance was inconsistent across the Arctic, and contained gaps in data quality and coverage that could not be addressed within the framework of this assessment. It is important to note that the areas of heightened cultural significance illustrate where additional data collection and integration efforts are required. The cultural significance assessments require ongoing effort. As a number of areas of heightened significance are closely linked to Arctic sea ice, they are also increasingly susceptible to change given the diminishing sea ice. Changing patterns of sea ice and marine mammal habitats may in turn necessitate new surveys throughout the Arctic, especially in straits and coastal areas.

As the availability of advanced spatial and temporal information on indigenous marine use and migratory patterns of marine mammals increases, an integration process can begin to examine the interactions of these components in the Arctic marine environment. Integration of these unique data sets can support the development of mitigation and adaptation measures for food security for Arctic communities, as well as other environmental protection and marine safety efforts (e.g., to promote the mitigation of air pollution from shipping in and near the Arctic). Such information will also assist in defining the spatial range and size of future special marine areas, and contribute to effective ecosystem-based management. The Arctic Biodiversity Data Service is one example of how CAFF makes marine monitoring and Arctic Biodiversity Assessment data more broadly available.

3.2 New Arctic Marine Operations and Challenges

3.2.1 Emerging developments in Arctic operations

AMSA provides a baseline view of Arctic marine traffic patterns in summer and winter, based on data provided by Arctic states for 2004 and 2005. Since AMSA's release in 2009, notable increases in marine vessels operating in Arctic areas have occurred but have not been systematically reported. Identifying the appropriate reporting bodies and drawing on increasingly available satellite data could help track these increases more effectively.

The increased vessel traffic in Arctic marine areas can only be summarized briefly here. With respect to offshore exploration, one of the many challenges is the number of local transits and marine operations within relatively small drilling sites or lease areas and to coastal support areas. During the 2010 and 2011 summer seasons, drill ships and a fleet of offshore support vessels operated in lease areas off the west coast of Greenland. Offshore hydrocarbon exploration continued in the Norwegian Arctic in several areas of the Barents Sea. In the U.S. maritime Arctic during the late summer of 2012, Shell conducted preliminary operations in leased areas in the Chukchi and Beaufort Seas. Two new shuttle systems are operating year-round in the eastern Barents Sea of the Russian Arctic, both without icebreaker escort (Brigham 2011).

During recent summer navigation seasons, the central Arctic Ocean – the high seas beyond the exclusive economic zones (EEZs) of the Arctic Ocean coastal states – has experienced the presence of advanced icebreakers conducting seabed data gathering on the continental shelf. The potential impacts of these marine operations are not clear, but the access implication is that very capable icebreaking ships from Arctic and non-Arctic states can operate today in summer in all regions of the central Arctic Ocean. Continued decreases in sea ice extent and thickness will increase the access for surface ships in a longer navigation season of potentially lighter ice conditions.

3.2.2 Vessels operating in the Arctic

Since AMSA, the cruise ship industry has continued to operate large- and medium-sized ships, some ice-capable, along Greenland's west coast during a two- to three-month summer season, and along its east coast and around Svalbard in fewer numbers. Both marine areas have limited or nonexistent marine infrastructure. However, as of July 2012, the Norwegian Pilotage Act and implementing regulations were made applicable to Svalbard, thus introducing state pilotage service, compulsory pilotage and pilot exemption certificates on Svalbard.

In summer 2010, two cruise ships sailed the length of the Northwest Passage (NWP), as did one each in 2011 and 2012. During summer 2012, The World, a 196.3 meter condominium ship, became the largest tourist ship to transit the NWP. The NWP has also experienced a notable increase in adventurers and small yacht voyages in 2010 (Arctic SAR 2011), 2011 (IMO 2010), and 2012 (IMO status 2012). These small vessel voyages along the

NWP present a new set of challenges for the maritime authorities in the remote Canadian Arctic. To put these numbers in perspective, as of the 2012 navigation season, there have been only 183 full voyages of the NWP since Roald Amundsen's voyages aboard Gjøa from 1903-1906 (Headland 2012). However, development of a trans-Arctic route through the NWP does not appear likely in the near future.

In the near term, destinational voyages related to natural resource development in the Canadian Arctic are likely to increase. For example, the Mary River Mine is being developed based on the use of a shuttle system of icebreaking iron ore carriers from Baffin Island to European ports. Recognizing that global supply and demand patterns are the dominant driver, other major mineral development prospects in Canada, Greenland and other Arctic locations may be more likely to proceed if comparable shipping services are feasible.

Russia is interested in further developing its Northern Sea Route (NSR), a route which has experienced renewed activity, to carry a greater volume of natural resources to global markets. Linking the Russian Arctic during a summer navigation season of three to four months (roughly July to October) to markets in China and Southeast Asia has been the focus of recent experimental voyages. In late August 2011, a super tanker, the Vladimir Tikhonov, crossed the NSR with icebreaker support to deliver 120,000 tons of gas concentrate from Murmansk to Bangkok, Thailand. A bulk carrier under Liberian flag with 66,000 tons of iron ore, Sanco Odyssey, sailed from Murmansk to Beilun, China, on the NSR during 3-10 September 2011 (Barents Observer 2011). These two voyages represent the largest tanker and bulk carrier to sail the NSR. This not only indicates an increase in the size of ships that can sail on more northerly routes along the Russian Arctic, but a significant change in the NSR shipping season.

During summer 2012, 46 ships sailed the NSR carrying more than one million tons of cargo, a 53 per cent increase in cargo volume over 2011 (Barents Observer 2012). More traffic on trans-Arctic voyages will also mean increased traffic in the Bering Strait Region and along the northern Norwegian coast. Thus far, shippers along the NSR focus on the transport of natural resources from west to east, in a summer navigation season of three to four months. However, in November 2012, the River Ob sailed the NSR to deliver liquefied natural gas (LNG) from Norway to Japan. Although escorted by icebreaker, the vessel encountered young sea ice of only 30 centimeters (Barents Observer 2012).

While Russia and several Asian nations pay significant attention to the NSR for all cargoes, regular container ship operations during such a short navigation season have not yet proven viable. The higher risks for delayed cargoes, the uncertainly of marine insurance for this remote region, and the variability of the regional sea ice cover all present unique challenges to international container shippers along the NSR.

3.2.3 Cruise ship operations

Two recent cruise ship accidents relevant to marine safety in polar waters are highlighted in the Sidebar 3.1. The ramifications of such incidents were anticipated in the discussions at the AMSA Arctic Marine Incidents Workshop in March 2008 (AMSA 2009). Passenger ships will fall within the scope of a mandatory IMO Polar Code, and provide an essential step towards enhancing marine safety and environmental protection. The Arctic states and flag states of passenger ships that visit Arctic waters should encourage and support a range of best practices by the cruise ship industry when operating in remote and frigid Arctic waters. Also relevant to passenger and cruise ships in the Arctic are new guidelines for mariners operating in polar waters, promulgated in the Manila

Sidebar 3.1 – Selected Major Cruise Ship Accidents of Relevance to the Arctic

Two recent cruise ship accidents have direct relevance to marine safety in polar waters. In November 2007, the M/V Explorer was holed by ice and sank off the Antarctic Peninsula; 100 passengers and 54 crew members were rescued by a Norwegian cruise ship operating in the region.

In August 2010, the M/V Clipper Adventurer grounded in the Canadian Arctic resulting in damage to its hull and a lengthy salvage operation; more than 200 passengers were safely removed from the stranded ship by a Canadian Coast Guard icebreaker.

Amendments (25 June 2010) to the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW). It is important to ensure that all seafarers on board ships operating in polar waters have additional training. Such training requirements should be mandatory and prescribed in relevant IMO instruments.

3.3 Technical, Policy and Governance Developments

3.3.1 Monitoring of shipping operations – AIS – LRIT

During the past five years, significant strides have been made in the monitoring and surveillance of ship traffic in the Arctic marine environment. These advances complement provisions in IMO agreements that require automatic identification systems (AIS) for collision avoidance on all vessels over 300 tons when engaged in international voyages, all cargo ships over 500 tons when not engaged in international voyages, and passenger vessels of any size. These useful size limits allow such vessels to provide information about themselves to other ships and to coastal authorities.

Shore-based systems in Norway and the United States that use ground-based radars and AIS transponders/receivers have the capability to gather detailed spatial and temporal information about Arctic ship traffic. Satellite tracking of ships in the central Arctic Ocean, which has begun to show patterns of shipping traffic and high density flows of vessels in select areas, might also be useful for future analyses. As well, Canada uses long-range identification and tracking (LRIT) to monitor vessels transiting its waters and has recently established two terrestrial AIS sites in the Arctic. These systems can be used to develop vessel tracking in international straits such as the Bering Strait, and can assist in the design of voluntary IMO marine traffic routes through complex and evolving patterns of commercial and indigenous marine use.

An Arctic marine traffic awareness system, called for in AMSA Recommendation III B, will be key to enhancing Arctic navigation safety and contributing to environmental protection. Essential elements of such a system include:

- ✓ enhanced data sharing in near real-time among all the Arctic states;
- ✓ improved Arctic state cooperation among themselves and with other entities (e.g., the European Maritime Safety Agency); and
- ✓ the use of AIS transponders as required under International Convention for the Safety of Life at Sea (SOLAS) for certain vessels.

Any such system should also explore:

- ✓ the use of vessel information required under SOLAS for the LRIT of Ships;
- ✓ IMO-approved vessel traffic systems;
- ✓ IMO-approved ship reporting systems; and
- ✓ the installation of instrumentation on ships that enables the transmission of real-time meteorological observations to national hydrometeorological services and other users.

3.3.2 Arctic Search and Rescue (SAR) Agreement 2011

The Agreement on Cooperation and Aeronautical and Maritime Search and Rescue in the Arctic (SAR), signed by the eight Arctic states in 2011 and entered into force in January 2013, is an important policy and governance development (Arctic SAR 2011). The Arctic states, under the cooperative framework of the Arctic Council, created a legally binding agreement on maritime and aeronautical SAR covering more than 13 million square miles of the Arctic marine environment. The remoteness of the Arctic, the limited SAR resources, and severe weather and ice conditions required that the Arctic states be proactive in the design of the agreement, under which all Arctic states commit to coordinated assistance to those in distress and cooperate with each other in SAR operations. The Arctic states defined the southern limit for the agreement so that all high latitude regions are included, e.g., all of the Bering Sea, the southern half of Greenland below the Arctic Circle, and the southern EEZ extending from Iceland into the north Atlantic. The Arctic states also agreed upon their respective areas of SAR responsibility for the central Arctic Ocean and these SAR boundaries were taken to the North Pole. The Arctic states also agree to promote the establishment, operation and maintenance of an adequate and effective SAR capability within their areas of responsibility. The agreement includes an article on requests to enter the territory of a Party for SAR operations.

3.3.3 Agreement on Cooperation on Marine Oil Pollution Preparedness and Response in the Arctic

In October 2012, the eight Arctic states concluded negotiations (again under the cooperative framework of an Arctic Council task force, as with the Arctic SAR Agreement) on a new legally-binding Agreement on Cooperation on Marine Oil Pollution Preparedness and Response in the Arctic. The Agreement, which will strengthen cooperation among states in the event of an oil pollution incident in the region, is to be presented for signature at the Arctic Council Ministerial Meeting scheduled for May 2013.

The new Agreement provides for mutual assistance in response to oil pollution incidents in the Arctic that are beyond the capacity of a single state to respond effectively on its own. Such assistance could include, among others, provision of human resources, know-how, equipment and technology. The Agreement also outlines other actions that are essential to spill response, such as maintaining national spill response systems, notifying other states of spills that may affect their marine areas, conducting monitoring activities to identify spills, and undertaking joint exercises and training. Provisions governing assistance, reimbursement for such assistance and moving resources across borders are also provided for in the Agreement, and will be further elaborated in a set of non-legally binding operational guidelines attached to the Agreement.

The Emergency Prevention, Preparedness and Response Working Group (EPPR) has prepared a set of operational guidelines for oil spill response in Arctic waters as an Annex to the Agreement. Included in the guidelines will be sections on *Notification, Assistance, Movement and Removal of Resources across Borders, Response Operations in Areas Beyond National Jurisdiction, Command and Control, Facilitation of Situational Awareness and a Common Operating Picture, Joint Review of Oil Pollution Incident Response Operations, Joint Exercises and Training, and Administrative Provisions.*

The proposed Agreement on Cooperation on Marine Oil Pollution Preparedness and Response in the Arctic focuses solely on oil. Although the Arctic states discussed the possibility of including other harmful substances within its scope, it was decided to not do so at this time. In the future, the Arctic Council could address preparedness and response with respect to other hazardous chemicals that are transported by bulk carriers in Arctic waters.

3.3.4 Hydrography, communications and monitoring

Improved Arctic charting and greatly enhanced Arctic marine observations are vital to current and future Arctic marine operations. Only an estimated six to seven per cent of the Arctic marine environment is charted to international navigation standards. This means that the Arctic needs extensive hydrographic surveying, in particular the coastal areas.

The recent creation of an Arctic Regional Hydrographic Commission (ARHC) within the International Hydrographic Organization (IHO) indicates that the maritime states have been proactive in hydrography and charting issues in a region of increasing access and longer seasons of navigation (IHO 2010). One of the ARHC's important tasks is to develop standards for Arctic spatial data to enhance quality assurance of bathymetric information for the whole of the Arctic Ocean. Collaboration between ARHC and the Arctic Spatial Data Infrastructure project, in which the national mapping agencies of all Arctic states participate to develop standards for Arctic spatial data, should be encouraged (Palmér et al. 2011).

The World Meteorological Organization (WMO), in concert with the IMO, has established five new meteorological and navigational areas (WMO METAREAs/IMO NAVAREAs) covering the Arctic with responsibility for provision of services accepted by Canada, Norway and the Russian Federation. The new Arctic METAREAs became operational in June 2011 (IMO 2011 Briefing Paper). This extends the Global Maritime Distress Safety System (GMDSS) to ensure that Arctic mariners would receive, as much as possible, the same standard of weather, wave and ice warning, and forecasts and navigation alerts as in the other world oceans. However helpful this information is, its general nature renders it critical that individual vessels possess additional detailed and location-specific information when operating in the area.

Together with the WMO, the International Ice Charting Working Group (IICWG), a forum of the national ice services, is working to implement policies and procedures for coordinated sea ice mapping and distribution of products (IICWG 2007). Full operational capability began in 2011, with standardized marine forecasts and warnings, ice edge information and the deployment of additional monitoring equipment. Services are being expanded incrementally as marine activity increases. Recognizing that floating ice in Arctic waters presents a major hazard to navigation, the WMO and IICWG are working on standards for the creation, distribution and display of ice information in shipboard Electronic Chart Display and Information Systems (ECDIS). A new product specification (under the IHO S-100 family of standards) is under development so that mariners will be able to display ice information from any of the national ice services as overlays on their electronic ECDIS displays.

The International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) is a non-profit, non-governmental, international and technical association that gathers marine aids to navigation authorities, manufacturers and consultants from all parts of the world. Moving forward, IALA is well placed to support the sustainable design, implementation and operation of aids to navigation, as well as related infrastructure, such as communications and vessel monitoring systems for the Arctic. IALA's diverse membership can expedite the identification of overall information needs to enable safe Arctic navigation; the technical complexities of virtual aids to navigation and other electronic means (complementary to conventional aids to navigation in Arctic waters); and the feasibility and benefits of harmonizing approaches and the sharing of best practices.

3.3.5 International Maritime Organization (IMO)

Recent work at IMO on the global oceans is timely and relevant for the Arctic marine environment. New amendments to annexes of the International Convention for the Prevention of Pollution from Ships (MARPOL) include: Annex IV on sewage; Annex V on garbage; and, Annex VI on air pollutant emissions and ship energy efficiency, particularly the control of sulfur and now CO_2 emissions. All of these advances at IMO point to continuing policy work at the Arctic Council and for the Arctic state IMO delegations. Among the issues that could be explored are: the identification and protection of ecologically or culturally important marine areas in the Arctic including Special Areas, Particularly Sensitive Sea Areas (PSSAs) and other sensitive ecological-biological and cultural areas, and possibly emission control areas.

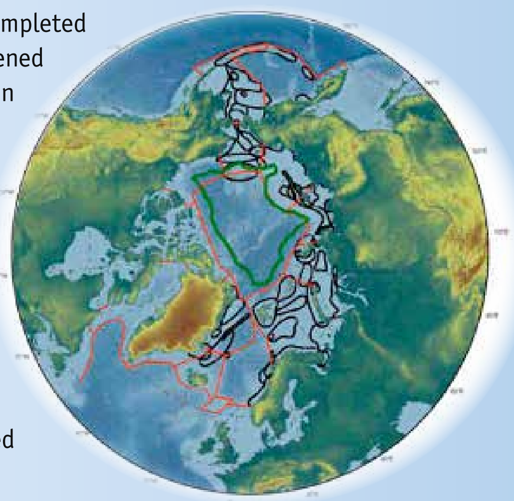
Internationally designated areas

As discussed in part 3.1.2, in their recognition of the uniqueness and vulnerability of these areas, the Arctic Council and its AMAP, CAFF and SDWG working groups have followed up on the AMSA II (C) recommendation and identified areas of heightened ecological and cultural significance in light of changing climate conditions and increases in marine activity. Similarly, taking into account the special characteristics of the Arctic marine environment, the PAME working group is currently exploring the need for internationally designated areas for the purpose of environmental protection from shipping in the central Arctic Ocean (AMSA II (D) recommendation) (see Sidebar 3.2).

Such protection can be achieved through various IMO "tools," including Special Area designations, various navigational measures and PSSA designations, as long as all applicable requirements are met. Thirteen PSSAs have been established by the IMO around the globe, although none are in the Arctic (IMO 2005). As for MARPOL Special Areas, none currently exist in the Arctic Ocean, as shown in Sidebar 3.3. Special Areas establish more stringent controls on discharges of oil, noxious liquid substances, sewage or garbage. Similarly, the Arctic Ocean currently has no MARPOL Emission Control Areas that establish more stringent controls on air pollution.

Sidebar 3.2 – Mapping Arctic Marine Areas of Ecological Significance

The Arctic Council, through several of its Working Groups, has completed a report on Identification of Arctic Marine Areas of Heightened Ecological and Cultural Significance, and has started a project on 'Specially-Designated Arctic Marine Areas' that may recommend International Maritime Organization protection designation (from the effects of international vessel activities) for one or more Arctic marine areas outside of national jurisdiction. Both these projects follow the recommendations of the Arctic Marine Shipping Assessment (AMSA) that stated the Arctic states should identify such areas and encourage development of special areas or Particularly Sensitive Sea Areas (PSSAs) as appropriate tools for environmental protection. These important, ongoing projects will be completed in 2013 and 2014 respectively.



Black Carbon

Current research and policy initiatives on black carbon impacts in the Arctic may also merit special controls – presumably under MARPOL Annex VI – with respect to ships sailing in and even outside Arctic waters (Litehauz 2012). The Bering Strait Region, as an international strait and chokepoint for entering and departing the Arctic Ocean, is a prime example of a region that requires policy initiatives and cooperation between the Russian Federation and the United States.

Heavy Fuel Oils (HFOs)

The Arctic Council's PAME working group is conducting a study on the environmental risks associated with the use and carriage of heavy fuel oil (HFO) by vessels in the Arctic and will identify options and make recommendations – including the possible adoption of new international regulations – to mitigate those risks. Norway has adopted a ban on the use of HFO for the east coast of Svalbard.

Polar Code

Harmonized and enhanced Arctic marine safety and environmental protection will be greatly improved with the adoption and full implementation of a mandatory IMO Polar Code by IMO member states. Defining the risks for various class ships within ice-covered and ice-free polar waters has been challenging, and there has been a focus on hazard identification and consequences. Appropriate inclusion of various environmental protection measures, in addition to those already provided under IMO instruments, has also been difficult, although a number of Arctic states have recently cosponsored a proposal to IMO for needed environmental provisions. When finalized, these measures are expected to take legal effect through amendments to existing IMO instruments. A new target completion date for a Polar Code is set for 2014.

Ballast Water Management and Anti-Fouling

The IMO adopted the International Convention for the Control and Management of Ship's Ballast Water and Sediments (BWM Convention) in 2004. To become effective, the BWM Convention requires ratification by 30 states representing at least 35 per cent of the world's merchant shipping tonnage. As of January 31, 2013, 36 nations had ratified, representing 29.07 per cent of world tonnage (IMO Status 2013). Five of the eight Arctic states (Canada, Denmark, Norway, Sweden and the Russian Federation) have ratified, and one (Finland) has signed subject to acceptance (IMO Status 2013). The BWM Convention is a maritime convention applicable to the global oceans, and is critical to the control of the introduction and spread of alien and invasive species to the Arctic marine environment. Recent growth in Arctic regional marine operations and trans-Arctic voyages, as well as evidence of alien and invasive species in the Arctic, highlight the need for ratification and entry into force of the BWM Convention and/or adoption of other domestic prevention measures as more regular summer voyages are conducted in Arctic waters. However, there are issues associated with the entry into force and effective implementation of the BWM Convention. The phase-in of ballast water management systems (BWMS) in a timely manner on certain ship types may be

Sidebar 3.3 – IMO MARPOL Special Areas*

Annex I – Oil: *Mediterranean Sea, Baltic Sea, Red Sea, 'Gulfs' Area, Gulf of Aden, Antarctic Area (South of Latitude 60 Degrees South), North West European Waters, Oman Area of the Arabian Sea, and Southern South African Waters.*

Annex II – Noxious Liquid Substances: *Antarctic Area*

Annex IV – Sewage: *Baltic Sea (1 January 2013 Entry into Force).*

Annex V – Garbage: *Mediterranean Sea, Baltic Sea, Black Sea, Red Sea, 'Gulfs' Area, North Sea, Antarctic Area (south of latitude 60 degrees south), and the Wider Caribbean Region (including the Gulf of Mexico and the Caribbean Sea).*

Annex VI – Prevention of Air Pollution by Ships (Emission Control Areas): *Baltic Sea (SOx), North Sea (SOx), North American (SOx, NOx, and PM), and the United States Caribbean Sea ECA (SOx, NOx, and PM)(1 January 2013 Entry into Force).*

*Adapted from an IMO table of Special Areas under MARPOL Annexes (for pollution prevention) including dates when adopted, entry into force, and when in effect.

especially problematic; also, questions have been raised regarding the operational efficacy of BWMSs in the colder settings of polar regions.

The International Convention on the Control of Harmful Anti-fouling Systems on Ships (AFS Convention), which entered into force in September 2008, has led to the elimination of organotins in anti-fouling paints that are harmful to the marine environment. All Arctic states are parties (IMO Status 2013), although anti-fouling systems seem to be less durable on ships operating in ice-covered waters. Hull fouling on ships sailing into Arctic waters from southern latitudes may pose an equal risk as ballast water for the introduction of alien and invasive species to the Arctic marine environment. IMO has, therefore, developed guidelines for the control and management of ships´ biofouling to minimize the transfer of invasive aquatic species.

3.3.6 Indigenous Marine Use, Marine Mammals and Biodiversity

The IMO and International Whaling Commission (IWC) both have technical working groups or scientific committees to address marine mammal issues in a global context. The North Atlantic Marine Mammal Commission (NAMMCO) addresses marine mammal issues in a regional context. More emphasis and focus on impacts of increased Arctic marine operations on marine mammals is needed to delegations to IMO, IWC and NAMMCO.

The Arctic states have opportunities to be more proactive in bringing marine mammal issues to Committees and Sub-committees of the IMO, as well as the scientific committees of the IWC and NAMMCO. Many issues need to be explored in an Arctic context including: ship strikes, noise impacts, and appropriate management and mitigation measures. Addressing incidentally generated noise from commercial ships and its adverse impacts on marine life is a work in progress within the IMO. The IMO's Ship Design and Equipment Sub-Committee recently finalized voluntary technical guidelines on ship quieting technologies and on navigation/operational practices to reduce impacts. These guidelines will be considered for approval by the IMO Marine Environment Protection Committee (MEPC). Arctic states could draw on the work of the Arctic Council-endorsed Circumpolar Biodiversity Monitoring Program (CBMP) discussed in Chapters 4 and 7 (sections 4.2.2, 4.2.5, and 7.5); the CBMP encompasses the Arctic Marine Biodiversity Monitoring Plan which includes an expert network on marine mammals.

3.4 Opportunities for Cooperative Action

3.4.1 International cooperation

Most of the policy and regulatory work for Arctic marine safety and environmental protection in the future will be undertaken through international bodies such as IMO, IALA, IHO, WMO, IWC, the Food and Agriculture Organization (FAO) and International Mobile Satellite Organization (IMSO), as well as by the individual Arctic Ocean coastal states. However, there are significant opportunities for the Arctic Council and its working groups to help guide, inform and influence this work through actions of the eight Arctic states, together and individually, within these international bodies. Some measures can be facilitated by the Arctic Council and attained by regional agreements among the Arctic states, such as the Arctic Search and Rescue (SAR) Agreement, entered into force January 2013, and the Agreement on Cooperation on Marine Oil Pollution Preparedness and Response in the Arctic to be presented for signature at the 2013 Arctic Council Ministerial.

3.4.2 Regional actions

Other regional actions can be taken to develop and apply Arctic ship traffic monitoring and surveillance; to define potential Arctic marine protected or special areas; to build and strengthen Arctic marine infrastructure; and to implement ecosystem-based management (EBM) in the Arctic Ocean. Much progress has been made in the Arctic Council with regards to response to marine accidents and oil spills, but greater attention is needed to foster international prevention measures.

The three-theme approach from AMSA – Enhancing Arctic Marine Safety, Protecting Arctic People and the Environment, and Building the Arctic Marine Infrastructure – remains a sound strategy for implementation of AMSA's 17 recommendations. Continued reporting by PAME to the Senior Arctic Officials on the status of the AMSA recommendations provides a consistent progress report, and can help identify new gaps and opportunities for action by the Arctic Council's working groups.

3.4.3 Opportunities for Cooperative Action

The Arctic states should support work at the IMO and other international organizations (with recognized competence) to promote and advance safe, secure, reliable and environmentally sound shipping, including through: timely completion and implementation of the Polar Code; efforts regarding training requirements for officers and crew of ships operating in polar waters; adoption (as appropriate) of ship routing and reporting measures (including vessel traffic services); and discussions regarding enhancement of weather and ice forecasting and nautical charts to aid navigation. Arctic states should also encourage ratification to enable entry into force and implementation of the BWM Convention and research into BWMSs that are effective in colder settings of polar regions.

(1) **Timely completion and implementation of a Mandatory IMO International Polar Code:** Arctic states should continue their close cooperation in the IMO on this matter to underline the necessity and urgency of protecting Arctic people and the environment in an era of expanding Arctic marine operations.

(2) **Encourage compliance and research regarding Ballast Water Management and Anti-Fouling System Conventions:** Arctic states should support inclusion in the Polar Code's Recommendatory Part B of compliance with the Ballast Water Management Convention as well as the IMO Resolution on Hull Fouling. The Arctic states should also encourage research into ballast water management systems that are effective in colder settings of polar regions and into anti-fouling systems that are durable on ships operating in ice covered waters.

(3) **Address preparedness and response for hazardous bulk chemicals:** In the future, the Arctic Council should, as appropriate, consider addressing preparedness and response with respect to other hazardous chemicals that are being transported by bulk carriers in Arctic waters.

(4) **Enhance cooperation on monitoring and surveillance of Arctic marine traffic and consider an Agreement to this end:** Arctic states should explore options for enhanced cooperation and possibly one or more new agreements or arrangements among themselves – and possibly with others – to collect and share Arctic marine traffic data through such means as LRIT, AIS and IMO approved ship reporting systems.

(5) **Update surveys of indigenous marine use: Arctic states in cooperation with the Arctic Council should** assist, as appropriate, the Permanent Participants with documentation of current and historical a) timing and geographical extent of local uses of the marine environment, and b) levels of traditional marine resources harvests, taking into account the differing documentation needs and capacities of Arctic states.

(6) **Increase Arctic Council collaboration with IMO, IWC and NAMMCO:** Arctic Council should increase collaboration with IMO, IWC and NAMMCO for information sharing and cooperation between their respective working groups and sub-groups on cetacean-related issues, such as ocean noise and ship strikes. Additionally, Arctic states should consider taking more proactive efforts in the IMO, IWC and NAMMCO on these issues, such as by contributing to the IWC ship strike database.

(7) **Advance conservation of Arctic marine ecosystems** by considering management measures in ecologically significant areas of the Arctic Ocean that Arctic states might pursue at the IMO, building on the results of the AMSA Recommendation II (D) Report on Specially Designated Arctic Marine Areas.

(8) **Invest in infrastructure for hydrographic surveys and an observing network:** Arctic states could explore new approaches and partnerships among themselves and with other public and private entities to share the burden of conducting critical hydrographic surveys in the Arctic.

(9) **Enhance passenger ship safety in Arctic waters:** The Arctic Council Working Groups (PAME and EPPR) and the cruise ship industry should explore forming closer links and maintaining a continuing dialogue related to issues of safety, environmental protection and response.

Arctic states should explore the possibility of developing voluntary guidelines and, if appropriate, best practices in implementing such guidelines for sustainable tourism. Moreover, the role the cruise industry plays in facilitating tourism in the region and the impacts of this industry on Arctic peoples, ecosystems, and the environment should be acknowledged. The Arctic Council should also give consideration towards the development of a broader sustainable tourism initiative.

(10) **Support training requirements for seafarers:** Arctic states should support efforts in the IMO in regard to training requirements for officers and crew onboard ships operating in polar waters.

(11) **Potential IMO measures for the Arctic.** Within an appropriate time after the mandatory Polar Code

has been adopted, the Arctic states should explore collaborative approaches to encourage effective implementation, including the possible development at IMO of port state control guidelines.

- ✓ Arctic states should support ongoing work at the IMO to address black carbon emissions from international shipping in the Arctic waters, including considering amendments to MARPOL or other IMO instrument.
- ✓ Arctic states could consider approaches, including at IMO, to address safety and environmental concerns with respect to other types of vessels that, due to their size, routes and nature of activity, may not be subject to the Polar Code.

References

Arctic SAR (Search and Rescue Agreement). 2011. Agreement on Cooperation on Aeronautical and Maritime Search and Rescue in the Arctic, signed by the Arctic Ministers on 12 May 2011 in Nuuk, Greenland).

AMSA. 2009. Arctic Marine Shipping Assessment 2009 Report. Protection of the Arctic Marine Environment, Ottawa, Canada.

Barents Observer. 2011. Record long Arctic navigation season. 18 November 2011.

Barents Observer. 2012a. Towards Cargo record on the Northern Sea Route. 15 October 2012.

Barents Observer. 2012b. 46 vessels through Northern Sea Route. 23 November 2012

Barents Observer. 2012c. LNG Arctic odyssey in times of climate change. 6 December 2012

Brigham, L. 2011. Russia Opens Its Maritime Arctic. U.S. Naval Institute Proceedings 137(5/1), p. 52.

DNV 2011. Sanko makes history on Northern Sea Route: Largest bulk carrier and first Japanese ship is DNV-classed. Det Norske Veritas Publications – Updates (online). www.dnv.com/industry/maritime/publicationsanddownloads/publications/updates/bulk/2011/3_2011/ sankomakeshistoryonnorthernsearoutelargestbulkcarrierandfirstjapaneseshipisdnvclassed.asp

Headland, R. K. 2012. Transits of the Northwest Passage to the End of the 2012 Navigation Season. Cambridge: Scott Polar Research Institute.

IHO (International Hydrographic Organization). 2010. Arctic Regional Hydrographic Commission established in October 2010.

IICWG (International Ice Charting Work Group). 2007. Charter and Terms of Reference, October 2007.

IMO (International Maritime Organization). 2001. Revised Guidelines for Designation of Special Areas under MARPOL73/78 were adopted on 29 November 2001, IMO Resolution A. 927(22).

IMO. 2005. Revised Guidelines for the Designation of Particularly Sensitive Sea Areas. Adopted on 1 December 2005, IMO Resolution A. 982(24).

IMO. 2009. Guidelines for Ships Operating in Polar Waters. Adopted by the IMO General Assembly on 2 December 2009, Resolution A. 1014(26).

IMO. 2010. Report of the IMO Marine Environmental Protection Committee in its 16th Session, MEPC 60/22 (12 April 2010), Annex 10.

IMO. 2011. Expansion of World-Wide Navigational Warning System into Arctic Waters by IMO, WMO and IHO Chiefs.

International Maritime Organization Briefing Paper, 8 March 2011, IMO. 2012a. IMO Design & Equipment Sub-Committee Report to the Marine Safety Committee, DE 56/25 (28 February 2012), Annex 16.2.

IMO. 2013. Data from the IMO Status of Conventions as of 31 January 2013.

Speer, L. and Laughlin, T. 2010. Workshop Report to Identify Areas of Ecological and Biological Significance or Vulnerability in the Arctic Marine Environment, 2-4 November 2010, La Jolla, CA, IUCN and NRDC.

STCW. 2010. Conference of the Parties to the International Convention on Training, Certification and Watchkeeping for Seafarers, 1978. Resolution 11. Measures to ensure the competency of masters and officers of ships operating in polar waters, in: Adoption of the Final Act and Any Instruments, Resolutions and Recommendations Resulting from the Work of the Conference, STCW/CONF.2/32, 1 July 2010, p. 15.

TNASS 2015. Trans North Atlantic Sightings Survey – TNASS (NAMMCO) 2015.


Dreamstime.com

MAREANO/Havforskningsinstituttet

Chapter 4 – Marine Living Resources

For many Arctic states, marine living resources support critical ecosystems, provide an important food source, are economically important and contribute to cultural identity. This chapter focuses on marine living resources and their conservation and management, a discussion that implicates not only the interests of the peoples and cultures who use the resources, but the ecosystems of which they are part. The chapter thus intersects significantly with others in this AOR Final Report, including *Peoples and Cultures, Arctic Pollution, Ecosystem-based Management, Arctic Offshore Oil and Gas, Arctic Marine Operations and Shipping, and Arctic Marine Science*. The first section of this chapter addresses Arctic fisheries, while the second focuses on Arctic seabirds and marine mammals (seals, polar bears, walruses and cetaceans). As reflected in the AOR-I, a wide range of global and regional instruments, as well as domestic and bilateral instruments, address the conservation and management of all these resources.

4.1 Part A: Fisheries Resources

4.1.1 Introduction

Scoping

For the purposes of describing Arctic fisheries, it is important to recognize certain spatial characterizations. Within the Arctic, eighteen Large Marine Ecosystems (LMEs) have been identified, including one that covers the area of the central Arctic Ocean (PAME 2013). These LMEs are not independent or self-contained ecosystems but are inter-connected. Commercial fishing activity now occurs in the North Atlantic and within the exclusive economic zone (EEZ) waters of the Bering and Barents Seas based on abundant resources located in these areas. In the central Arctic Ocean, there is no commercial fishing activity at this time.

According to the 1982 UN Convention on the Law of the Sea (UNCLOS), coastal States have sovereign rights over all marine living resources within their EEZ, which may extend up to 200 nm from their coasts, and sedentary species on their continental shelf also beyond 200 nm. All of the Arctic states have enacted legislation to regulate the utilization of living marine resources and have implemented fisheries management regimes. The national fisheries management frameworks are structured differently in the various states due to constitutional and legal differences, yet each of the relevant states manage the fishery resources within its waters in a manner consistent with local conditions, sustainable development, ecosystem-based management (EBM) and other fisheries management goals, including its obligations under international law.

In international law, a freedom to fish exists on the high seas beyond coastal states' EEZs, subject to limitations in international law. Where fisheries occur in such areas, relevant states are called upon to establish Regional Fisheries Management Organizations or Arrangements (RFMOs/As) to ensure conservation and management of such stocks. However, no pan-Arctic fisheries management agreements exist for the central Arctic Ocean. Commercial fishing is still limited in Arctic marine regions, and most harvesting currently takes place in sub-Arctic ocean areas.

The Resources

Little is known about the potential existence of fisheries resources in the central Arctic Ocean. Commercial fishing is still limited in Arctic marine regions and most harvesting currently takes place in sub-Arctic ocean areas. A meeting of scientific experts on Arctic fisheries in June 2011 reviewed existing data and knowledge on Arctic fisheries and their ecosystems, and identified areas of needed collaborative and independent research among the Arctic coastal states to further understand fish and their ecosystems in the Arctic (Experts Report 2011). Individuals of some of the commercial fish stocks in the Barents Sea, the Bering Sea and areas that border the central Arctic Ocean, have been observed there. While it is possible to identify which commercial species have a potential to colonize the shelf seas of the Arctic Ocean, additional monitoring and research is needed to evaluate these predictions. Several studies conclude that because of high vertical stratification, the primary production of the central Arctic Ocean will remain too low to support commercial fisheries (e.g., Termblay et al. 2012). By contrast, a recent assessment that examined the potential for movement of 17 stocks or stock complexes determined that six stocks or stock complexes have a high potential to exhibit expansions or movement into the Arctic (Hollowed et al. 2013).

> While it is possible to identify which commercial species have a potential to colonize the shelf seas of the Arctic Ocean, additional monitoring and research is needed to evaluate these predictions.

An overlooked aspect of potential exploitation of fish resources in the central Arctic Ocean is the needs to access any potential stocks. Commercial vessels will be subject to challenges regarding vessel construction, design, equipment and training in waters where sea ice may be encountered. However, technologies to overcome these obstacles have been developed by Norway and other Arctic states.

4.1.2 Relevant International Instruments

The UNCLOS applies to the Arctic Ocean in the same manner as it applies to other oceans. The Convention recognizes areas of national exclusive economic jurisdiction (EEZ, extending a maximum of 200 nm) for the purposes, inter alia, of fisheries management; high seas beyond the EEZ; exclusive national authority over the resources of the continental shelf both within and, in some cases, beyond 200 nm; and different navigational rights for all vessels. The Convention prohibits fishing for anadromous species (e.g., salmon) on the high seas, subject to a limited exception. The 1995 UN Fish Stocks Agreement (UNFSA) elaborates on the provisions of the Convention regarding fisheries management, regional cooperation, enforcement of management measures and dispute resolution.

The principal approach to circumscribing high seas fishing rights is through RFMOs/As. These organizations generally manage fishing activity for stocks that "straddle" the areas of national jurisdiction and the high seas or for the entire range of stocks both within and beyond waters under national jurisdiction that are "highly migratory" (e.g., tuna). Measures adopted by RFMOs/As bind only their member states, although states that are party to the UNFSA are also obligated to respect the regulatory authority of RFMOs/As, including by agreeing to apply relevant conservation and management measures established by RFMOs/As.

Although no pan-Arctic fisheries management agreement exists for the central Arctic Ocean, relevant regional fisheries bodies exist for parts of the high seas areas of the Arctic and sub-Arctic: the Northwest Atlantic Fisheries Organization (NAFO), the North Atlantic Salmon Conservation Organization (NASCO) and the North East Atlantic Fisheries Commission (NEAFC). NEAFC has regulatory authority in the high seas areas of the Norwegian Sea, the Barents Sea and part of the Arctic Ocean north of the Atlantic. Although no specific management measures have been adopted for the central Arctic Ocean, all general management measures in NEAFC also apply in its northern most regulatory area.

Fishing activities on the high seas respecting:

- ✓ stocks not covered by an RFMO (or an equivalent arrangement); or
- ✓ stocks covered by an RFMO to which the flag State of the vessel engaged in the fishing activity is not internationally obligated to adhere; or
- ✓ "discrete" stocks (stocks primarily located in a high seas area that are not straddling or highly migratory stocks)

are subject to general obligations under Articles 63-64 and 118-119 of the UNCLOS respecting conservation of stocks. States that are party to the 1993 Food and Agriculture Organization (FAO) Compliance Agreement are to require all their fishing vessels to have licenses/permits for fishing on the high seas and to ensure that their vessels "do not engage in any activity that undermines the effectiveness of international conservation and management measures."

Articles 8(5) and 6(6) of the UNFSA require the following for high seas areas:

> *Article 8(5):* *Where there is no subregional or regional fisheries management organization or arrangement to establish conservation and management measures for a particular straddling fish stock or highly migratory fish stock, relevant coastal States and States fishing on the high seas for such stock in the subregion or region shall cooperate to establish such an organization or enter into other appropriate arrangements to ensure conservation and management of such stock and shall participate in the work of the organization or arrangement.*
>
> *Article 6(6):* *For new or exploratory fisheries, States shall adopt as soon as possible cautious conservation and management measures, including, inter alia, catch limits and effort limits. Such measures shall remain in force until there are sufficient data to allow assessment of the impact of the fisheries on the long-term sustainability of the stocks, whereupon conservation and management measures based on that assessment shall be implemented. The latter measures shall, if appropriate, allow for the gradual development of the fisheries.*

While the UNFSA applies to fish stocks beyond areas under national jurisdiction, Articles 6 and 7, which deal with the precautionary approach, also apply to areas within national jurisdiction.

Other relevant international instruments applicable to the central Arctic Ocean include several FAO agreements, action plans and guidance documents. Although not an international treaty, an important international instrument is the 1995 FAO Code of Conduct for Responsible Fisheries. The Code is supported by international action plans, among them the 2001 FAO International Plan of Action to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing (IPOA – IUU). "Unregulated fishing," as defined in the 2001 IPOA-IUU, does not mean all fishing activity on the high seas where no RFMO or other management arrangement exists. "Unregulated fishing," which states undertake to deter, is defined as fishing done in areas or for fish stocks for which there are no applicable conservation or management measures "and where the activities are conducted in a manner inconsistent with state responsibilities for the conservation of living marine resources under international law." (FAO 2001, para. 3.3.2 and see para. 3.3.3)

Also under FAO auspices, the 2009 Port State Measures Agreement, when it comes into force, will require its Parties to deny a vessel to land or transship fish in its ports where the fish has been harvested through IUU fishing. Under the 1993 Compliance Agreement, Parties are to take measures to ensure the compliance of vessels flying their flag with relevant management measures. The FAO has also adopted International Guidelines for the Management of Deep Sea Fisheries in the High Seas (2009), and has recently concluded Voluntary Guidelines for Flag State Performance (2013), still to be adopted by the FAO.

Many fish stocks in the Arctic are transboundary in nature and thus shared between countries. This requires bilateral or trilateral cooperation for their management in addition to the multilateral instruments mentioned above. A large number of such bi and trilateral arrangements exist to facilitate management, cooperation, and scientific research and exchange.

4.1.3 Cooperation to address challenges

With respect to fisheries resources in the Arctic Ocean, more scientific information is needed. As the Arctic has difficult conditions in which to operate, covers a vast area, and has few (and often remote) ports, the conduct of research and collection of scientific information can be challenging. Baseline data to measure change is particularly important. The June 2011 meeting of scientific experts on fish stocks in the Arctic Ocean reviewed current information and data on fish stocks, as well as their ecosystems and patterns of migrations, and reviewed on-going and planned scientific activities. It also identified pan-Arctic research priorities, including improved monitoring, enhanced understanding of productivity of key species and of life stage and habitat linkages, and development of ecological models to predict changes in fish populations (Experts Report 2011). Consideration should be given to follow-up on the recommendations from this meeting. Identifying when and if fish stocks will expand or move into the Arctic in quantities sufficient to make them economically viable is a scientific challenge.

Arctic states already promote scientific cooperation and encourage that any fishing activities must be based on the best scientific knowledge available. The International Council for the Exploration of the Sea (ICES) promotes and coordinates marine research in the North Atlantic Ocean, the North Sea and Baltic Sea. In 2012, the ICES decided to enhance its scientific activities in Arctic waters. Similarly, the North Pacific Marine Science Organization (PICES) promotes and coordinates marine research in the northern North Pacific and adjacent seas, especially northward of 30 degrees North. This cooperation could be expanded to include aspects of the Arctic Ocean. Further meetings and cooperation of scientific experts on fish stocks and other related matters in the Arctic Ocean should be encouraged, including cooperation to enhance efforts in data collection, modeling and analysis.

4.1.4 Opportunities for Cooperative Action

Arctic states recognize the need to move with great care regarding exploratory and commercial fishing activities in Arctic marine areas, consistent with current practice in the sub-Arctic areas where commercial fisheries are generally well managed and sustainable. However, the Arctic Council is not a body that regulates fisheries. The global framework of fisheries instruments mandates that regional fisheries management organizations and arrangements, and bilateral fisheries instruments, play a lead role in the management of straddling, highly migratory and transboundary stocks. A number of fora therefore exist to manage most current Arctic fisheries. Critical to implementation of internationally agreed management measures, all Arctic states have laws and policies that apply to fishery resources and their national fishing vessels.

Opportunities relevant to fisheries within national jurisdiction can be distinguished from opportunities in relation to potential fishery resources in the central Arctic Ocean. As pointed out above, currently there are no known significant fish stocks of commercial viability in the central Arctic Ocean. Scientific research to date indicates some of the difficulties associated with supporting commercially viable stock in the central Arctic Ocean such as low primary production, habitat limitations, distance to spawning grounds, and bathymetric characteristics, such as depth. Transboundary stocks of living marine resources are in most cases managed by regional and bilateral bodies. The performance of such bodies should be measured against transparent criteria and take into account best practices of RFMOs/As, including those criteria used in performance reviews by a number of RFMOs/As.

Several models exist for Arctic states to address high seas fisheries management based on existing domestic practices and policies. As a precautionary approach, the United States has adopted a closure of commercial fishing in its waters north of the Bering Strait until there is appropriate science and management in place. Canada's *New Emerging Fisheries Policy* establishes three types of licenses for three different stages in the development of a new fishery (feasibility, exploratory, and commercial), and relies on establishing a scientific base against which stock responses to new fishing pressures can be assessed. In the Northeast Atlantic, Norway and Russia manage the major fisheries in the Barents Sea under a bilateral cooperation that has existed for nearly four decades. Norway prohibits Norwegian flagged fishing vessels to engage in fishing in unregulated areas outside national jurisdiction. Other relevant measures include various forms of time or area-based regulations (such as temporary restrictions in areas), gear limitations, and catch limits. Arctic states, as parties to the UNFSA, are required to ensure that any fishing on the high seas is consistent with its provisions and occurs only pursuant to one or more regional or sub-regional fisheries management organizations or arrangements.

Despite the current lack of evidence of straddling or highly migratory fish stocks in the central Arctic Ocean, there have been calls to establish one or more management mechanisms in this area. Establishing management mechanisms in advance and/or at the commencement of sustainable commercial fisheries is important. In order for sustainable resource management to occur, scientific knowledge of the area and fish stocks would be required, which could be facilitated through coordinated scientific research.

Opportunities exist for the Arctic states to engage collectively or bilaterally in cooperative research and scientific study and exchanges of information, building on the existing scientific cooperation described in section 4.1.3, above.

The establishment of a treaty-based body focusing on the promotion and cooperation of high seas fisheries research - and perhaps also within areas of national jurisdiction - similar to PICES or ICES could be an option. PICES was created by the 1992 Convention for a North Pacific Marine Science Organization and ICES was established in 1902 and formalized by the 1964 Convention for the International Council for the Exploration of the Sea. An even less formal structure for the same purpose could be the establishment of a scientific committee perhaps modeled on the International Scientific Committee (ISC) for Tuna and Tuna-like Species in the North Pacific, which was initialized in 1995. A specific purpose of the ISC is to "establish the scientific groundwork" for a possible tuna-based RFMO in the North Pacific Ocean. In contrast to the central Arctic Ocean, at the time PICES and ICES were created there was, and continues to be, significant active research in those regions. Discussions regarding the need and timing with respect to utilizing or establishing a multilateral scientific body for the Arctic are ongoing.

Three broad areas of opportunities for cooperative action are as follows:

Part A: Fisheries Resources

(1) Fisheries resources should be managed in accordance with the law of the sea, relevant fisheries agreements and modern principles of fisheries management, including the precautionary and ecosystem approaches, also being mindful of the interests of the indigenous peoples of the Arctic.
(2) Fisheries resources should be managed based on the best scientific knowledge available, and necessary scientific understanding should be enhanced, including on changes in fish stocks.
(3) Fisheries resources in areas beyond national jurisdiction should be managed based on cooperation in accordance with international law to ensure long term sustainability of fish stocks and ecosystems.

4.2 Part B: Marine Mammals and Seabirds

4.2.1 Introduction

Seabirds and marine mammals (including polar bears, walruses, seals and cetaceans) are a prominent element in Arctic marine ecosystems. Although the fauna of high latitudes tend not to be high in species diversity, this is not true of either seabird or pinnipeds, both of which reach their greatest diversity in polar regions (Gaston 2004). Many species of air-breathing vertebrates retreat from Arctic waters in winter, migrating back as the ice clears away in early summer. The annual expansion and contraction of polar sea ice places a premium on mobility, and seabirds and marine mammals, being capable of long migrations, are especially well-adapted to make use of the opportunity for feeding presented by the polar summer. While marine mammals shift principally to low Arctic or subarctic waters in winter (except polar bears and six species of seals), seabirds may range anywhere on the planet outside the northern summer, with several species wintering south of the equator. Changing Arctic conditions due to climate change will likely affect the seasonal distribution and abundance of Arctic species.

4.2.2 Status and Trends

Conservation statuses and classifications for marine mammals and seabirds as defined by international agreements and other processes, such as the International Union for the Conservation of Nature (IUCN) Red List and the Convention on Trade in Endangered Species (CITES) appendices, vary across the Arctic seabird and marine mammal species.

The Arctic Council collects and disseminates information on status of and trends in Arctic biodiversity through CAFF's Circumpolar Biodiversity Monitoring Program (CBPM as described in Sidebar 4.1). Additionally, with respect to marine mammals, IWC and NAMMCO have criteria for defining species stock status. The IWC, as an international Commission, has competence over large whales globally, including the Arctic regions, and NAMMCO, as a regional body, has competence over various North Atlantic cetaceans (large and small) and pinniped species (including walruses), many of which exclusively inhabit the Arctic. Both the IWC and NAMMCO are concerned with species status from the regional stock/population perspective and regularly and periodically undertake stock assessments through their scientific committees. Regional assessments (e.g., IWC and NAMMCO) and global assessments (e.g., IUCN and CITES) may use different criteria and may therefore indicate different conservation statuses for some populations (e.g. North Atlantic fin whales) as discussed in AOR Phase 1 section 2.3.2.

Marine Mammals

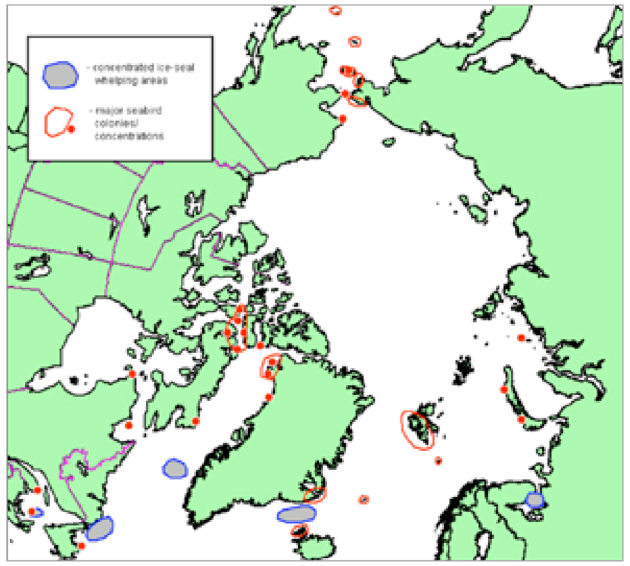
There are ten species of pinnipeds – including true seals (seven species), fur seals, sea lions and walrus – within the circumpolar Arctic. Most of these are more or less resident, although harp seals undertake lengthy migrations to whelping areas in the low and subarctic, possibly to escape predation by polar bears (Lavigne & Kovacs 1988). Hooded seals make similar, although shorter, migrations (Riedman 1990). Information on population trends among seals is variable in quality. Those species subject to commercial harvest, for example, are well monitored, whereas other species, especially those without concentrated whelping areas, are poorly understood. Harp seals have recovered from low populations in the 1950s and are currently the most numerous seal species in the northern hemisphere (Kovacs 2008b). In contrast, northern fur seals have been declining since the 1970s and are now at less than 50 per cent of their former population size (Towell et al. 2006).

Sidebar 4.1 – CAFF's Circumpolar Biodiversity Monitoring Program

CAFFs Circumpolar Biodiversity Monitoring Program (CBMP) is an international network of scientists, government agencies, indigenous organizations and conservation groups working to harmonize and integrate efforts to monitor the Arctic's living resources (CAFF 2012). A key objective of the CBMP is to create a publicly accessible platform for collecting and disseminating information on the status of and trends in Arctic biodiversity. Towards this objective, the CBMP has developed the Arctic Biodiversity Data Service, an online platform for discovering and accessing data on the Arctic's biodiversity (CAFF 2013).

The Arctic Marine Biodiversity Monitoring plan (Gill et al. 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.

www.caff.is/monitoring



Baffin Bay-Lancaster Sound; Ungava Bay; W Hudson Strait; Spitsbergen, W coast Novaya Zemlya; Bering Strait islands; Pribilof Islands; NW Iceland; Bear Island; W Greenland; Labrador front (Harp seal), S Davis Strait (Hooded seal); Foxe Basin (Atlantic walrus)
Interactive maps are available at http://axiom.seabirds.net/maps/circumpolar-seabirds/

Polar bears occur everywhere that seals are found on sea ice and retain the majority of their historic range to date. Such inter-relationships between species underline a central theme of AOR Final Report, namely the need for an ecosystem approach to managing activities in the Arctic marine environment. The polar bear is a large, specialized ice-seal predator and largely dependent on annual sea ice. Although basically resident on sea ice, polar bears also form seasonal aggregations on land in areas such as Canada's Hudson Bay, where sea ice disappears during the summer (Peacock et al. 2010). In specific denning areas, pregnant females lie up during the middle of winter to give birth and, in early spring, there are above-average concentrations of families comprising a mother with one or more first-year cubs (Peacock et al. 2010). While polar bears may consume a variety of foods (e.g., bird eggs, berries, and other vegetation) while on land (Stirling, 2011), they can be considered specialized predators of seals.

Polar bear populations have remained fairly stable over recent years and decades, although individual subpopulations may be declining and data are not sufficient to evaluate trends for some populations (Obbard et al. 2010). Climate change is considered the major threat to polar bears, with warming temperatures leading to reduced time, extent and depth of the annual sea ice on which polar bears are so dependent (Stirling & Derocher 2012).

The walrus hauls out frequently on sea ice, although it gives birth in the water. It also hauls out regularly on land after annual sea ice has cleared (Riedman 1990). The walrus is listed on CITES Appendix III, which includes all species that "any Party identifies as being subject to regulation within its jurisdiction for the purpose of preventing or restricting exploitation, and as needing the co-operation of other Parties in the control of trade" (CITES article II, para. 3).

Seventeen species of cetaceans are found within the Arctic, many with wide and often circumpolar distributions. While the number of species in various groups of Arctic animals may be low compared to warmer latitudes, patterns of high 'within-species' variability exist for many, often in the form of distinct subspecies in various parts of the Arctic area. Many species have different subspecies in the Atlantic and Pacific sectors (e.g., minke whales). Blue whales, humpback whales, fin whales and sei whales have different subspecies in the northern and southern hemispheres, and different subpopulations within the North Atlantic and North Pacific.

The CAFF working group has established an expert network on marine mammals as part of the CBMP (Sidebar 4.1).

Seabirds

Among the nearly 300 species of seabirds worldwide, more than 30 breed in the Arctic (Ganter & Gaston, in press,), some of which reach their greatest diversity in the Arctic and subarctic. Some Arctic-breeding species are among the most numerous seabirds in the world, having populations in excess of 10 million (ABA, in press). All seabirds shift their range between summer and winter, with the exception of a few low Arctic populations. Some species are trans-equatorial migrants, wintering in tropical or temperate waters of the southern hemisphere or sub-Antarctic waters. These species are vulnerable to changes that occur outside the Arctic and beyond the jurisdiction of the Arctic states.

Many seabirds gather in large, dense aggregations at certain times of the year and are highly vulnerable to point source disturbance and pollution events during those times (Heubeck et al. 2003). Colony sites tend to be constant from year to year, with some seabird colonies having persisted in the same location for centuries (Gaston & Donaldson 1996). Birdlife International has identified a network of Important Bird Areas, based on specific population criteria (www.birdlife.org/action/science/sites/). Those based on marine bird populations provide an excellent summary of sensitive breeding sites across the Arctic.

Most seabirds inhabiting Arctic waters are found in the peripheral seas (Barents Sea, Beaufort Sea, Kara Sea and waters of the Canadian archipelago) and principally in continental shelf waters. The central Arctic Ocean supports relatively few seabirds. One exception is Ross's gull *Xema sabini*, which migrates into the Arctic Ocean for a period in late summer and fall (Hjort et al. 1997). Increased dispersal and colonization of new breeding areas by seabirds is likely as Arctic summer sea ice continues to retreat.

The Arctic Council addresses seabird conservation issues through the CAFF Circumpolar Seabird Expert Group (CBird).

4.2.3 Relevant International and Regional Instruments

Seabirds and Marine Mammals

CITES. The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) is an important international instrument with the aim of ensuring that international trade in specimens of wild animal and plant species does not threaten their survival, including Arctic marine mammals and seabirds. All Arctic states (Canada, Denmark including the Government of Greenland, Finland, Iceland, Norway, Russia, Sweden and the United States) are party to CITES. Because it concerns international trade, CITES does not apply to limited situations in which products from species taken domestically are for domestic consumption only. It becomes highly relevant, however, when a CITES-listed species (or its products or derivatives) is intended to cross an international border. Under CITES, species and geographical populations are subject to listing in one of three appendices. The goals of monitoring and regulation are achieved through a system of permits and certificates for export or import, issued by national governmental authorities, and based upon criteria set forth in the articles of CITES. All species of cetaceans are listed in CITES appendices and are therefore subject to CITES requirements. In addition, since 1979 the CITES Conference of the Parties has adopted several resolutions regarding cetaceans and the relationship with the IWC, the current version of which is Resolution Conf. 11.4 (Rev. CoP12), which among other things calls for CITES member states to honor IWC restrictions on whaling and the trade of whale products. This latest resolution remains in effect. However, some Arctic states conduct whaling, of which some also have a reservation under CITES regarding certain cetacean populations and are therefore treated as States not Party to CITES with respect to trade in specimens of those populations, while the Faroe Islands are not bound by the CITES Convention. A CITES reservation is a unilateral statement by a country, stating that it will not be bound by the provisions of the Convention relating to trade in a particular species. Consistent with resolutions adopted by the CITES Conference of the Parties, species on Appendix I of CITES are treated as if they were on Appendix II to the extent they are subject to a reservation.

Seabirds

A mechanism to address seabird conservation issues is established within the CAFF CBird expert group with an overall goal to promote, facilitate, coordinate and harmonize seabird conservation, management and research activities among circumpolar countries, as well as to improve communication between seabird scientists and managers in and outside the Arctic. This ad hoc working group, active since 1993, has produced several reports on the status of Arctic seabirds and on specific threats to their populations (www.caff.is/expert-group-documents/view_category/16-circumpolar-seabird-expert-group-cbird). Recently, it devised several online tools to enable timely tracking of seabird populations and reproductive success (www.caff.is/seabirds-cbird/seabird-information-network).

Many existing threats to seabirds occur in their wintering areas outside the Arctic (ABA, in press). A number of international conventions aim to protect the year-round habitat of migratory species and promote cooperation among range states and countries.

CAFF cooperation with other international agreements. In 2012, CAFF signed non-binding Resolutions of Cooperation with the secretariats of two international agreements: the African-Eurasian Waterbird Agreement and the Ramsar Convention (The 1971 Convention on Wetlands of International Importance, especially as Waterfowl Habitat) to build and share knowledge, and create awareness regarding matters of common concern. As neither CAFF nor the Arctic Council possess international legal personality, these resolutions are without legal effect,

Convention on the Conservation of Migratory Species of Wild Animals. One habitat protection convention relevant to the Arctic is the 1979 Convention on the Conservation of Migratory Species of Wild Animals, to which Denmark, Norway and Sweden are the only Arctic states that are party.

Marine Mammals

NAFO/ICES. The Northwest Atlantic Fisheries Organization (NAFO) is an intergovernmental fisheries science and management body. It works with ICES to provide advice on the management of harp and hooded seals in the Atlantic through a joint NAFO/ICES working group.

Polar Bears. The 1973 Agreement on the Conservation of Polar Bears was the first agreement to which all five Arctic coastal states (Canada, Norway, Denmark/ Greenland, Russia and the United States) were party. In addition, a Polar Bear Specialist Group operates under the IUCN to provide guidance and recommendations on polar bear conservation in support of this Agreement.

IWC. The International Whaling Commission (IWC) was set up under the International Convention for the Regulation of Whaling (ICRW). All Arctic states, except Canada, are among the 89 member governments of the IWC. The Convention's purpose is to provide for the conservation and utilization of large whale resources and the management of whaling, covered by the Convention. The Commission reviews and revises, as necessary, measures in the Convention's Schedule that concern the conservation and utilization of large whale resources. Among other things, these measures provide for the complete protection of certain species; designate specified areas as whale sanctuaries; and set limits on the numbers and size of whales that may be taken.

The IWC is responsible for setting catch limits for commercial whaling. However it currently has a commercial whaling moratorium in place. Norway and Iceland have, registered respectively, an objection and a reservation to the moratorium decision. Both countries establish their own catch limits but must provide information on those catches and associated scientific data to the Commission. The Russian Federation has also registered an objection to the moratorium decision but does not exercise it. Canada is not a commercial whaling nation.

The IWC also addresses aboriginal subsistence whaling (ASW), and three Arctic states have historically received ASW catch limits: Denmark/Greenland, the Russian Federation and the United States. Since its inception, the IWC has acknowledged that ASW is of a different nature than commercial whaling and is therefore not subject to the moratorium.

NAMMCO. The Agreement on Cooperation in Research, Conservation and Management of Marine Mammals in the North Atlantic entered into force in 1992. It established a regional organization, the North Atlantic Marine Mammal Commission (NAMMCO). The Parties to the Agreement are the Faroe Islands, Greenland, Iceland and Norway, with Canada, Denmark, the Russian Federation and Japan participating as observers.

NAMMCO's geographical scope is the North Atlantic. Its objective is to contribute through regional consultation and cooperation to the conservation, management and study of marine mammals, including large whales, smaller cetaceans and pinnipeds in the NAMMCO region. NAMMCO has been instrumental in the management of cetaceans in NAMMCO countries by providing scientific management advice both on larger species (minke, fin, and humpback whales) and, in particular, on medium-sized and small cetaceans that are not covered by the IWC. With respect to Arctic species, NAMMCO cooperates with the Joint Canada Greenland Commission on Narwhal and Beluga (JCNB) via a joint scientific working group on narwhal and beluga, with the mandate to provide management advice. In addition, NAMMCO provides management advice on seals and walruses, a particularly important service for Greenland.

Sidebar 4.2 – Cetacean Density and Distribution Mapping

In 2011, NOAA (the U.S. National Oceanic and Atmospheric Administration) convened the CetMap Working Group to produce cetacean density and distribution maps. The project aims to produce maps for U.S. waters that are time- and species-specific, and that estimate density using predictive environmental factors. CetMap has identified a hierarchy of preferred density and distribution model or information types, conducted a cetacean data availability assessment, modeled or re-modeled density, created standardized GIS files from new and existing modeling results and created a NOAA website interface to organize the datasets and maps, make them searchable by region, species, and month and provide the files for download.

CetMap also identifies Biologically Important Areas (BIAs) where cetacean species or populations are known to concentrate for specific behaviors, or be range-limited to assist resource managers in planning how reduce adverse impacts to cetaceans resulting from human activities.

http://cetsound.noaa.gov/cetacean.html

UNCLOS. The United Nations Convention on the Law of the Sea (UNCLOS)) did not create specific provisions for the regulation of whaling, but does contain sections relevant to cetaceans. Article 64 provides for the conservation of highly migratory species (HMS) and Annex I identifies cetaceans as HMS. Specifically, Article 64 calls on the coastal State and other States whose nationals harvest HMS to cooperate directly or through appropriate international organizations to ensure conservation and the promotion of optimum utilization of HMS, both within and beyond EEZs. In regions for which no appropriate international organization exists, the coastal State, and other States whose nationals harvest HMS in the region, shall cooperate to establish such an organization and participate in its work.

Article 65 of the UNCLOS applies specifically to marine mammals. Article 65 reads: *"Nothing in this Part restricts the right of a coastal State or the competence of an international organization, as appropriate, to prohibit, limit or regulate the exploitation of marine mammals more strictly than provided for in this Part. States shall co-operate with a view to the conservation of marine mammals and in the case of cetaceans shall in particular work through the appropriate international organizations for their conservation, management and study."*

IMO. The International Maritime Organization (IMO) is the United Nations' specialized agency with responsibility for the safety and security of shipping and the prevention of marine pollution by ships. A number of legally binding and non-legally binding IMO instruments are relevant for shipping in the Arctic. Some potentially relevant measures are presented in the General Provisions on Ships Routing, the Particularly Sensitive Sea Areas Guidelines, the Guidelines for Ships Operating in Polar Waters, and the Guidance document for minimizing the risk of ship strikes with cetaceans. In addition, two IMO processes now underway are relevant to Arctic cetaceans: the development of a binding Polar Code and the development of voluntary technical guidelines considering ship quieting technologies, both of which are discussed in Chapter 3, sections 3.3.5 and 3.3.6.

4.2.4 Challenges

Most of the regulatory and policy work for the management and conservation of Arctic seabirds and marine mammals is currently addressed and conducted through existing international and regional instruments or organizations such as the IWC, IMO, IUCN, UNCLOS, CITES, NAFO and NAMMCO, and by Arctic states' domestic instruments and bilateral agreements. Opportunities exist, however, for the Arctic Council to be more proactive in addressing the most pressing conservation issues that face Arctic seabirds and marine mammals. These include knowledge on climate change, changes in sea ice, increased marine operations and pollution. Some of these issues are covered in depth in other chapters, including Chapter 3, *Marine Operations and Shipping, Chapter 5, Arctic Offshore Oil and Gas, and Chapter 6, Arctic Marine Pollution*.

Climate Change and Diminished Sea Ice

Until recently the main threat to Arctic seabirds and marine mammals was over-harvesting (Meltofte et al. 2013, ABA, Synthesis). In the past few decades, however, climate change has emerged as a growing threat to seabirds and marine mammals, both directly, through earlier break-up and reductions in total extent of sea ice (Parkinson & Cavalieri 2008, Perovich & Richter-Menge 2009), and indirectly through changes in the food web, prey species and facilitation of developments such as mineral exploitation, increased shipping, tourism and new potential commercial fisheries in previously untouched areas (ABA, SWIPA). These changes impact Arctic marine ecosystems, affecting the structure of the ice platform, the timing of biological events like plankton blooms and bird nesting, the amount of primary production (Arrigo et al. 2011, Arrigo et al. 2008, Popova et al. 2012), and the availability of open water at different times of year.

Possible effects on Arctic marine mammals were among the first biological signals of climate change to be identified (e.g., Stirling & Derocher 1993, Tynan & DeMaster 1997). Ice-associated Arctic marine mammals are of particular concern because of the current rapid changes in Arctic summer sea ice extent (e.g., ACIA, 2005, SWIPA 2011). The reduction in total sea ice area diminishes the habitat available for whelping and other hauling out activities, and may also affect the timing of food flushes resulting from changes in the balance of under-ice and pelagic primary production along with the associated food webs (Moline et al. 2008). As ice conditions continue to change, it is anticipated that vital rates such as fertility and mortality will also be affected.

Decadal patterns of sea ice variation suggest that changes in recent years are likely to impact resident marine mammal populations at regional and hemispheric scales (Barber & Iacozza 2004), and that seals that whelp on ice in spring are likely to be the most susceptible to changing ice conditions. Reduced sea ice can also lead to increased predation of seals, including, for example, increased incursion into Arctic water by killer whale pods (Ferguson 2009, Higdon & Ferguson 2009, SWIPA). These feed mainly on whales but also take seals (Ferguson et al. 2010). Although the proportion of local seal populations killed by killer whales is probably small, the effect of their presence may alter the seals' feeding habits and distribution (the "landscape of fear" effect).

Polar bears feed mainly on ice-associated seals and consequently are dependent on sea ice as their primary hunting platform. Early ice-break up and delayed freeze-up has reduced the duration of sea-ice, causing bears to spend more time ashore. This can lead to reductions in reproductive rates, cub and adult survival rates, and population size (Stirling et al. 1999, 2004, Parks et al. 2006, Stirling & Parkinson 2006), as well an increase in the number of defense kills from human-bear interactions (e.g., Towns et al. 2009, Clark et al. 2012). In East Greenland, bears are now smaller than they were some decades ago, perhaps because of a reduction in the availability of prey (Pertoldi et al. 2009). As multi-year ice becomes less extensive, polar bears make less use of this habitat for denning and increasingly den on land (e.g., Fischbach et al. 2007).

Earlier ice clearance, causing bears to come ashore earlier in the summer, has led to increased predation on nesting birds, especially those breeding in large colonies (Rockwell & Gormezano, 2009, Smith et al. 2010). Although the number of bears involved is small and the effect of augmentation of food supplies for bears is likely to be negligible at the population level, such predation can have strong effects on the breeding success of the birds (Rockwell et al. 2011), perhaps leading to changes in breeding sites and nest dispersion (Gaston and Elliott, in press). Timing of ice break-up is also known to have a strong effect on the success of breeding for some seabirds, and has been implicated in population declines (Gaston et al. 2005a, Byrd et al. 2008a,b). Conversely, in more high Arctic areas, early ice break-up has been associated with earlier breeding and enhanced reproductive success for some seabird species (Gaston et al. 2005b).

Pollution

Pollution in the Arctic is a well-recognized challenge, with biomagnification being of particular concern with regards to Arctic marine mammals and seabirds. Polar bears, situated at the top of a lengthy food chain (primary producers, copepods, larger zooplankton, Arctic cod, seal), are the recipient of highly biomagnified contaminants (e.g., McKinney et al. 2010). Several species of gulls are positioned at similarly high levels on the food chain, as a result of feeding on seabird eggs and chicks, as well as scavenging on polar bear kills and seal afterbirths. Levels of organochlorine contaminants have been identified as a cause of adult mortality in some seabird species (Bustness et al. 2003) and high levels of mercury may be implicated in the decline of ivory gulls in Canada (Braune et al. 2006). More detailed information appears in Chapter 6, *Arctic Marine Pollution*.

Increased Marine Operations

As described in Chapter 3, *Arctic Marine Operations and Shipping, shipping patterns are expected to alter as the Arctic climate continues to change. For example, changing sea ice conditions in the Arctic will inevitably bring greater ship traffic (PAME, AMSA 2009). With increased ship traffic also come increased risks to Arctic seabirds and marine mammals through* more ocean noise, the introduction of alien invasive species through ballast water, the possibility of oil spills, and increased possibility of ship strikes.

Although there are few known incidents of collisions between ships and cetaceans in the Arctic, as ship traffic increases some species may be affected. It is very likely that seasonally migrant Arctic cetaceans will range farther north and perhaps stay longer if current trends in sea ice reduction continue. For example, fin, humpback, minke, gray, and killer whales seem especially poised for such opportunity (Moore et al. 2008). Other species, such as the bowhead whale, may be able to migrate to other areas, through new routes previously inaccessible due to ice (Heide-Jørgensen et al. 2012). The most effective way to reduce collision risk is to keep marine mammals and ships apart. Reducing such risk relies on good data and an understanding of the seasonal patterns of marine mammal distribution, as well as consideration of practicable alternative routes for shipping. The movements of marine mammals are not always predictable and their distribution is becoming less predictable with climate change. Nevertheless, regional actions can be taken to increase data on seasonal movements and residence areas, develop Arctic ship traffic monitoring and surveillance, establish traffic routing schemes, and define potential Arctic marine protected areas such as IMO Particularly Sensitive Sea Areas (PSSAs).

With respect to oil spills in marine waters, seabirds are among the organisms most severely affected (Heubeck et al. 2003). More than 300,000 seabirds were estimated killed by the Exxon Valdez oil spill in the subarctic waters of Prince William Sound, Alaska (Piatt et al. 1990). Even small, chronic spills that result from everyday ship discharges and routine oil operations were estimated to kill 300,000 murres and little auks annually off Newfoundland in the 1990s (Wiese & Robertson 2004). Seals are also vulnerable to oil pollution, especially when confined by the demands of whelping (SWIPA 2011).

Developments in offshore drilling technology, along with extended open water seasons, have led to increased interest in oil and gas activities in Arctic marine waters. However, responding to spill incidents in ice-affected waters presents a number of technical and logistical challenges. Moreover, the extremely aggregated distribution of many marine organisms, especially the very large colonies of seabirds that are particularly vulnerable to oil spills, indicate the importance in examining proposals for offshore oil developments with great care, and of locating development at a distance from seabird colonies and seal whelping areas. Since 2010, the Arctic Council has been negotiating a binding Agreement on Cooperation on Marine Oil Pollution Preparedness and Response in the Arctic, which is expected to be signed at the 2013 Ministerial. The Agreement will contain provisions regarding pollution preparedness and response, notification of other Parties and interested states of oil pollution incidents, the monitoring of Arctic maritime areas for possible oil pollution incidents, facilitating information exchange and assistance in oil spill preparedness and response operations, coordinating joint response operations and cooperating in joint exercises and reviews of operations.

4.2.5 Opportunities for Cooperative Action

Measures that can be put into place to address several of the conservation threats identified above can include protection from direct and indirect interactions with fisheries, clean-up of existing contaminants and prevention of further contamination, protection of key reproductive habitat, measures to reduce ship strikes such as vessel corridors, speed limits and observer programs, regulations on increased human activity such as oil and gas and coastal development, and marine protected areas.

In addition, objective indicators are needed against which to measure population or habitat loss, and to assist in assessing trends and measure conservation effectiveness. Recognizing that data for Arctic seabirds and marine mammals are often difficult to obtain, it is essential that basic indicators be identified, such as sea ice extent, population trends in well-studied seabird and marine mammal species, or health and reproductive trends, and that efforts be made to better study and monitor lesser known species. Monitoring of populations and stocks is also essential to understand their response to the cumulative impact of all risk factors. CAFF's CBMP is an important step in this direction, with its indices and indicators designated to provide a comprehensive picture of the state of Arctic biodiversity, from species to habitats to ecosystem processes to ecological services.

Specific opportunities could include:

Part B: Marine Mammals and Seabirds

(1) **Increase Arctic Council collaboration with IMO, IWC and NAMMCO:** The Arctic Council, IMO, IWC and NAMMCO should increase information sharing and cooperation between their respective working groups and sub-groups on cetacean-related issues, such as ocean noise and ship strikes, and consider Ecosystem-based Management (EBM). Additionally, Arctic states have the opportunity to be more proactive in the IMO, IWC and NAMMCO on these issues such as by contributing to the IWC ship strike database.

(2) **Collaborate and cooperate with the IWC on its cetacean ship strike database as necessary/ appropriate:** Arctic states have the opportunity, both independently and collectively, to contribute to the IWC's ship strike database. The IWC has developed a standardized global database of collisions between vessels and whales that includes information on whales (e.g., species, size, observed injuries) and vessels.

(3) **Finalize the IMO Polar Code: Arctic states should work together closely on the Polar Code and encourage their IMO delegations to increasingly cooperate in this regard. The mandatory Code is expected to replace existing non-mandatory guidelines for** ships operating in Arctic ice covered waters. It is expected to cover the full range of design, construction, equipment, operational, training, search and rescue, as well as environmental protection matters relevant to ships operating in Antarctic and Arctic waters. Additional recommendatory measures would address such things as vessel voyage planning to avoid and minimize interaction with cetaceans.

(4) **Promote the IMO Ballast Water Management Convention:** The IMO's International Convention for the Control and Management of Ship's Ballast Water and Sediments (the Ballast Water Management Convention) was adopted by the IMO in 2004. Five of the eight Arctic states have ratified it, and the remaining Arctic states should consider doing so. The Ballast Water Management Convention is important to controlling the introduction of alien, invasive species to the Arctic marine environment.

(5) **Implement the Arctic Agreement on Cooperation on Marine Oil Spill Preparedness and Response,** expected to be signed at the 2013 Ministerial.

(6) **Advance conservation of Arctic marine ecosystems,** by considering management measures in ecologically significant areas of the Arctic Ocean that Arctic states might pursue at the IMO, building on the results of the AMSA Recommendation II (D) Report on Specially Designated Arctic Marine Areas.

(7) **Map seabird and marine mammal density and distribution:** To the extent practicable, Arctic states should continue to create and/or share seabird and marine mammal density and distribution maps, including through common databases such as the National Oceanic and Atmospheric Administration (NOAA) CetMap for Cetaceans (http://cetsound.noaa.gov/index.html) and CAFF's CBird online tools for timely tracking of seabird populations (www.caff.is/seabirds-cbird/seabird-information-network); and through cooperation of relevant Arctic states with NAMMCO on development of trans-Atlantic cetacean surveys (T-NASS 2015).

(8) **Strengthen cooperation and the implementation of agreements on conservation and sustainable use of marine mammals and sea birds, and their habitats,** as appropriate, by continuing development and application of ecosystem-based management with the aim of ensuring sustainability in light of human activities:

- ✓ Improve data collection on harvest and by-catch (commercial, sport and subsistence) in collaboration with the user communities;
- ✓ Continue international cooperation on monitoring, planning and management;
- ✓ Focus concerted efforts on management of species by stocks and populations that are still considerably below former population levels.

References

ABA. Arctic Biodiversity Assessment, in press (expected 2013).

ACIA 2005. Arctic Climate Impact Assessment (ACIA). Cambridge University Press.

MSA. 2009. Arctic Marine Shipping Assessment 2009 Report. Protection of the Arctic Marine Environment, Ottawa, Canada.

Arrigo, K.R., van Dijken, G. and Pabi, S. 2008. Impact of a shrinking Arctic ice cover on marine primary production. Geophysical Research Letters 35, L19603, doi: 10.1029/ 2008 GL035028.

Arrigo, K.R., Matrai, P.A. & van Dijken, G.L. 2011 Primary productivity in the Arctic Ocean: Impacts of complex optical properties and subsurface chlorophyll maxima on large-scale estimates. Journal of Geophysical Research-Oceans 116: C11022.

Barber, D.G. & Iaccoza, J. 2004. Historical analysis of sea ice conditions in McClintock Channel and the Gulf of Boothia, Nunavut: implications for ringed seal and polar bear habitat. Arctic 57: 1-14.

Braune, B.M., Mallory M.L. & Gilchrist H.G. 2006. Elevated mercury levels in a declining population of ivory gulls in the Canadian Arctic. Mar. Pollut. Bull. 52: 978-982.

Bustnes, J.O., Erikstad, K.E., Skaare, J.U., Bakken, V. & Mehlum, F. 2003. Ecological effects of organochlorine pollutants in the Arctic: a study of the glaucous gull. Ecol. Appl. 13: 504–15.

Byrd, G.V., Schmutz, J.A. & Renner, H.M. 2008a. Contrasting population trends of piscivorous seabirds in the Pribilof Islands: A 30-year perspective. Deep-Sea Res. Part II -Topical Studies in Oceanography 55: 1846-1855.

Byrd, G.V., Sydeman, W.J., Renner, H.M. & Minobe, S. 2008b. Responses of piscivorous seabirds at the Pribilof Islands to ocean climate. Deep-Sea Res. Part II -Topical Studies in Oceanography 55: 1856-1867.

Ferguson, S.H. 2009. Killer whales on the rise in the Canadian Arctic. Arctic Circle 4: 20-23.

Fischbach, A.S, Amstrup, S.C. & Douglas, D.C. 2007. Landward and eastward shift of polar bear denning associated with recent sea ice changes. Polar Biology 30: 1395-1405.

Ganter, B. & Gaston, A.J. Birds, *In Meltofte, H. (ed.) 2013. Arctic Biodiversity Assessment. Status and trends in Arctic biodiversity. Conservation of Arctic Flora and Fauna, Akureyri, Iceland.*

Gaston, A.J., & Donaldson, G. 1996. Peat deposits and Thickbilled Murre colonies and Hudson Strait and northern Hudson Bay: clues to postglacial colonization of the area by seabirds. Arctic 48: 354358.

Gaston, A.J. and Elliott, K.H. 2013. Effects of climate-induced changes in parasitism, predation and predator-predator interactions on reproduction and survival of an Arctic marine bird. Arctic 66: 43-51.

Gaston, A.J., Gilchrist, H.G., & Hipfner, J.M. 2005a. Climate change, ice conditions and reproduction in an Arctic nesting marine bird: the thick-billed murre (*Uria lomvia*, L.). J. Anim. Ecol. 74: 832-841.

Gaston, A.J., Gilchrist. H.G., & Mallory, M.L. 2005b. Variation in ice conditions has strong effects on the breeding of marine birds at Prince Leopold Island, Nunavut. Ecography 28: 331-344.

Experts Report. 2011. Report of the meeting of scientific experts on fish stocks in the Arctic Ocean, Anchorage, Alaska, June: 2011 (unpublished report).

Heubeck, M., Camphuysen, C.J., Bao, R., Humple, D., Rey, A.S., Cadiou, B., Bräger, S. & Thomas, T. 2003. Assessing the impact of major oil spills on seabirds populations. *Marine Pollution Bulletin, 46: 900-902.*

Heide-Jørgensen, M.P., Laidre, K.L., Quakenbush, L.T. & Citta, J.J. 2012. The Northwest Passage opens for bowhead whales. BIOLOGY LETTERS 8: 270-273.

Higdon, J.W. & Ferguson, S.H. 2009. Loss of Arctic sea ice causing punctuated change in sightings of killer whales (*Orcinus orca*) over the past century. Ecological Applications 19:1365–1375. http://dx.doi.org/10.1890/07-1941.1

Hjort, C., Gudmundsson, G.A. & Elander, M. 1997. Ross's gulls in the central Arctic Ocean. Arctic 50: 289-292.

Hollowed, A. Palnque, B., Loeng, H. 2013. Potential movement of fish and shellfish stocks from the sub-Arctic to the Arctic Ocean (unpublished paper).

Kovacs, K. (IUCN SSC Pinniped Specialist Group) 2008. *Pagophilus groenlandicus*. In: IUCN 2012. IUCN Red List of Threatened Species. Version 2012.2. <www.iucnredlist.org>. Downloaded on 09 April 2013.

Meltofte, H., Barry, T., Berteaux et al. Synthesis: implications for conservation, *In CAFF 2013. Arctic Biodiversity Assessment. Status and trends in Arctic biodiversity. Conservation of Arctic Flora and Fauna, Akureyri, Iceland.*

McKinney, M.A., Stirling, I., Lunn, N.J. Peacock, E. & Letcher, R.J. 2010. The role of diet on long-term concentration and pattern trends of brominated and chlorinated contaminants in western Hudson Bay polar bears, 1991-2007. Science of the Total Environment 408: 6210-6222.

Molenaar, E.J. 2012. Arctic Fisheries and International Law: Gaps and Options to Address Them, No. 1, Carbon and Climate Law Review 63-77.

Moline, M.A., Karnovsky N.J., Brown Z., Divoky G.J., Frazer T.K., Jacoby C.A., Torrese J.J. & Fraser W.R. 2008. High latitude changes in ice dynamics and their impact on polar marine ecosystems. Ann. NY Acad. Sci. 1134: 267-313.

Moore, S.E. & Huntington, H.P. 2008. Arctic marine mammals and climate change: Impacts and resilience. Ecological Applications 18: S157-S165.

Obbard, M.E., Thiemann, G.W., Peacock, E. & DeBruyen, T.D. (Eds.) 2010. Polar Bears: Proceedings of the 15th Working meeting of the IUCN/SSC Polar Bear Specialist Group, Copenhagen, Denmark, 29 June-3 July 2009. Gland, Switzerland and Cambridge, UK: IUCN.

PAME. 2013. Large Marine Ecosystem Map (in press), Protection of the Arctic Marine Environment (PAME) Secretariat, Akureyri, Iceland, 2013.

Parkinson C.L. & Cavalieri D.J. 2008. Arctic sea ice variability and trends, 1979-2006. Journal of Geophysical Research-Oceans 113, Article Number: C07003.

Parks, E.K., Derocher, A.E., and Lunn, N.J. 2006. Seasonal and annual movement patterns of polar bears on the sea ice of Hudson Bay. Canadian Journal of Zoology 84(9): 1281-1294.

Peacock, E., Desrocher, A.E., Lunn, N.J. and Obbard, M.E. 2010. Polar bear ecology and management in Hudson Bay in the face of climate change. In S.H. Feguson, L.L. Loseto and M.L. Mallory (eds) A little less Arctic. Springer: London, New York. Pages 93-115.

Perovich, D.K. & Richter-Menge, J.A. 2009. Loss of Sea Ice in the Arctic. Annu. Rev. Mar. Sci. 1: 417-441.

Pertoldi, C., Sonne, C., Dietz, R., Schmidt, N.M., and Loeschcke, V. 2009. Craniometric characteristics of polar bear skulls from two periods with contrasting levels of industrial pollution and sea ice extent. Journal of Zoology 279(4): 321-328.

Piatt, J.F., Lensink, C.J., Butler, W, Kendziorek, M. & Nysewander, D.R. 1990. Immediate Impact of the Exxon Valdez Oil-Spill on Marine Birds. Auk 107: 387-397.

Riedman, M. 1990. The Pinnipeds: seals, sea lions and walruses. University of California Press, Berkeley, CA.

Rockwell, R.F. and Gormezano, L.J. 2009. The early bear gets the goose: climate change, polar bears and lesser snow geese in western Hudson Bay. Polar Biology 32: 539-547.

Rockwell, R.F., Gormezano, L.J. & Koons, D.N. 2011. Trophic matches and mismatches: can polar bears reduce the abundance of nesting snow geese in western Hudson Bay? Oikos 120: 696-709.

Smith, P.A., Elliott, K.H., Gaston, A.J. & Gilchrist, H.G. 2010. Has early ice clearance increased predation on breeding birds by polar bears? Polar Biol. 33: 1149-1153.

Stirling, I. & Derocher, A.E. 1993. Possible impacts of climate warming on polar bears. Arctic 46: 240-245.

Stirling, I. & Derocher, A.E. 2012. Effects of climate warming on polar bears: a review of the evidence. Global Change Biology 18: 2694-2706.

Stirling, I., and Parkinson, C.L. 2006. Possible effects of climate warming on selected populations of polar bears (Ursus maritimus) in the Canadian Arctic. Arctic 59: 261-275.

Stirling, I., Lunn, N.J., Iacozza, J., Elliott, C. and Obbard, M. 2004. Polar bear distribution and abundance on the southwestern Hudson Bay coast during open water season, in relation to population trends and annual ice patterns. Arctic 57(1): 15-26.

Stirling, I., Lunn, N.J., and Iacozza, J.O. 1999. Long-term trends in the population ecology of polar bears in western Hudson Bay in relation to climatic change. Arctic 52: 294–306.

Stirling, I.R. 2011. Polar Bears: A Natural History of a Threatened Species. Fitzhenry and Whiteside, Markham, ON.

SWIPA. 2011. Snow, Water, Ice and Permafrost in the Arctic (SWIPA): Climate Change and the Cryosphere. Arctic Marine Assessment Programme (AMAP).

Termblay, J.-E., Robert, D., Varela, D., Lovejoy, C., Darnis, G., Nelson, R.J., and Sastri, A.R. 2012. Current state and trends in Canadian Arctic marine ecosystems: I. Primary production. Climatic Change, 115/1: 161-178. November 2012.

Towell, R.D., Ream, R.F. & York, A.E. 2006. Decline in Northern Fur Seal (*Callorhinus ursinus*) pup production on the Pribilof Islands. Mar. Mamm. Sci. 22(2): 486–491.

Towns, T., Derocher, AE, Stirling, I, Lunn, N.J. & Hedman, E. 2009. Spatial and temporal patterns of problem polar bears in Churchill, Manitoba. Polar Biol. 32: 1529-1537.

Tynan, C.T. & DeMaster, D.P. 1997. Observations and predictions of Arctic climate change: potential effects on marine mammals. Arctic 50: 308-322.

United States. 2008. S.J.Res. (Senate Joint Resolution) 17 - A joint resolution directing the United States to initiate international discussions and take necessary steps with other Nations to negotiate an agreement for managing migratory and transboundary fish stocks in the Arctic Ocean. Became Public Law No: 110-243, 122 Stat. 1569, June 3, 2008.

Wiese, F. & Robertson, G.J. 2004. Assessing seabird mortality from chronic oil discharges at sea. J. Wildlife Manage. 68: 627-638.


NOAA/Shawn Harper


Randy Howell

Chapter 5 – Arctic Offshore Oil and Gas

5.1 Introduction

As offshore oil and gas activity in the Arctic increases[1], it will be important to implement measures designed to control and reduce the risk of oil pollution incidents. Strict standards and high safety levels for offshore oil and gas activities have proven to be efficient ways to minimize the risk of incidents with potential adverse effects on the Arctic marine environment. The industrial activity of oil and gas exploration and production is subject to national and, for some states, sub-national regulation and control. Unlike shipping, which operates in a global market, offshore petroleum activity is under the jurisdiction of the costal state. Individual coastal states regulate and control industrial activity in their offshore areas, taking into consideration individual characteristics such as judicial traditions and the distribution of responsibility between industry and authorities. As a consequence, there are differences in the national regulatory frameworks (Amos 2012, Baram 2010, Campion et al. 2011, Dagg et al. 2011, Moe & Wilson Rowe 2009). However, the specific technical and operational solutions applied by the industry are, to a large extent, defined in common industrial standards and not in national regulations. Available international instruments generally address marine activity; opportunities also exist for better international collaboration and coordination (Chabason 2011, Spicer 2013). To render exploration and production activities in the Arctic safer, states need to address them in a way that respects the special character of the region (Porta and Bankes 2011, Deepwater Commission 2011, NEB 2011).

[1] See Chapter 1: Introduction for a brief summary of recent offshore oil and gas activity in the Arctic Ocean.

The Arctic Council has produced significant outcomes for offshore oil and gas both in recent years, and in the deliverables anticipated for the 2013 Ministerial (Sidebar 5.1). For example, the 2007 Arctic Monitoring and Assessment Programme (AMAP) Oil and Gas Assessment identifies the precautionary approach, polluter pays, and environmental, strategic and risk assessments as bases for Arctic offshore oil and gas activity (AMAP 2007, iii, viii). The 2009 Arctic Council's Arctic Offshore Oil and Gas Guidelines (Arctic Council's AOOGG), section 1.3, indicate that such activity should be based on the precautionary approach as reflected in Principle 15 of the Rio Declaration, polluter pays as reflected in Principle 16 of the Rio Declaration, continuous improvement, and sustainable development. This chapter refers to these Guidelines in the discussion that follows, which focuses on global and regional arrangements relevant to Arctic offshore oil and gas activity.

5.2 Global Instruments

Arctic states should encourage full participation and implementation (by Arctic and non-Arctic states alike) of four key global agreements applicable to the maritime

Sidebar 5.1

The Arctic Council and Offshore Oil & Gas 2004-2013

2004 PAME Arctic Marine Strategic Plan

2004 PAME/EPPR Guidelines for Transfer of Refined Oil and Oil Products in Arctic Waters (TROOP)

2007 AMAP Oil and Gas Assessment

1997, 2002 and 2009 Arctic Council's Arctic Offshore Oil and Gas Guidelines

2009 PAME Arctic Marine Shipping Assessment

2011 EPPR Behaviour of Oil and other Hazardous and Noxious Substances on Arctic Waters (BoHaSa)

2011 PAME Arctic Ocean Review Phase I Report; see §4.55 for additional EPPR projects

2013 EPPR Operational Guidelines for the Agreement on Cooperation on Marine Oil Pollution Preparedness and Response in the Arctic

2013 Arctic Ocean Review Final Report

Ongoing - PAME Management Regulation and Enforcement Web-based Information Resource aspects of offshore oil and gas activity. The 1982 United Nations Convention on the Law of the Sea (UNCLOS), the 1973/78 International Convention for the Prevention of Pollution from Ships (MARPOL), the 1990 International Convention on Oil Pollution Preparedness, Response and Cooperation (OPRC), and the London Convention and its 1996 Protocol, are each designed to address specific aspects of maritime activity. They do not, however, relate to or provide a comprehensive regulatory regime for offshore hydrocarbon activity. Further, none deals specifically with prevention of marine pollution from industrial mineral exploration and production activity, such as the operation of fixed stations, or Mobile Offshore Drilling Units (MODUs) when they are on station. This section considers three of these four agreements in turn, omitting further discussion of the OPRC Convention, which the new Arctic Agreement on Cooperation on Marine Oil Pollution Preparedness and Response in the Arctic discussed in 5.3, below, builds upon. Neither does this section discuss the International Convention on Civil Liability for Oil Pollution Damage (CLC Convention), or the Intervention Convention and the Fund Convention, which cover marine – not industrial – activity, namely the transport of oil by ships and its use as fuel, and which are discussed in the shipping chapter of this AOR Final Report.

UNCLOS: All Arctic states (except the United States) are party to UNCLOS, which contains provisions relevant to seabed oil and gas exploration in, most notably, Parts VI and XI. In addition, the UNCLOS contains relevant provisions concerning protection and preservation of the marine environment in Part XII, several of which are highlighted here.

Article 197, for example, requires states to cooperate regionally as appropriate in formulating and elaborating international rules, standards and recommended practices and procedures for environmental protection consistent with the UNCLOS, "taking into account characteristic regional features." Given the Arctic's distinctive sea ice, harsh climate and seasonal cycles of light and dark, this general requirement can inform how Arctic states address specific issues covered by other cooperation provisions in the Convention including, for example, harmonizing approaches to offshore industrial activity, responding to transboundary marine pollution, researching effects of pollution on the marine environment, and creating science-based rules for preventing and managing those effects.

Pollution and Harmonization. Article 192 states broadly that "States have the obligation to protect and preserve the marine environment". Under Article 194(1) "States shall take, individually or jointly as appropriate, all measures consistent with this Convention that are necessary to prevent, reduce and control pollution of the marine environment from any source, using for this purpose the best practicable means at their disposal and in accordance with their capabilities, *and they shall endeavour to harmonize their policies in this connection"* (emphasis added). Article 194(2) provides that States shall take all measures necessary to ensure, inter alia, "that pollution arising from incidents or activities under their jurisdiction or control does not spread beyond the areas where they exercise sovereign rights in accordance with this Convention" and Article 194(3)(c) provides that State measures taken under Part XII shall include those designed to minimize to the fullest possible extent "pollution from installations and devices used in exploitation or exploration of the natural resources of the sea-bed and its subsoil".

Offshore Installations. Article 208 concerns pollution from sea-bed activities subject to national jurisdiction, and offers a basis for cooperation among individual states regulating industrial activity in their offshore areas (Baker 2012). Under Article 208, coastal states shall adopt laws and regulations, and take other measures regarding pollution arising from sea-bed activities subject to their jurisdiction and from offshore artificial islands, installations and structures under their jurisdiction; these measures shall be "no less effective than international rules, standards and recommended practices and procedures." However, there are few international rules or procedures for exploration and production activities undertaken by mobile offshore facilities (Chabason 2011, Spicer 2013.) Further, States shall endeavor to harmonize their policies in this connection at the appropriate regional level; and "States, acting especially through competent international organizations or diplomatic conference, shall establish global and regional rules, standards and recommended practices and procedures to prevent, reduce and control pollution of the marine environment" from such installations. Article 214 provides that "States shall enforce their laws and regulations adopted in accordance with article 208."

Liability. It is beyond the scope of the AOR Final Report to address whether individual states have ensured that recourse is available in accordance with their legal systems for "prompt and adequate compensation or other relief in respect of damage caused by pollution of the marine environment by natural or juridical persons under their jurisdiction," as provided in Article 235(2). UNCLOS Article 235(3) says States shall cooperate in developing "international law relating to responsibility and liability for the assessment of, and compensation for, damage and the settlement of related disputes, as well as, where appropriate, development of criteria and procedures for payment of adequate compensation, such as compulsory insurance or compensation funds." (de La Fayette 2005) However, international law does not currently address liability for damage from drilling activities in the way the CLC and Fund Conventions have for oil spills from vessels (Chabason 2011, CCLOP 1977).

In 2012, the International Maritime Organization (IMO) Legal Committee declined to extend to offshore installations the coverage of IMO Strategic Direction 7.2, under which the IMO focuses on mitigating and responding to environmental impacts of shipping incidents and operational pollution from ships. It chooses rather to analyze these issues further with the aim of developing guidance for states interested in bilateral or regional responses to liability and compensation issues related to transboundary pollution damage from offshore exploration and exploitation activities (IMO 2011, IMO 2012).

MARPOL 73/78. All eight Arctic states are party to the 1973 International Convention for the Prevention of Pollution from Ships, and its 1978 Protocol, known as MARPOL 73/78, and three of its six Annexes – I (oil), II (noxious liquid substances in bulk) and III (harmful substances, packaged). MARPOL aims to eliminate pollution of the sea by oil, chemicals and other harmful substances that might be discharged to the sea and air in the course of vessel operation. Broadly applicable to seagoing vessels, MARPOL contains no Arctic-specific references and explicitly excludes from its definition of "discharge" the "release of harmful substances directly arising from the exploration, exploitation and associated off-shore processing of sea-bed mineral resources," as well as dumping within the meaning of the London Convention (MARPOL 73/78, Article 2(3)(b)). This exclusion did not prevent Arctic Council's AOOGG from recommending, for example, that with respect to production waste discharges from the operation of offshore industrial facilities, operators apply certain MARPOL 73/78 requirements, or their equivalent (OSPAR 2010, PAME Offshore Guidelines, p. 33).

MARPOL's exclusion of discharges related to seabed mineral activity also excludes discharges from MODUs directly arising from offshore exploration and production activities. MARPOL Annex V, as recently amended, contains provisions on the discharge of garbage from fixed or floating platforms, to the extent such discharge does not fall under MARPOL's exclusion of discharges arising directly from certain seabed mineral activity. MODUs are the subject of the IMO's free-standing, voluntary 2009 MODU Code, IMO, A 26/Res.1023, adopted by the IMO Assembly 18 January 2010 (IMO 2009). Different views have been expressed at the IMO Legal Committee as to whether IMO conventions – as opposed to its non-binding guidelines – could accommodate both fixed and mobile drilling units in other regards.

Special Areas may be established under MARPOL 73/78 Annex I, Regulation 15 (prohibiting, with very few exceptions, oily discharges in the designated area), and Annexes II, IV and V, but no part of the Arctic has yet been so designated.

London Convention and Protocol: All eight Arctic states are party to the 1972 Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, known as the London Convention; five of the eight are party to its 1996 Protocol. Similar to MARPOL, the London Convention and Protocol exclude from their scope the disposal of wastes related to offshore seabed mineral exploration, exploitation and associated processing activity, although they do cover the deliberate disposal of platforms. The Arctic Council's AOOGG note that decommissioning provisions are spread throughout multiple instruments, pointing to two more on the removal of offshore structures: 1989 IMO Guidelines and standards, which consider that complete removal of structures placed on the seabed after 1998 should be feasible; and the 1998 OSPAR Decision 98/3 on the Disposal of Disused Offshore Installations, which generally prohibits the disposal of such installations at sea, with exceptions involving a lengthy consultation process that leaves the ultimate decision to the Contracting Party (IMO 1989, OSPAR 1998).

5.3 Regional Instruments

Multiple regional agreements are relevant to offshore oil and gas activity in the Arctic. This section focuses on two agreements recently negotiated between all eight Arctic states and on the OSPAR Convention on the Prevention of Marine Pollution from Land-Based Sources, and briefly mentions several agreements between Nordic countries.

Since 2010, two Arctic Council Task Forces have served as negotiating forums for separate binding agreements among all eight Arctic states relevant to offshore oil and gas activity, although both instruments will have status independent from the Arctic Council. The 2011 Arctic Search and Rescue Agreement (Arctic SAR) aims to strengthen aeronautical and maritime search and rescue cooperation, coordination and infrastructure in the Arctic generally, but is not related to offshore oil and gas activity per se. The Agreement on Cooperation on Marine Oil Pollution Preparedness and Response in the Arctic (Arctic Oil Pollution Agreement) is expected to be signed at the 2013 Ministerial. A primary objective of the Agreement is to provide a mechanism for a Party to request assistance when an oil spill exceeds its capacity to respond on its own. The Agreement will contain provisions regarding maintenance of national systems for pollution preparedness and response in the Arctic, notification of other Parties and interested States of oil pollution incidents, monitoring Arctic maritime areas (including, in some circumstances, high seas areas) for possible oil pollution incidents, facilitating information exchange and assistance in oil spill preparedness and response operations, coordinating joint response operations, and cooperating in joint exercises and joint reviews of operations. The Parties are also developing non-binding operational guidelines to be followed in any response operations.

Other regional agreements that informed negotiations for the Arctic Oil Pollution Agreement, including the Bonn Agreement for Co-operation in Dealing with Pollution of the North Sea by Oil, the Copenhagen Agreement of the Nordic States on Oil Pollution and other Harmful Substances, and the Helsinki Convention on the Protection of the Marine Environment of the Baltic Sea, and the Nordic Environmental Protection Convention, are not discussed further here. Similarly, this chapter does not address bilateral arrangements such as the non-binding Canada – United States Joint Marine Pollution Plan.

OSPAR is a robust regional convention with Arctic initiatives, an offshore industries strategy, and a well-coordinated Joint Assessment Monitoring Program (JAMP) for assessing the marine environment. Unlike the international instruments above, it applies explicitly to offshore installations used to explore for or exploit hydrocarbons, e.g., Article 1(g), (j–m). The Offshore Industry Committee (OIC) is the responsible body within OSPAR. OSPAR's Region 1, Arctic waters, includes a sector of the Arctic Ocean. OSPAR's 15 members include all five Nordic members of the Arctic Council. The Arctic Council's AMAP working group is one of OSPAR's sixteen intergovernmental observers; the IMO is another, and maintains a Memorandum of Understanding with OSPAR. PAME and CAFF are not observers but are considered relevant to OSPAR's oil and gas initiatives and JAMP, respectively.

OSPAR's 2010 North-East Atlantic Environment Strategy promotes coordination with the Arctic Council. According to OIC's work program for 2012-2013, Contracting Parties shall assess the suitability of existing measures to manage oil and gas activities in Region 1, and information on this process is being shared with PAME. Contracting Parties participating in other forums will endeavor to ensure that initiatives relevant to the work of OSPAR and the OIC developed within those forums (e.g., The European Community, the Bonn Agreement, the London Convention and its Protocol, the Helsinki Commission) are compatible with any OSPAR programs and measures (OSPAR 2010, Article 5.1).

Sidebar 5.2 – Avenues for cooperation between OSPAR and the Arctic Council

Two of OSPAR's "Strategies" offer potential avenues for cooperation with the Arctic Council on offshore hydrocarbon activity: the Offshore Industry Strategy (OIS) and the Joint Assessment Monitoring Programme (JAMP).

<u>The OIS "Strategic Directions"</u> include coordinated regional information collection, environmental monitoring, and assessment; progressively developing Best Available Techniques and Best Environmental Practices, promoting information and experience sharing between Contracting Parties and maintaining an offshore hydrocarbon installation inventory.

<u>The Joint Assessment Monitoring Programme (JAMP).</u> applies in several sectors, including offshore oil and gas, where contracting parties assess impacts such as underwater noise from offshore oil and gas activity and develop as appropriate guidance for mitigation measures (JAMP A-10 and B-15 and North-East Atlantic Environment Strategy 4.2.h.)

The OIC implements the Offshore Industry Strategy (OIS), whose "Strategic Directions" include coordinated regional information collection, environmental monitoring and assessment; progressively developing Best Available Techniques (BAT) and Best Environmental Practices (BEP), promoting information and experience sharing between Contracting Parties and maintaining an offshore hydrocarbon installation inventory (OSPAR 2010). The Contracting Parties to OIC agree upon recommendations and decisions that contribute to reduced discharges from ordinary operations such as drilling and production. This includes drilling fluids and drill cuttings, oil and other components discharged with produced water, other effluents such as displacement water and drainage water, and the characterization, use and discharges of chemicals.

OSPAR requires Contracting Parties to "cooperate in carrying out monitoring programmes" (Articles I/II). JAMP specifies how, requiring Contracting Parties to gather data under agreed OSPAR procedures so that it can be compared across all OSPAR areas, and to apply common quality assurance measures to the whole chain of JAMP assessments. The Offshore Oil and Gas Industry is one of six themes to be assessed (See Sidebar 5.2).

The Arctic Council's AOOGG reference OSPAR practices as providing potential Arctic-wide standards for environmental monitoring of oil and gas activities (pp. 24, 82), testing acute toxicity (p. 35), decommissioning (p. 49) and requiring BAT and BEP (p. 79 ff.).

A separate regional agreement, the Convention on the Protection of the Environment between Denmark, Finland, Norway and Sweden (1974), allows individuals in one state to challenge the legality of, and seek damages for, activities in another state that affect them and that give, or may give, rise to environmental harm. Its broad definition of environmentally harmful activities expressly covers discharges of gas or other substances from installations into the sea or other uses of the seabed or installations "which entails or may entail environmental nuisance." (Art. 1)

Apart from regional instruments and arrangements, the Barents 2020 project is an example of government-industry cooperation to recommend standards for common use in offshore oil and gas activity for a specific region (Barents 2020. 2010).

5.4 Opportunities for Cooperative Action

Ministers of all eight Arctic states endorsed the 2009 Arctic Council's AOOGG. As introduced in 5.1 above, the Guidelines state that "Arctic offshore oil and gas activities should be based on the precautionary approach as reflected in Principle 15 of the Rio Declaration, polluter pays as reflected in Principle 16 of the Rio Declaration, continuous improvement and sustainable development" (section 1.3). With respect to the latter, in permitting offshore activity, states "should be mindful of their commitment to sustainable development", which includes "the duty not to transfer, directly or indirectly, damage or hazards from one area of the marine environment to another or transform one type of pollution into another" (echoing language from UNCLOS Article 195); promoting "the use of best available technology/techniques and best environmental practices" and "the duty to cooperate on a regional basis for protection and preservation of the marine environment, taking into account characteristic regional features and global climate change effects."

As petroleum activities increase in the Arctic, new opportunities and challenges appear. Effective intergovernmental venues for improving safety in the petroleum industry are established outside of international agreements or instruments, such as the ISO follow-up to the Barents 2020 project for developing Arctic technical standards in 7 discrete areas, the Ministerial Forum on Offshore Drilling Containment, the work of the Performance Measurement Workgroup in the International Regulators Forum, and standards and best practices work by industry such as the Oil and Gas Producers International. The Arctic Council should engage with standards organizations and industry as they evaluate, modify, or develop standards and/or best practices relevant to oil and gas operations in the various parts of the Arctic, in order to ensure necessary support in the Arctic states.

Taking into account these general principles and ongoing work related to oil and gas activities the following opportunities have been identified:

(1) The Arctic Council should urge its members to support, as appropriate, efforts in the ISO and other processes to develop standards relevant to Arctic oil and gas operations.

(2) Arctic states should move toward circumpolar policy harmonization in discrete sectors such as, e.g., environmental monitoring based on existing studies such as the Arctic Council's AOOGG and the EPPR Recommended Prevention Practices report.

(3) Arctic Council should promote interactions with the appropriate international treaty bodies on offshore

oil and gas issues that address for example discharges, oil spill preparedness and response, and environmental monitoring. This could include coordinating information exchange on reporting, monitoring, assessment and/or other requirements under relevant entities, encouraging inclusion of science and traditional knowledge, and keeping abreast of Arctic-specific developments relevant to the appropriate instruments.

(4) Arctic states should further engage industry and regulator involvement, as appropriate, in PAME and EPPR initiatives on offshore oil and gas activity by utilizing existing industry forums, or by convening an Arctic-specific oil and gas dialog for industry and contractor groups.

References

AMAP. 2007. Arctic Monitoring and Assessment Programme, Arctic Oil and Gas 2007. Arctic Oil and Gas Assessment, Overview Report, available at http://www.amap.no/oga/.

Amos, W. 2011. Development of Canadian Offshore Oil and Gas Drilling: Lessons from the Gulf of Mexico, RECIEL 20/1 (2011): 39-46.

Baker, B. 2012. Offshore Oil and Gas Regulation in the Arctic: Room for Harmonization? The Yearbook of Polar Law IV (2012): 475–504.

Baram, M. Preventing Accidents in Offshore Oil and Gas Operations: The U.S. Approach and Some Contrasting Features of the Norwegian Approach, Boston University School of Law Working Paper No. 09-43 (December 1, 2010), available at http://ssrn.com/abstract=1705812.

Barents 2020. 2010. Barents 2020, Phase 3 Report. Assessment of international standards for safe exploration, production and transportation of oil and gas in the Barents sea. Harmonisation of Health, Safety, and Environmental Protection Standards for The Barents Sea. Final Report. Russian-Norwegian Cooperation Project, Report no 2009 – 1626.

Campion, L., Jones, B., Peterson, C., Sidortsov, R., Zhang, Z., 2011. The Arctic Offshore Oil and Gas Guidelines in Greenland and The Russian Federation,Arctic Offshore Oil and Gas Guidelines White Paper No. 5, Vermont Law School Institute for Energy & the Environment, Prepared for the Inuit Circumpolar Council, http://www.vermontlaw.edu/Documents/IEE/20110215_IEEBakerWP5.pdf. February 2011.

Chabason, L. 2011. Offshore oil exploitation: a new frontier for international environmental law, IDDRI (Institut du développement durable et des relations internationales/Institute for Sustainable Development and International Relations), Working Papers N°11/11. Paris, SciencesPo. Available at http://www.iddri.org/ Publications/Collections/Idees-pour-le-debat/WP%201111_chabason_offshore.pdf. November 2011.

CCLOP. 1977. Convention on Civil Liability for Oil Pollution Damage resulting from Exploration for and Exploitation of Seabed Mineral Resources (with Final Act of the Intergovernmental Conference on the Convention on Civil Liability for Oil Pollution Damage from Offshore Operations 20-31 October 1975 and 13-17 December 1976) , Open for signature May 1, 1977 UK Miscellaneous Series 008/1977 : Cmnd 6791. Not in force.

Dagg, J., Holroyd, P., Lemphers, N., Lucas, R., and Thibault, B. Comparing the Offshore Regulatory Regimes of the Canadian Arctic, the U.S., the U.K., Greenland and Norway. Pembina Institute, Drayton Valley, Alberta, June 2011.

Deepwater Commission. 2011. National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling, Deep Water: The Gulf Oil Disaster and the Future of Offshore Drilling, Report to the President, 2011.

de La Fayette, L.A. 2005. New Approaches for Addressing Damage to the Marine Environment, International Journal of Marine & Coastal Law 20 (2005): 167- 224.

IMO. 2009. International Maritime Organization Code for the construction and equipment of mobile offshore drilling units, A26/Res.1023, adopted by the IMO Assembly 18 January 2010.

IMO. 2011. Legal Committee 98th session, Agenda item 13, LEG 98/13 (18 February 2011) Information relating to liability and compensation for oil pollution damage resulting from offshore oil exploration and exploitation, Note by the Secretariat.

IMO. 2012. Legal Committee, 99th session, Agenda item 14, LEG 99/14 24 April 2012 Original: Report of the Legal Committee on the Work if its Ninety-Ningth Session, §13, pp. 23-28.

Moe, A. and Wilson Rowe, E. 2009. Northern Offshore Oil and Gas Resources: Policy Challenges and Approaches'. In Wilson Rowe, E. (ed.), Russia and the North, 107-128. Ottawa, University of Ottawa Press, 2009

NEB (National Energy Board of Canada). 2011. The past is always present. Review of Offshore Drilling in the Canadian Arctic. Preparing for the future. The Final Report of the NEB Arctic Offshore Drilling Review. Ottawa 2011.

OSPAR. 2010. The North-East Atlantic Environment Strategy. Strategy of the OSPAR Commission for the Protection of the Marine Environment of the North-East Atlantic 2010-2020 (OSPAR Agreement 2010-3), Part 2.2 of Offshore Strategic Objectives.

PAME 2009. Arctic Offshore Oil and Gas Guidelines. PAME (Protection of the Arctic Marine Environment) Secretariat, Akureyri 2009.

Porta, L. and Bankes, N., Becoming Arctic-Ready: Policy Recommendations for Reforming Canada's Approach to Licensing and Regulating Offshore Oil and Gas in the Arctic (Oceans North Canada/Pew Environment Group: Ottawa 2011), available at oceansnorth.org/system/files/attachments/PewOilGasReport_web.pdf.

Spicer, W. Deepwater Horizon: Lessons for the Offshore, Dalhousie Law Journal 35 (2013): In Press.

Loribut, Shutterstuck

Chapter 6 – Arctic Marine Pollution

6.1 Introduction

The Arctic plays a key role in the global energy budget and global ecosystem processes. Energy and contaminants are transported into the Arctic and redistributed within the Arctic by atmospheric currents, ocean currents and hydro-biological cycling, and contaminants are biomagnified in the food chains, ultimately reaching apex predators (including humans). For transport of contaminants such as persistent organic pollutants (POPs) and heavy metals into the Arctic, atmospheric currents are by far the fastest transport mechanism. Based on past experience and increased knowledge about the physical behavior of POPs and heavy metals in the environment, the Arctic serves as an indicator region for the persistence of chemicals and their ability for long-range transport (see Figure 6.1 on long-range transport mechanisms of pollutants to the Arctic).

Over the past 20 years, the priority issues of concern for the Arctic environment and its inhabitants with respect to pollution have been associated with: POPs, radionuclides, certain heavy metals (especially mercury), acidifying substances, petroleum hydrocarbons, and greenhouse gases and other climate-forcing substances such as black carbon and aerosols. Some contaminants are of circumpolar concern, while others are of more regional or local concern. Several reports documenting the state of knowledge regarding pollution threats to Arctic ecosystems and humans have been produced by AMAP in the past two decades, during which time Arctic climate change has also grown to be a major regional and global concern. A reference list is provided at the end of the AOR Final Report and outlines the applicable AMAP assessments conducted over the past 10 years related to pollution and climate change issues.

Figure 6.1. *Long-range Transport Mechanisms of Pollutants to the Arctic (Source: AMAP Assessment 2003b)*

6.2 Status, trends and effects in the environment

The information below on status, trends and effects of contaminants in the Arctic environment is based on current knowledge. Generally, there is a lack of long-term trends data for many potentially harmful pollutants in the marine environment. For many Arctic areas, scientific information about contaminant levels and effects are limited and this is especially true for our understanding of cumulative effects in the Arctic.

Petroleum hydrocarbons

Petroleum hydrocarbons found in the marine environment have several sources. The main anthropogenic sources of petroleum hydrocarbons entering the marine environment are discharges from land (industrial effluents containing oil, precipitation runoffs, waste oil and sewage), and direct discharges to the sea (chronic releases from oil tankers, commercial fishing and other vessels, dry docking and accidents, and offshore oil and gas activities) and water courses, and atmospheric inputs. The majority of hydrocarbon contamination measured in seawater throughout the Arctic, however, originates primarily from natural oil seeps. Except for local pollution in harbors, the highest levels occur just off river mouths. Away from areas of human activity, levels of petroleum hydrocarbons are generally low and do not pose an ecological or human health risk

While routine oil and gas activities have produced relatively little hydrocarbon contamination, oil spill incidents can kill large numbers of animals, especially birds. An oil spill in Arctic waters, especially in ice-covered or partly ice-covered seas, may remain in the environment for a long period of time due to low degradation rates and difficulties in cleaning up spills in dark and cold conditions. At present, there is no oil-combating equipment stored in the vicinity of the Arctic that has proven efficient and effective in ice-covered waters. The ice edge is an important Arctic habitat for primary production, fish, seabirds and marine mammals. An oil spill in such areas at a critical time of the year might have serious consequences for vulnerable Arctic ecosystems.

(AMAP 1998, AMAP 2007)

Persistent Organic Pollutants (POPs) – Legacy and New

Levels of many legacy POPs such as alpha hexachlorocyclohexane (a pesticide) have generally decreased in both air and biota over the past two decades. However, for some POPs (e.g., PCBs, DDTs), there are local variations in patterns over time. The most significant finding, in contrast to the above-mentioned general declining trend, is that the levels of PCBs, HCB and DDT at the Svalbard Zeppelin station have stopped decreasing or show a slight increasing trend during the last five to ten years. A possible explanation for this may be related to impacts of climate change, such as reduced sea ice.

A number of newer POPs, such as flame retardants, e.g., polybrominated diphenyl ethers (PBDEs) and the industrial chemicals, e.g., perfluorooctane sulfonic acid (PFOS), have also begun to decrease in the Arctic environment as a result of international regulations that are enshrined in the Stockholm Convention on POPs and the Convention on Long-range Transboundary Air Pollution (LRTAP) Protocol on POPs. To date, there is limited data to indicate whether the addition of these chemicals to these international treaties will result in further reductions in the Arctic environment.

Due to the persistent and biomagnifying nature of legacy POPs, concentrations found in marine foodwebs still pose a risk to ecosystem and human health. In some regions the level of PCBs in high trophic level species such as polar bear, glaucous gulls and ivory gulls, put them at risk of immune and reproductive effects, which could be exacerbated by the cumulative effects of other environmental stressors brought on by climate change and development. As a result of their diet, which includes marine mammals, Inuit are exposed to levels of POPs that are of concern to health authorities.

(AMAP 2002; AMAP 2009)

Heavy metals, especially Mercury, Lead, and Cadmium

Mercury

Mercury is a naturally occurring element that has been enriched in the environment by human activities such as coal combustion, waste treatment and mining. Global anthropogenic emissions of mercury to air have been fairly constant since 1990. Although emissions in Europe and North America have decreased over the past two decades, this has been offset by increasing emissions from East Asia. There are some indications that overall emissions from human sources, primarily coal-fired power plants, may increase in the future (AMAP, 2011). Mercury is transported to the Arctic by air currents, ocean currents and rivers. Long range atmospheric transport is particularly important in considering Arctic impacts. Recent increasing trends, observed in marine species from Canada and West Greenland, could continue if global emissions were to rise.

Once in water bodies, mercury can be transformed by microscopic organisms into methylmercury, the main biomagnifying and most toxic form of mercury. Since mercury biomagnifies through the food chain, dietary intake is the main source of mercury exposure in top predators and humans. New biological effects have been documented among Arctic peoples who have a high intake of fish and marine mammals in their diets. Such exposure can result in neurological damage, including learning disabilities and IQ deficiencies in developing children, and cause ecological impacts. As a result, health authorities in some jurisdictions recommend that women of child-bearing age limit their consumption of certain traditional foods such as whale meat.

(AMAP 2011)

Cadmium

Cadmium occurs naturally in mineral ores and is found at background levels in the marine environment. Long-range transport of cadmium by air is reflected in ice cores from Greenland. Emissions from Eurasia and North America must be considered important sources for cadmium to the Arctic region. While levels of cadmium in some Arctic marine organisms are higher than in other regions of globe, concern is limited since levels appear to be stable and effects have not yet been detected in wild populations.

(AMAP 2005)

Lead

Atmospheric transport is the major route of lead entry into marine areas. The global reduction of lead air emissions from decreased use of leaded gasoline has resulted in decreased deposition of lead in the Arctic. Lead is considered to be of less toxicological importance in the Arctic than cadmium and mercury. Monitoring data generally show low levels of lead in the marine environment.

(AMAP 2005)

Radionuclides

Like other long-range contaminants, radionuclides can be transported over long distances and reach the Arctic Ocean. Sources of radionuclides to the Arctic include fallout from atmospheric testing of nuclear weapons in the 1950s and 1960s, direct ocean dumping, discharges to the sea from reprocessing of spent nuclear fuel at Sellafield (U.K.) and Cap de la Hague (France), and nuclear accidents such as Chernobyl, Ukraine, in 1986 and Fukushima, Japan, in 2011 (Edson et al. 1997). Due to the wide dispersion and dilution of radionuclides in the marine environment, wildlife and human exposure has been minimal and does not pose significant ecosystem or human health risks. Furthermore, impacts from the largest historic source to the Arctic – the fallout from nuclear testing – have steadily diminished over time. At Sellafield and Cap de la Hague, the application of new technology has greatly reduced the release of radionuclides, formerly the largest source of ongoing contamination. The impacts from Chernobyl have also diminished with time (AMAP 2004, AMAP 2009), and the impact of Fukushima on the Arctic appears to have been minimal based on recent monitoring results.

Within the Arctic region, there are a significant number of sites that represent potential sources of radioactive materials to the Arctic, particularly in Northwest Russia. The risks associated with these sites have been significantly reduced through national and international cleanup efforts that have overseen the decommissioning of nearly all obsolete nuclear submarines. Technologically enhanced naturally occurring radioactive material (TENORM), a byproduct in the process water from oil and gas production, may represent a risk to the marine environment in the future if oil and gas activity increases. Finally, Russian plans for the construction of floating nuclear power plants raise concerns over risks to the marine environment associated with the storage and handling of waste and increased marine transport of spent fuel in the Arctic.

(AMAP 2002; AMAP 2009)

Climate change

Since the 1980s, the Arctic has been warming at twice the rate of the global average. The recent five-year period (2005-2010) exhibited the highest yearly surface air temperatures since measurements began in 1880. The greatest increase in surface air temperature occurs in autumn in regions where sea ice has disappeared by the end of the summer. There is evidence that feedbacks associated with albedo and cloud cover are accelerating Arctic warming and sea-ice loss. The summer of 2012 marked the greatest loss of sea ice on record.

The largest and most permanent bodies of ice in the Arctic, namely, multi-year sea ice, mountain glaciers and ice caps, and the Greenland Ice Sheet, have all declined faster since 2000 than in the previous decade. Loss of ice and snow exposes darker underlying surfaces and leads to increased absorption of solar energy, which could release large amounts of powerful greenhouse gases, such as carbon dioxide and methane from currently frozen reservoirs (e.g. permafrost). Ultimately, the impact of warming could change large-scale ocean currents.

There has been increasing attention to the role that black carbon aerosols may play in Arctic climate change. Black carbon directly absorbs incoming sunlight in the atmosphere, and darkens snow and ice surfaces after deposition. This in turn can accelerate melting in the Arctic. Black carbon and methane have been referred to as "short-lived climate forcers" because their atmospheric lifetimes are shorter than those of most other greenhouse gases, and therefore reductions in these emissions can produce a more immediate effect on the climate.

Climate change is expected to result in considerable changes in the Arctic marine ecosystem. Ice-dependent species will be under increasing pressure from loss of ice habitats. Southern species are expected to move northwards, resulting in competition with native Arctic species and altering food webs. Contaminant uptake, accumulation, and effects on Arctic biota will be altered and potentially magnified by changes in food web structure and increased environmental stress on Arctic species. Changes in meteorological and cryospheric conditions will also alter contaminant processes (e.g., emissions, depositions and cycling in the marine environment), which may enhance or diminish contaminant accumulation.

(ACIA 2004; AMAP 2011b; AMAP 2011c; AMAP 2011d)

Ocean acidification

Anthropogenic emissions of CO_2 cause acidification of the world oceans because CO_2 reacts with seawater to form carbonic acid. The cold surface waters of the Arctic Ocean absorb atmospheric CO_2 more rapidly than warmer waters, leading to a disproportionately higher fraction of the global net CO_2 uptake. However, over the past three decades, the melting of more summer sea ice cover has added freshwater to the ocean, increasingly exposed shelf waters, and allowed greater CO_2 exchange to occur in these cold waters. The combination of these processes accelerates the rates at which both the pH and the carbonate mineral saturation state decrease.

There are limited observations and research on the effects of ocean acidification on Arctic marine ecosystems. The direct effects are expected to be most pronounced for phytoplankton, zooplankton and benthos. However, ocean acidification has the potential to constrain and marginalize species distribution, including fish. Fish, seabirds and marine mammals can be affected indirectly. An assessment of the status, trends and effects due to ocean acidification of the Arctic Ocean will be released by AMAP in May 2013.

(AMAP 2010, AMAP 2013)

Physical disturbances

Physical disturbances from human activities such as bottom trawling, gravelling, oil and gas activities, and harbor construction have not been specifically analyzed for the Arctic marine areas. In the North Sea, such human-induced disturbances have documented effects on bottom ecosystems in areas with high human activities. There are also some studies on the scale of damage to coral reefs in the Barents Sea–Lofoten area. In the areas that have been mapped, approximately 20 per cent of the coral reefs are damaged to some extent, and about six per cent of all reefs that have been inspected in the Barents Sea–Lofoten management plan area have been destroyed. Much of the observed damage is several years old.

Noise

Noise from commercial shipping operations, as well as oil and gas activity, is increasingly recognized as a potential threat for many marine animals, in particular whales, seals and fish. Scientific data, while not conclusive, suggest that commercial shipping and navy ships cause significant increases in the overall underwater sound environment in many ocean areas, particularly coastal zones. Incidental noise from commercial shipping occurs within the same low frequencies used by some marine animals for communications essential to key life functions, such as reproduction and locating prey. Interference with (or „masking" of) such communications could have significant impacts on marine life, particularly migratory species, and related subsistence fisheries and traditional economies.

(IMO 2007)

6.3 International Pollution Instruments

International (global and regional) agreements and other instruments are of major importance in the control and reduction of the amount of pollution to the Arctic marine environment. These legal instruments include the regulation of activities and restrictions on the use of, or ban on, hazardous substances. (Chapter 5 on *Arctic Offshore Oil and Gas* has already examined instruments relating to petroleum hydrocarbons.) The key gaps in legal instruments that continue to put Arctic people and the environment at risk from pollution related impacts are outlined below.

While there have been some key successes in global and regional legal agreements and conventions to control and reduce the amount of pollution to the Arctic marine environment, particularly on hazardous substances such as POPs, gaps do remain. These include seeking further controls for substances at both the global and regional levels that have been shown to affect Arctic peoples and the marine environment.

Long-range transport of contaminants of concern to the Arctic are at the heart of global agreements such as the Stockholm Convention on POPs and a new United Nations Environment Programme (UNEP) legally-binding, global agreement for mercury (completion anticipated for 2013). These agreements aim to have a positive effect on the health of the Arctic environment and its peoples, particularly the Inuit who rely on marine mammals and fish as a major part of their diets. Significant gaps exist on control of pollutants related to climate change, including greenhouse gases (GHG) and short-lived climate forcers (SLCFs) such as black carbon. In addition, the influence of climate change on the effects and trends of hazardous substances in the Arctic, such as POPs and mercury, has not been fully evaluated and needs further scientific attention to determine its effects and any consequences for consideration under existing legal regimes.

Persistent Organic Pollutants (POPs)

The Arctic marine environment is particularly affected by POPs. The chemical industry is estimated to introduce thousands of new chemicals to the commercial market every year. While these chemicals can be screened for persistence and long-range transport potential, these characteristics are most easily demonstrated through measurements in the field. The Arctic is one of the few areas left in the world where remote, long-range transport can be demonstrated and used as a criterion for adding new POPs to the UNEP Stockholm Convention on POPs. Thus, Arctic POPs data continues to be critical for adding new POPs to the Convention for control.

The importance of states for the provision of such data remains critical, even though recent years have seen increased international efforts to reduce the use and emission of a number of POPs, and have resulted in generally declining levels of legacy POPs such as PCBs, DDTs, HCHs, and HCB. National policy efforts to reduce the use and emissions of these POPs have been extended regionally and globally through the regional UN Economic Commission for Europe (UN ECE) Convention on Long-range Transboundary Air Pollution (LRTAP) POPs Protocol and the UNEP Stockholm Convention. Currently, 22 POPs are being banned or restricted for use and production under the Stockholm Convention (nine new POPs were added in 2009 and another in 2011). It is critical that Arctic POPs data and trend information is provided in a timely manner to enable parties to evaluate the effectiveness of these legal regimes (e.g., Global Monitoring Plan's coordinating committee under the Stockholm Convention) and determine whether new substances should be added. Finally, the influence of climate change on POPs is a new area of research for which limited monitoring and data are available. The nascent understanding of this area renders it critical that states provide relevant data and support related research.

A Strategic Approach to International Chemicals Management was adopted by a consensus of Environment Ministers, Health Ministers and other delegates, including civil society and private sector representatives from more than one hundred countries participating in the International Conference on Chemicals Management (ICCM) in Dubai, February 2006. The Strategic Approach to International Chemicals Management (SAICM) is an international policy framework to foster the sound management of chemicals. The Strategic Approach supports the achievement of the goal agreed upon at the 2002 Johannesburg World Summit on Sustainable Development to ensure that, by the year 2020, chemicals are produced and used in ways that minimize significant adverse impacts on the environment and human health.

Heavy metals:
The Heavy Metals Protocol to the UN ECE Convention on Long-range Transboundary Air Pollution (1998) targets mercury, lead and cadmium. Parties to the protocol are required to reduce their total annual emissions to below the levels emitted in 1990 or another year between 1985 and 1995 identified by the party.

In 2000, the Arctic Council called on UNEP to initiate a global assessment of mercury that could form the basis for appropriate international actions. In February 2001, the UNEP Governing Council decided to initiate the Global Mercury Assessment. In 2003, UNEP agreed that there was sufficient evidence of significant global adverse impacts of mercury to warrant future international actions to reduce the risk to human health and the environment from the release of mercury and its compounds to the environment. In 2009, countries began a process under UNEP aimed at negotiating, by 2013, a legally binding agreement to control mercury pollution, including emissions to the atmosphere. The final negotiation session in January 2013 successfully concluded with the adoption of the UNEP Minimata Convention on Mercury. The Convention is scheduled for signature in October 2013. Implementation of the agreement could help significantly reduce Arctic mercury contamination over the long term. Since 2005, AMAP has worked closely with UNEP to support the UNEP mercury process and recently through its Intergovernmental Negotiating Committee (INC). Based on the recent AMAP Mercury Assessment, the impacts of global sources of mercury on Arctic people and the environment calls for urgent global action to reduce mercury emissions and thus reduce depositions of mercury in the Arctic marine environment. Finally, the influence of climate change on mercury is a new area of research and monitoring, and limited data are available. Here, too, it is critical for states to provide relevant data and support research related to climate change-mercury interactions.

Radionuclides: The main legal instrument controlling radionuclide pollution is the London Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (1972) and its Protocol (1996). The International Atomic Energy Agency (IAEA) has a role in controlling global sources from nuclear accidents (such as the Chernobyl, Russia and Fukushima, Japan incidents) that may impact the Arctic environment..

Climate Change: Among the instruments and initiatives relevant to climate change are the 1992 UN Framework Convention on Climate Change, its 1997 Kyoto Protocol, and the 2009 Copenhagen Accord, as well as the international Climate and Clean Air Coalition to reduce Short Lived Climate Pollutants. Under the 1979 UN ECE Convention on Long-Range Transboundary Air Pollution, its 1999 Gothenburg Protocol to Abate Acidification, Eutrophication and Ground-level Ozone was amended in 2012, with revisions that included ceilings for emissions of fine particulate matter and national commitments for emissions reductions to be accomplished by 2012 and beyond.

Physical Disturbances: Increased development in the Arctic marine environment, such as from oil and gas, shipping and mining operations due to climate change influences (e.g., melting sea ice), and the corresponding increased levels of accessibility to natural resources and seasonal ice-free seas for shipping navigation, may result in increased levels of pollution to the Arctic marine environment from these industrial sectors. Existing international guidelines have been developed by the IMO and Arctic Council Arctic Offshore Oil and Gas Guidelines (PAME 2009). Still, there is a need for Arctic states to consider mechanisms and control measures above and beyond current regulatory regimes to ensure protection of the Arctic marine environment and its peoples. This could include consultations and cooperation with IMO on the prospective mandatory Polar Code, and investigate further options for protecting marine sensitive areas.

Noise: Addressing noise from commercial ships and its adverse impacts on marine life is a work in progress within the IMO. The IMO's Design and Equipment Sub-Committee has recently finalized voluntary technical guidelines considering ship-quieting technologies and navigation/operational practices to minimize impacts. These guidelines will be considered for approval by the Marine Environment Protection Committee (MEPC).

6.4 Opportunities for Cooperative Action

(1) Participate in relevant agreements. The Arctic States recognize the importance of participation in relevant agreements in three areas:

- ✓ with respect to **Persistent Organic Pollutants**, providing timely POPs data and trend information, emphasizing identification of new chemicals, as part of encouraging all Arctic states to implement their obligations as appropriate under the Stockholm Convention and the UNECE LRTAP Convention – POPs Protocol or to consider ratifying that Convention and Protocol if they have not yet done so. AMAP, through national monitoring and research programs and its POPs Expert Group, should continue to provide these data products for the Conventions' use, with a particular emphasis on identifying new chemicals with the potential to contaminate the Arctic.
- ✓ with respect to **mercury**, implementing their obligations under the Heavy Metals Protocol to the UN ECE Convention on Long-range Transboundary Air Pollution, as appropriate, or to consider ratifying that Protocol if they have not done so; and to consider ratifying and actively implementing, as appropriate, the provisions of the UNEP Minamata Convention to be adopted in October 2013. Based on national monitoring and research programs, the AMAP Mercury Expert Group may be able to play an important role in contributing to the implementation of the new convention in ways similar to how the AMAP POPs Expert Group does for the Stockholm POPs Convention, by providing important Arctic monitoring data and information to evaluate the effectiveness of a new agreement. In addition, the ongoing work of the Arctic Contaminants Action Program (ACAP) Mercury Project Steering Group will play an important role in helping to identify and demonstrate viable means of reducing mercury emissions in Russia and other Arctic nations, in support of both ACAP and UNEP objectives.
- ✓ with respect to **conventions and negotiations relevant to climate change**, supporting research on climate change influences on POPs and mercury. This is a new area of research, and limited monitoring and data are available. It is therefore important that Arctic states support this area of research and ensure that the data and information is made available to the Stockholm Convention, the UNEP Intergovernmental Negotiating Committee process and forthcoming mercury convention, the United Nations Framework Convention on Climate Change (UNFCCC), the Intergovernmental Panel on Climate Change (IPCC) and the UN ECE – LRTAP Convention. These data can be used to determine if control measures for these harmful pollutants are effective or need to be revised based on new research and monitoring results.

(2) **Consider strengthening or creating new measures to address pollution from oil- and gas-related activity. Arctic states should consider strengthening or** developing measures, if a specific gap in current regulatory regimes has been identified, to ensure protection of the Arctic marine environment and its peoples. This could include consultations and cooperation with IMO on the prospective mandatory Polar Code, and investigating further options for protecting marine sensitive areas.

(3) **Reinforce monitoring.** Arctic states should reinforce the work of AMAP and CAFF in maintaining and increasing long-term monitoring efforts for pollutants in the Arctic marine environment, and encourage member states to continue or where lacking, develop such long-term monitoring programs to support this effort. These monitoring efforts, combined with complementary research and modeling, must ensure proper assessment of effectiveness of controls on pollution to the Arctic marine environment (e.g., monitoring of POPs, mercury and climate pollutants, biodiversity and combined effects as conducted by AMAP and CAFF).

(4) **Continue or increase involvement in IAEA review of nuclear safety standards.** Concerning radionuclides and following the 2011 Fukushima accident, IAEA member states have been active in reviewing, with an aim to improving, safety standards. Those Arctic states currently involved in this work should continue to engage with the IAEA, and those who have not been engaged should be encouraged to engage with the discussions in the IAEA, as appropriate.

(5) **Seek to control Short-Lived Climate Forcers (SLCF).** Concerning climate change and based on recommendations from the SLCFs Task Force under the Arctic Council, the Arctic states should seek opportunities at various global and regional levels, including through enhanced multilateral cooperation, to quantify and control black carbon emissions and other short-lived climate pollutants such as methane and tropospheric ozone. For example, Arctic states should consider supporting the recent amendments, made in May 2012, to the Gothenburg Protocol to the UN ECE Convention on Long-Range Transboundary Air Pollution. These amendments include voluntary actions to address black carbon. Another key target of opportunity could be to better quantify and reduce emissions of black carbon and methane from gas flaring in arctic oil and gas operations. It will be important that Arctic states avoid duplication at various levels, seeking instead to work in concert with on-going and new initiatives and instruments.

(6) **Exercise Arctic leadership on ocean acidification.** Recognizing the significant potential threats posed to Arctic marine ecosystems and Arctic biodiversity from climate change and ocean acidification identified by AMAP and CAFF, Arctic states should reaffirm the importance of their engagement in the UNFCC to reduce global greenhouse gas emissions as a matter of urgency. Arctic states should also increase their leadership role in the study of ocean acidification in Arctic waters.

(7) **Strengthen protections against land-based sources of marine pollution.** Arctic states should strengthen implementation of the Regional Programme of Action for the Protection of the Arctic Marine Environment from Land-based Activities (RPA Arctic) that may arise from current and future activities in the Arctic (such as mining or oil and gas development).

(8) **Continue to identify, monitor and assess the combined effects of multiple stressors** – *inter alia,* climate change, ocean acidification, shipping, living marine resource use, regional and long-range pollution, and offshore oil and gas exploration and extraction – on Arctic marine species and ecosystems. The Arctic Council Working Groups should continue on-going work under EBM, including the initiative "Adaptation Actions for a Changing Arctic" to achieve this endeavor, and strengthen the link between the current known status and future management of Arctic marine species and ecosystems.

(9) **Continue to identify and assess contaminants.** Arctic states should identify and assess contaminants that may pose a threat to Arctic marine species, ecosystems, and inhabitants, and consider options to address these threats.

References

ACIA 2005. Arctic Climate Impact Assessment (ACIA). Cambridge University Press.

AMAP 1998. AMAP Assessment Report: Arctic Pollution Issues. Arctic Monitoring and Assessment Programme (AMAP), Oslo, Norway.

AMAP 2003a. AMAP Assessment 2002: Human Health in the Arctic. Oslo: Arctic Monitoring and Assessment Programme (AMAP).

AMAP, 2003b. AMAP Assessment 2002: The influence of global change on contaminant pathways to, within and from the Arctic. Arctic Monitoring and Assessment Programme (AMAP), Oslo, Norway.

AMAP 2004a. AMAP Assessment 2002: Radioactivity in the Arctic. Oslo: Arctic Monitoring and Assessment Programme (AMAP)

AMAP 2004b. AMAP Assessment 2002: Persistent Organic Pollutants in the Arctic. Oslo: Arctic Monitoring and Assessment Programme (AMAP).

AMAP 2005. AMAP Assessment 2002: Heavy Metals in the Arctic. Oslo: Arctic Monitoring and Assessment Programme (AMAP).

AMAP 2006. Arctic Assessment 2006: Acidifying Pollutants, Arctic Haze, and Acidification in the Arctic. Oslo: Arctic Monitoring and Assessment Programme (AMAP)

AMAP 2009a. AMAP Assessment 2009: Radioactivity in the Arctic. Oslo: Arctic Monitoring and Assessment Programme (AMAP).

AMAP 2009b. AMAP Assessment 2009: Persistent Organic Pollutants in the Arctic. Science of the Total Environment. Volume 408/15 (2010). [Hung, H., Kallenborn, R, Breivik, K, Su, Y., Brorström-Lundén, E., Olafsdottir, K, Thorlacius, JM., Lepännen, S., Bossi, R., Skov, H., Manø, S, Patton, G.W., Stern, G, Sverko, Fellin, P. Atmospheric monitoring of organic pollutants in the Arctic under the Arctic Monitoring and Assessment Programme (AMAP): 1993-2006, Science of the Total Environment. Volume 408/2854-2873 (2010).

AMAP 2009c. AMAP Assessment 2009: Human Health in the Arctic. Oslo: Arctic Monitoring and Assessment Programme (AMAP).

AMAP 2010. Assessment 2007: Oil and Gas Activities in the Arctic – Effects and Potential Effects. Oslo: Arctic Monitoring and Assessment Programme (AMAP). Vol. 1 & Vol. 2.

AMAP 2011a. AMAP Assessment 2011: Mercury in the Arctic. Oslo: Arctic Monitoring and Assessment Programme (AMAP).

AMAP 2011b. Snow, Water, Ice and Permafrost in the Arctic (SWIPA): Climate Change and the Cryosphere. Oslo: Arctic Monitoring and Assessment Programme (AMAP).

AMAP 2011c. The Impact of Black Carbon on Arctic Climate. AMAP Technical Report No. 4 (2011). Oslo: Arctic Monitoring and Assessment Programme (AMAP).

AMAP 2011d. Combined Effects of Selected Pollutants and Climate Change in the Arctic Environment. AMAP Technical Report No. 5. Oslo: Arctic Monitoring and Assessment Programme (AMAP).

AMAP 2013. Arctic Ocean Acidification Report, 2013 (in press).

AMAP/UNEP 2008. Technical Background Report on the Global Atmospheric Mercury Assessment. Oslo: Arctic Monitoring and Assessment Programme (AMAP)/Geneva: UNEP Chemicals Branch.

Edson, R., Johnson, G.L., Codispoti, L.A., Curtin, T., and the ANWAP Science Team, 1997. The Arctic Nuclear Waste Assessment Program, Oceanography 10:1 (1997) 4-10.

Chapter 7 – Ecosystem-based management in the Arctic

7.1 Introduction

Population growth, technological development and the economic changes associated with globalization place increasing pressures on the entire earth system, including the Arctic. Over the last few decades, these strains have intensified concerns about the impact of economic development and accompanying effects, such as climate change, ocean acidification, pollution and changes in biodiversity on natural systems.

Integrated approaches to managing human uses of nature, such as ecosystem-based management and the ecosystem approach to management (EBM), are increasingly considered important strategies for confronting these challenges. This AOR Final Report uses the terms interchangeably and applies the abbreviation EBM as shorthand for both. The protection of ecosystems structures and functions is at the core of these strategies.

The complexity inherent in the marine environment, with its high biophysical dynamics, biological diversity and ecological interaction, combined with the common pool characteristics of marine resources, does not support single management approaches that often overlook interactions. Single sectoral approaches drastically reduce the ability of users, researchers and managers to have a complete picture and predict outcomes of both use and management (Píriz 2004). These general statements apply also to the Arctic, which is still a relatively pristine area. New and increasing demand for natural resources and reliance on ecosystem goods and services create a more complex picture.

Many of the challenges related to EBM are regional in nature. This holds true in the Arctic as well. As each of the preceding chapters indicates, EBM is key to framing and understanding both human uses and interests in ecosystems, and in responding to stresses and opportunities that increased shipping, oil and gas, and marine pollution are bringing to the Arctic, its people, the ecosystems and living marine resources. An important question for the Arctic Ocean Review is, therefore, what the future role of the Arctic Council should be in EBM. This chapter addresses that question and, because sound ecosystem-based approaches are intimately tied to the science that supports them, it also sets the stage for the concluding chapter on the role of science in addressing issues raised in the Arctic Ocean Review.

EBM has been on the agenda of the Arctic Council for more than a decade and is an area of emphasis for the Protection of the Arctic Marine Environment (PAME)

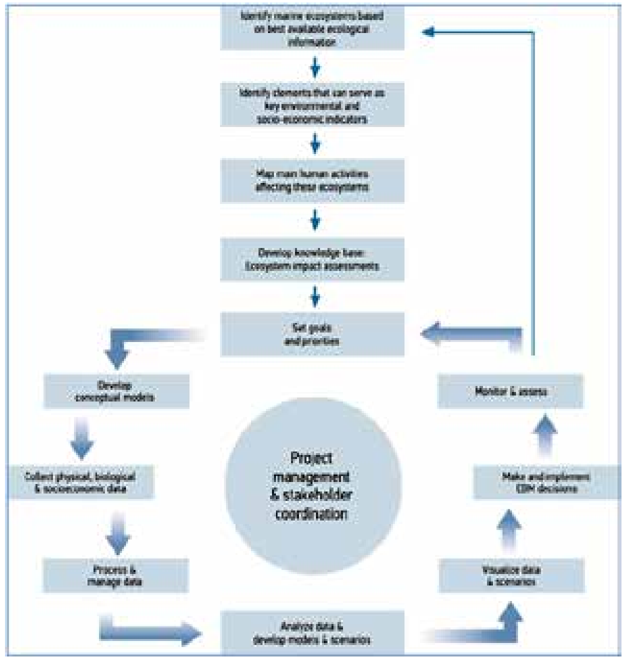


Figure 7.1. *Possible Methodology for Applying EBM.*

working group. The Arctic Council's Arctic Marine Strategic Plan, endorsed by the Arctic Council Ministers in 2004, pointed to EBM as key to "achieve the sustainable development of the Arctic marine environment" (PAME 2004, sec. 1.3). Subsequently, in 2009, Arctic Council Ministerial endorsed Best Practices for the Ecosystem-based Oceans Management in the Arctic Countries (BePOMAr). These guidelines were the outcome of a joint project of PAME and the Sustainable Development Working Group. EBM is also a guiding principle for the work of the Conservation of Arctic Flora and Fauna Working Group (CAFF). More recently, in May 2011, Arctic Council Ministers called for the establishment of an Expert Group on Arctic EBM. This group was tasked with "fostering a common understanding of EBM and EBM principles across the Arctic Council and providing guidelines or recommendations for advancing EBM in the coastal, marine and terrestrial ecosystems of the Arctic."

A critical step in the implementation of EBM is the description and identification of the marine ecosystems (see Figure 7.1). The Arctic marine environment can be defined in a number of ways, but can broadly be understood to include the northern North Atlantic, the North Pacific and the central Arctic Ocean (see map on the inside cover of this report). This is a vast region, with enormous differences in natural conditions, ranging from temperate waters in the north Atlantic to the ice-covered central Arctic Ocean. The Arctic thus understood is very diverse in terms of economic development, population and administrative systems. The management needs and what EBM would mean in practice varies from region to region.

The diversity of the Arctic marine environment is recognized in PAME's work to identify and define 18 Large Marine Ecosystems (LMEs) with very different characteristics (PAME 2011-2013). Ecosystems can be delimited in different ways, and using LMEs is one approach to this. The LME are relatively large regions (~200,000 km^2) and characterized by distinct bathymetry, hydrography, productivity and trophic dependent populations (Sherman et al. 1993).

7.2. Defining ecosystem-based management

Dozens of definitions exist for EBM, and while no universally agreed definition has been arrived at, most include the same concepts.

The four elements commonly found in EBM definitions are: to integrate management of human activities; assess or conserve the ecosystem itself; take appropriate measures based on best available scientific and traditional knowledge; and the dual objectives of sustainable use and conservation.

For the purpose of the Arctic Council, EBM can be defined as the comprehensive integrated management of human activities based on best available scientific and traditional knowledge about the ecosystem and its dynamics, in order to identify and take action on influences that are critical to the health of ecosystems, thereby achieving sustainable use of ecosystem goods and services and maintenance of ecosystem integrity.

7.3 Global and regional efforts to enable ecosystem-based management

The Arctic marine environment is largely under the jurisdiction of states that, from a global perspective, are relatively well endowed with the legal, financial and administrative resources to implement EBM. Regional oceans management bodies in the North Atlantic and the North Pacific – both seas with substantial Arctic and sub-Arctic components – have taken an active role in developing EBM.

Ecosystem-based management of the marine environment is advanced through developments in marine science, through an increasing number of binding and non-binding international instruments and the development of EBM strategies at the national level. At the global level, the legal foundations for EBM trace to the 1982 UN Convention on the Law of the Sea (UNCLOS). The term EBM was not sufficiently developed when the Convention was negotiated, but Article 194 refers to fragile ecosystems and the preamble explicitly states that "... the problems of ocean space are closely interrelated and need to be considered as a whole."

The UNCLOS is the basis for international and many domestic efforts relating to oceans management. It establishes global rules for the use of ocean space, for sovereign rights over living and non-living marine natural resources, for their management, for how international and regional cooperation and marine scientific research are to take place, and for enforcement and dispute resolution (Ebbin et al. 2005). A dynamic framework evolving over time in response to new challenges, the Convention has been supplemented with additional instruments, such as the 1995 UN Fish Stocks Agreement (UNFSA), which refers explicitly to EBM in Article 5(e).

Efforts to develop principles for applying EBM can be found in a range of international and regional instruments. These include UN General Assembly Resolutions, the 1992 Convention on Biodiversity and three landmark UN environmental summits.

The UN General Assembly included a paragraph related to EBM in its 2007 resolution on oceans and the law of the sea (UN 2007. A/RES/61/222). Paragraph 119 is based on agreed consensual elements relating to ecosystem approaches and oceans developed by the UN Open-ended Informal Consultative Process on Oceans and the Law of the Sea in 2006 (UN 2006. A/RES/61/156). The agreed elements include a comprehensive listing of components that an ecosystem approach to oceans management should consider, as well as requirements for improved application of an ecosystem approach. This paragraph has been reaffirmed by the General Assembly every year since 2006, as, for example, in paragraph 157 of the 2012 oceans resolution (UN 2012. A/RES/66/231). Various documents, including the Resolutions, refer to "principles," "elements" and "criteria" relating to EBM. The use of such terms across the various documents is not consistent, but the concepts are.

The global environmental summits in 1992 (UN Conference on Environment and Development (UNCED), 2002 World Summit on Sustainable Development (WSSD) and 2012 (Rio+20) all addressed EBM. The Convention on Biological Diversity (CBD), which arose from the 1992 UNCED, uses the ecosystem approach to address Coastal and Marine Biodiversity. In Agenda 21, UNCED's action plan for the global environment, Chapter 17 (on oceans) specifically addresses integrated oceans management. The 2002 WSSD Johannesburg Joint Plan of Implementation states that ensuring the sustainable development of the oceans requires effective coordination and cooperation between relevant bodies, and actions at all levels to "Encourage the application by 2010 of the ecosystem approach." The 2012 Rio+20 meeting adopted "The Future We Want" declaration, in which the oceans chapter addresses ecosystem concerns.

Regional conventions such as the Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR) and the Convention for the Conservation of Antarctic Marine Living Resources (CCAMLR), as well as scientific organizations such as the International Council for the Exploration of the Sea (ICES) and the North Marine Science Organization (PICES), address ecosystem concerns. Cooperative arrangements between regional seas conventions, fisheries management organizations and scientific organizations, such as OSPAR, the Northeast Atlantic Fisheries Commission (NEAFC) and ICES, offer a robust framework for EBM.

The AOR Final Report does not enter into the issue of bilateral cooperation, but in practice this is an important aspect of EBM: ecosystems shared between countries necessitate cooperation in bilateral management. A case in point is the Barents Sea, which is divided between Norway and Russia, but can be said to constitute one LME. Norwegian and Russian fisheries cooperation, as well as cooperation on environmental issues, underpins EBM in the Barents Sea. Their cooperation on fisheries management dates back to the 1950s, the Joint Fisheries Commission was established by an Agreement from 1975, and an agreement on reciprocal fisheries relations was entered into in 1976. The maritime delimitation treaty between Norway and Russia from 2010 confirms the continuation of the fisheries cooperation between Norway and Russia in the whole of the Barents Sea.

7.4 Science – policy interaction

EBM is a knowledge-intensive approach to the management of human activities in ecosystems. Science is a fundamental underpinning of EBM. An essential component of EBM is the description and definition of the structure and functions of ecosystems, a single task that requires substantial scientific effort. Article 61 of the UNCLOS obliges states to take into account the "best scientific evidence available" in the management of the living marine resources in their exclusive economic zones. Also critical to EBM is monitoring over time of key elements of the ecosystems. This too requires considerable scientific effort. In addition, there are other types of expert knowledge that can enrich EBM. There is also knowledge by users or observers of nature that is based on long-term practice and/or repeated observation. This latter type is commonly referred to as traditional and/or local knowledge and tends to be situational and somewhat limited in space and time.

The science that contributes to operational, day-to-day EBM is mostly found at the national level, the application of which is beyond the scope of the Arctic Ocean Review. However, a number of international science bodies and endeavors have programs relevant to the Arctic. These include ICES, PICES, the International Arctic Science Committee (IASC), the Sustained Arctic Observing Network (SAON), the International Polar Year (IPY) and its follow-up, and others. Significant funding of research programs comes from Arctic states as well as other interested parties. The need to establish baseline data of ecosystem properties at a pan-Arctic level has been raised in a number of these entities and programs. The Arctic Biodiversity Assessment (ABA), Snow, Water, Ice and Permafrost in the Arctic (SWIPA) and Human Health assessments are examples of how the Arctic Council addresses this need. International science programs are important for setting research agendas and fostering international scientific collaboration.

7.5 The role of the Arctic Council in EBM

As noted above, in practice most of the actual work on implementing the ecosystem approach takes place at the domestic level. Arctic states have for some time invested substantial efforts in the development and implementation of EBM at the domestic level (Hoel et al. 2009). This is where the legal, financial and administrative means to actually do EBM exist. There is a need to also develop such means at other scales or units. Advances in scientific understanding of ecosystems and experiences in the implementation of EBM mean that EBM will evolve over time.

This does not mean that regional and international cooperation is unimportant for EBM. The international legal framework, regional cooperation on science and developing principles for EBM are all vital to the subsequent domestic EBM efforts. Regional and international cooperation are also important for sharing of experiences and learning from each other as the practice of EBM evolves.

The Arctic Council has been significantly engaged in increasing understanding of EBM for some time. A PAME expert group has studied EBM; the Arctic Council Ministers endorsed a joint SDWG/PAME Summary of Observed Best Practices for Ecosystem-based Oceans Management in Arctic Countries in 2009; and, in the Nuuk Declaration in 2011, the Expert Group on EBM that was established by the Arctic Council for the 2011-2013 period provided a report to the Ministers in 2013 containing 12 recommendations, as well as supporting documents further describing EBM in the Arctic and opportunities to advance it. Further, the Arctic LME map has practical implications for how information about ecosystems is presented.

This EBM work is consistent with the objectives of the 1996 Ottawa Declaration on the Establishment of the Arctic Council, which states that the Council should "promote cooperation, coordination and integration among the Arctic States, with the involvement of the Arctic indigenous communities and other Arctic inhabitants on common Arctic issues, in particular issues of sustainable development and environmental protection in the Arctic." The Council's work also incorporates lessons learned from international policies that encourage EBM globally, and institutional frameworks that enable EBM regionally.

The Arctic Council members can contribute to the further development of EBM by supporting management efforts at domestic and international levels in the five areas identified below. Background information on these five areas is presented here. Opportunities for action associated with each of these can be found in the concluding section of the chapter.

1. Adopt definition and principles for EBM. A common understanding on what is meant by EBM is an important basis for advancing the work on this issue in the Arctic Council.

The Arctic Council EBM expert group has formulated an EBM definition. The Expert Group has also identified a number of principles that can represent common elements of a potential approach by the Arctic Council.

2. Provide an identification and description of ecosystems. A critical first step when implementing EBM is defining specific ecosystems based on ecological criteria. This is not an easy task in the sea where the ecological boundaries can by fluid, and the temporal and spatial coordinates of multiples species are so different, and particularly when the movement of highly migratory species like cetaceans and birds is considered.

LMEs in the Arctic have been identified in the format of the Arctic LME map, introduced at the end of section 7.1.

The question of how to define ecosystem boundaries for management purposes at small and large scales suggests that ecosystems should be seen as hierarchically nested across scales. This supports the idea of starting with large-scale management units such as the LME. For example, CAFF, through the Circumpolar Biodiversity Monitoring Program (CBMP), has already defined Arctic marine areas that are similar to the LMEs. A suite of common parameters, sampling approaches and indicators are being applied in these areas.

An ecosystem description would include elements of the system such as the seafloor, currents and water masses, plankton, benthos, fish stocks, marine mammals and birds. Descriptions could include lists of species, the biology and ecology of the dominant species, accounts of food webs, trophic interactions, animal migrations, and several other aspects of ecosystems. Such basic descriptions may remain valid over time, although periodic updates to reflect new knowledge and/or changes in the ecosystem may be needed.

Valuable and vulnerable areas, where ecosystem properties are particularly important for the functioning of the ecosystem and the delivery of ecosystem services, are an important feature of LMEs.

While an Arctic LME map exists, actual management will often require more substantial assessments of the ecosystems in question. Several Arctic states already manage their oceans on the basis of ecologically defined areas. In order to be useful in the context of management of large marine ecosystems or similar geographically defined eco-regions, ecosystem assessments should be based on the LME map as far as practicable, and complemented by other processes. Since identified ecosystems can overlap within two or more countries, bilateral and international cooperation are important.

3. Develop ecological objectives. An important step in the implementation of EBM is the development of ecological objectives for management. The OSPAR Commission for the North-East Atlantic has developed Ecological Quality Objectives for the North Sea as part of its ecosystem approach. The work has taken a long time and remains a work in progress. Another example is how ICES advises OSPAR in the work of defining Ecological Quality Objectives.

The Marine Strategy Framework Directive of the European Commission implements the ecosystem approach in the European Union (EC 2008). The directive sets ecological objectives, with Good Environmental Status as an overarching objective. Good environmental status is defined and characterized by 11 qualitative descriptors, such as no adverse effects from pollution, eutrophication, introduced species, noise and hydrological changes.

The diversity of marine ecosystems in the Arctic may preclude the development of one, universal set of ecological quality objectives for the Arctic marine environment as a whole. But the Arctic Council could play a role in initiating work on such objectives and the establishment of overarching ambitions that such ecological quality objectives are to address. Inspiration for such ambitions can be found, for example, in the CCALMR or the Food and Agriculture Organization (FAO) Technical Guidelines for Responsible Fisheries (FAO 2009). Such a standard would need to incorporate conservation as well as use concerns. Also, work on ecological quality objectives in an Arctic context could address possible methods for identifying and operationalizing them.

4. Assess ecosystems. While management objectives identify a desired status that management measures are to achieve, ecological quality objectives provide more detailed standards against which developments can be measured. Ecological quality objectives need to be continuously monitored in order to assess progress towards management objectives. Integrated assessments of ecosystems are therefore a core element of the ecosystem approach (Levin et al. 2009). By evaluating the status and trends in significant ecosystem components, the overall state of the ecosystem can be assessed. This includes impacts from human activities such as fishing, pollution, coastal development, etc., as well as the overall or cumulative impacts of those activities. Integrated assessments also include socioeconomic factors.

Marine ecosystems are inherently dynamic. Physical forcing, expressed by variability in ocean climate (currents, water masses etc.), has large influences on populations of fish and other organisms and on ecological processes. The large natural variability of marine ecosystems in the Arctic poses a challenge for assessing the impact of human activities. Assessments need to distinguish anthropogenic effects from the natural fluctuations in ecosystem components.

The role of indicators and ecological modeling as tools for carrying out integrated assessments are being explored in many contexts. Indicators may have limitations in assessments because of the complex and dynamic nature of marine ecosystems. The Arctic Council, through the CBMP, is implementing a marine biodiversity monitoring plan. This plan identifies eight Arctic marine areas where a suite of common parameters, sampling approaches and indicators will be used with the first state of the marine environment scheduled for 2015.

The development and testing of assessments that are informed by different knowledge forms (scientific and practical or traditional) and different disciplines, is implemented around the world. Integrated assessments provide a framework for organizing different knowledge forms and scientific information in order to inform decisions on the management of the marine ecosystems at multiple scales and across sectors.

5. Promote common understanding and the mutual exchange of lessons learned. One of the most important legacies of the Arctic Environmental Protection Strategy and the Arctic Council is their ability to foster a common understanding among Arctic states of challenges facing the Arctic. Many examples exist of the Arctic Council's promotion of such collaboration over time between scientists, administrators and Northern Peoples from different countries, including the Arctic Climate Impact Assessment, the Arctic Marine Shipping Assessment, the Arctic Human Development Report, and ongoing work such as ABA, SWIPA and the Arctic Oil and Gas Assessment. These initiatives have greatly contributed to enhanced mutual understanding of the driving forces and effects of change in these areas.

Such common understanding is also critically important in the context of Arctic EBM, where there is a need for a flexible and adaptive management approach. Arctic ecosystems and human activities are dynamic, and the understanding of these systems and activities is constantly evolving. Furthermore, ecosystems are not discrete, isolated geographical areas with tightly-defined boundaries. Rather, Arctic ecosystems are nested within larger dynamic regional and global systems. EBM provides an inclusive framework for balancing competing priorities and interests. Ongoing efforts are required to foster common understanding of coastal, marine and terrestrial ecosystems, and to find ways to effectively implement EBM.

A possible role for the Arctic Council in the context of EBM is to develop a mechanism for countries to exchange lessons learned as they implement integrated assessments, best practices and other measures adopted by the Council.

7.6 Opportunities for Cooperative Action

The Arctic states should:

(1) **Agree on definition and principles**

- ✓ Adopt the definition of, and principles for, EBM developed by the Expert Group on EBM in response to the request by the Arctic Council Ministers in Nuuk in May 2011.

(2) **Identify and describe ecosystems**

- ✓ Endorse the need for revisions to ecosystem understanding based on changing conditions in the Arctic, and for data and information in Arctic Council marine assessments to be organized on the basis of the LME map as appropriate.

(3) **Set ecological objectives**

- ✓ Establish a project to develop ecological objectives, with a view to exchanging experiences and learning, and to consider implementing "conservation and use standard" for EBM in Arctic marine environments drawing on the UNCLOS Convention, CAFFs' 1997 Cooperative Strategy for the Conservation of Biological Diversity, and other relevant international instruments for EBM.

(4) **Assess and value ecosystems**

- ✓ Develop Best Practices for assessment work in Arctic Council working groups.
- ✓ Develop methodologies for integrated assessments and discussion of indicators, where needed, through workshops that encourage the exchange of experiences.

(5) **Promote common understanding and the mutual exchange of lessons learned**

- ✓ Continue the work of the PAME Ecosystem Approach expert group with regular meetings to share information, strategies and plans and, as appropriate, with the cooperation of other working groups.
- ✓ Convene as appropriate periodic Arctic-wide meetings for states to exchange knowledge and lessons learned with respect to management and science across Large Marine Ecosystems.
- ✓ Institute periodic Arctic Council reviews of marine EBM in the Arctic, including BePOMAr, to exchange information on integrated assessment and management experiences, including highlighting examples from Arctic states.
- ✓ Develop as needed a mechanism for acknowledging and fostering the implementation of EBM related measures in the Arctic in accordance with the recommendations of the EBM Expert Group, to ensure that Working Groups coordinate marine EBM efforts and best practices, including with related efforts in the coastal and terrestrial environments, as appropriate.

References

Literature

AMSP. 2004. Arctic Council, Arctic Marine Strategic Plan 2004, Protection of the Arctic Marine Environment (PAME) Secretariat, Akureyri, Iceland.

Cochrane, K.L., Augustyn, C. J., Fairweather, T., Japp, D.; Kilongo, K., Iitembu, J., Moroff, N., Roux, J. P., Shannon, L., Van Zyl, B. & F. Vaz Velho, F. 2012: The Benguela Current Large Marine Ecosystem: Governance and Management for an Ecosystem Approach to Fisheries in the Region. Coastal Management 37(3-4): 235-254.

Ebbin, S.A., Hoel, A.H., Sydnes, A.K. (eds.), 2005. A Sea Change: The Exclusive Economic Zone and Governance Institutions for Living Marine Resources. Dordrecht: Springer.

Hoel, A.H., von Quillfeldt, C., Olsen, E., 2009. Norway and integrated oceans management – the case of the Barents Sea. In: Hoel, A.H. (Ed.), Best Practices in Ecosystem-Based Oceans Management in the Arctic. Report Series No. 129. Tromsø: Norwegian Polar Institute.

Levin, P., Fogarty, M., Murawski, S., & Fluharty, D. (2009). Integrated ecosystem assessments: developing the scientific basis for ecosystem-based management of the ocean. PLoS Biology, 7(1), e1000014.

Píriz. L. 2004. Hauling home the comanagement of coastal fisheries. A Study on Institutional Barriers to Fishermen's Involvement in the Management of Coastal Fisheries on the West Coast of Sweden. Doctoral Thesis, Department of Environmental and Regional Studies of the Human Condition. Human Ecology Section, Göteborg University, Sweden.

Sherman, K. et al. (eds.). 1993. Large Marine Ecosystems: Stress, Mitigation, and Sustainability, Washington, D.C.: American Association for the Advancement of Science, 1993.

Documents

EC (European Commission). 2008. Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008 establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive). 25.6.2008 Official Journal of the European Union L 164/19.

FAO Technical Guidelines for Responsible Fisheries. No. 4, Suppl. 2, Add. 2. Rome, Food and Agricultural Organization (FAO). 2009.

OSPAR/HELCOM. 2003. Joint Ministerial Statement on the Ecosystem Approach to the Management of Human Activities. Towards an Ecosystem Approach to the Management of Human Activities. First Joint Ministerial Meeting of the Helsinki and OSPAR Commissions (JMM) Bremen: 25-26 June 2003, Agenda item 6, Annex 5, (Ref. §6.1). Available at http://www.helcom.fi/stc/files/BremenDocs/JointEcosystemApproach.pdf

PAME Work Plan 2011-2013, undated, p. 7

United Nations. 2006. General Assembly, A/61/156 Report of the work of the United Nations Open-ended Informal Consultative Process on Oceans and the Law of the Sea at its seventh meeting. 17 July 2006.

United Nations. 2007. General Assembly, Resolution A/61/222. Oceans and the law of the sea. 16 March 2007.

United Nations. 2012. General Assembly Resolution A/RES/66/231. Oceans and the law of the sea. 5 April 2012.

Jeremy Potter NOAA/OAR/OER

Chapter 8 – Arctic Marine Science

8.1 Introduction

A goal of the AOR is to assist Arctic Council Ministers in efforts to strengthen governance and to achieve environmental, economic and socio-cultural outcomes in the Arctic, through a cooperative, coordinated, and integrated approach to the management of activities in the Arctic marine environment. Science plays an essential role in these processes across a broad range of disciplines and issues.

Science as a means to an improved understanding of the natural world can be distinguished from the social sciences, which focus primarily on understanding the human condition, including human behaviors and interactions. While science involves pure research in relation to biological, geophysical and human-oriented fields, it also includes numerous applied sciences in relation to the Arctic marine environment. These include, but are not limited to, marine engineering, renewable and non-renewable resource development technologies, navigation systems, monitoring and communication technologies.

In this context, increasing the effectiveness of Arctic marine science, by necessity, requires ongoing research and development, better acquisition, storage, management and dissemination of data and information, more reliance on science-based decision-making, better knowledge-to-action or science-to-policy approaches, and more coordination and cooperation across disciplines and among Arctic states. A related issue is integration among scientific disciplines to provide a more holistic or balanced understanding of the dynamic systems at play in the Arctic, in respect of both natural systems and human-built systems.

Chapter 2, *Indigenous Peoples and Cultures*, indicates how other forms of knowledge acquisition and dissemination are also relevant for governance and management processes in the Arctic marine environment. Integrating indigenous/local knowledge with the various fields of natural and social science to effectively inform management processes will require considerable ongoing efforts. Indeed, there is some urgency in conducting appropriate studies of local practices to provide information while there is still time to use it.

8.2 Translating Knowledge into Action

The scientific community today faces an increasing demand for reliable, policy relevant information that can be acted upon. The phrases "science to policy" and "knowledge to action" are commonly used to describe the processes involved in addressing this demand.

It is important to note that not all science leads to policy- or law-making. There is no predictable timescale for the translation of science to policy or knowledge to action. Some scientific knowledge might incubate for generations before its practical application is recognized or possible. In addition, the phrases "science to policy" and "knowledge to action" imply that science and knowledge follow a linear, uni-directional path to practical policy, law or action: science leads to policy, knowledge leads to action. In reality, the relationships among science, knowledge, law and policy are complex, and involve a range of factors such as time scale, geographical (spatial) scale, budget cycles, political philosophies, socio-cultural priorities, and national and geopolitical interests.

Whether science should lead policy and law, or whether policy and law should direct science, is an ongoing discussion. In reality, science, law and policy should reinforce each other. There are many situations where policy and law directly influence research agendas, how science is conducted, and how scientific knowledge is applied or utilized. For example, institutional mandates and budgets for research and scientific activities are based on policy choices that are often driven by attempts to resolve conflicting or competing human interests.

Similarly, science contributes to and influences the development of laws and policies over time. The science cooperation within the Arctic Council provides a number of examples that are cited in this AOR Final Report. Science is also important in ongoing processes for monitoring and assessing the successes and shortcomings of existing laws and policies in meeting their stated objectives for environmental integrity, sustainability, and other issues relating to economic, social and political efficiency and effectiveness.

Given the rapid increase in interest in marine shipping, mining, petroleum development, tourism and other activities in Arctic waters, it is important that decisions be based on the best available information. A lack of data, information or knowledge, coupled with imperfectly understood complex relationships within and among Arctic ecosystems and Earth systems, present significant challenges for policy makers and governance systems (ICSU, 2010). In addition, positive relationships among science, indigenous/local knowledge, policy and law are important for the translation of new knowledge into practical measures to implement existing instruments and to develop new instruments for the Arctic marine region.

8.3 Challenges and Emerging Issues

The foregoing chapters contain many references to the importance of science, and more generally, knowledge, in the management of activities in the Arctic marine environment. Some of those references are tied directly to the individual instruments that are the focus of this AOR Final Report; others suggest how the instruments could benefit from a better flow of information between scientists and knowledge-producers on the one hand, and those that need that information to make good decisions on the other.

Chapter 2, *Indigenous Peoples and Cultures*, stresses the importance of local and traditional knowledge in Arctic marine management systems. It highlights that the people and communities of the Arctic have long-term connections to coastal and marine environments that enable them to understand these ecosystems in ways that science is only beginning to appreciate. The challenge is to find ways to work with existing instruments, institutions of governance, private companies and even other local communities to develop responses that can minimize the negative impacts of environmental and social change, while allowing Arctic residents to maximize any benefits or opportunities that arise. Chapter 2 notes, however, that studies of the use areas or harvest levels for many renewable resources are often decades out of date.

Similarly, Chapter 3, *Arctic Marine Operations and Shipping*, points to the vital need for improved Arctic charting and greatly enhanced marine observations to improve operational safety. Most of the coastal Arctic requires extensive hydrographic surveying. Chapter 4, Marine Living Resources, observes that more information is needed regarding the existence of fish stocks or the potential for the existence of fisheries resources in large parts of the Arctic Ocean. Chapter 5, *Arctic Offshore Oil and Gas*, notes that there is speculation about development of offshore petroleum resources, but projections are based on undiscovered and unproven fields. Science to support environmentally responsible exploration, development and delivery of petroleum resources in Arctic marine areas is ongoing (for example, USGS 2011, An Evaluation of the Science Needs to Inform Decisions on Outer Continental Shelf Energy Development in the Chukchi and Beaufort Seas, Alaska, circular 1370).

Chapter 6, *Arctic Marine Pollution*, notes the need for long-term monitoring efforts for pollutants in the Arctic marine environment, in part to assess the effectiveness of pollution control measures. Chapter 7, *Ecosystem-based Management*, stresses the importance of science in describing and defining the structures and functions of ecosystems and the interconnections of activities as they relate to impacts on ecosystems. Long-term monitoring of key elements of ecosystems is critical to EBM and requires considerable scientific effort.

8.4 Instruments Relevant to Arctic Marine Science

A number of existing international instruments provide a framework for scientific cooperation to guide and regulate the conduct of marine scientific research, globally and regionally. The UN Convention on the Law of the Sea (UNCLOS) is a primary instrument in this context, while the Declaration on the Establishment of the Arctic Council (Ottawa 1996) provides for a high-level forum for cooperation among the Arctic states that is increasingly relevant in the context of integration of science into policy and law. While there is no single comprehensive, legally-binding global or regional instrument in relation to Arctic environmental protection and sustainable development, current legal regimes at the global, regional, national and local levels constitute complex, detailed management frameworks (Molenaar 2012, Young 2012) that can support the promotion of sustainable, integrated and/or ecosystem-based approaches.

The Arctic Monitoring and Assessment Programme's (AMAP) assessments on Arctic contaminants in the 1990s led Arctic Council Ministers to express their support through Arctic Council Ministerial declarations for legally-binding instruments to control emissions and discharges of persistent organic pollutants (POPs). As a part of their commitment to take AMAP findings into consideration in their policies and programs, Ministers agreed "to work vigorously for the early completion and implementation of a protocol on the elimination and reduction of persistent organic pollutants (POPs) under the framework of the United Nations Economic Commission for Europe (UN ECE) Convention on Long-range Transboundary Air Pollution" (Alta Declaration 1997), and to promote international cooperation to secure support for international actions in order to address the serious pollution risks reported by AMAP (Iqaluit Delaration 1998). The Convention on Long-Range Trans-boundary Air Pollution adopted the Protocol on Persistent Organic Pollutants in June 1998 in Aarhus, Denmark.

Ecosystem-based Management

Chapter 7, *Ecosystem-based Management*, examines the use of "best scientific evidence available" for the management of the activities in the marine environment and the importance of science for implementing EBM. These matters will not be re-examined here, other than to mention the importance of local and indigenous knowledge in setting research agendas, building cooperation among local, national and regional management organizations, and giving proper consideration to competing uses and priorities.

While not related specifically to EBM, the preamble to the 2001 Stockholm Convention on Persistent Organic Pollutants acknowledges that Arctic ecosystems and indigenous communities are particularly at risk because of the bio-magnification of persistent organic pollutants, and that contamination of traditional food is a public health issue. A similar preambular clause is also included in the UN ECE POPs Protocol to the Convention on Long-range Transboundary Air Pollution. The references to indigenous peoples and the Arctic region in these international instruments reflects, in part, the prominence of Arctic data presented by the Arctic Council as the context in which the negotiations took place, and the very effective participation of a coalition of Arctic indigenous peoples as observers in the negotiations. However, in practice, incorporating indigenous knowledge into the decision-making process is a challenge.

EBM and the science that supports it must recognize all the factors that can affect an ecosystem and therefore regional and global issues also need to be taken into account.. This necessitates international science cooperation and a framework of common or compatible standards, systems and policies for monitoring, accessing and sharing of data

As Chapter 7 indicates, science that contributes to actual day-to-day EBM is mostly found at the national level. However, EBM and the science that supports it must recognize all the factors that can affect an ecosystem and therefore regional and global issues also need to be taken into account. This necessitates international science cooperation and a framework of common or compatible standards, systems and policies for monitoring, accessing and sharing of data. Given the operational costs in Arctic marine areas, opportunities for using or sharing platforms and other infrastructure should be examined.

Arctic Council working groups and a number of international science bodies (marine and terrestrial) have the capacity to provide advice on such matters to the Arctic Council to support EBM in Arctic marine areas, and to inform the sectors discussed in other chapters of this AOR Final Report. These include the International Council for the Exploration of the Sea (ICES), the North Pacific Marine Science Organization (PICES), the International Arctic Science Committee (IASC), the International Arctic Social Sciences Association (IASSA); the International Study of Arctic Change (ISAC); the Pacific Arctic Group (PAG); a circum-Arctic network of terrestrial field bases referred to as ScanNet; the Arctic Regional Ocean Observing System (Arctic ROOS); the Sustaining Arctic Observing Networks (SAON); and the International Network for Terrestrial Research and Monitoring in the Arctic (InterAct).

Marine Scientific Research

At the global level, Part XIII of the UNCLOS, which is applicable in the Arctic, contains provisions that address the rights and obligations of States with respect to the conduct of marine scientific research in the different maritime zones. The Convention also contains general principles for the conduct of marine scientific research. While the term "marine scientific research" is not defined in the Convention, it does not appear to include social sciences.

Several scientific-related fields are covered by other provisions of the Convention or other legal regimes, and are not part of the Marine Scientific Research (MSR) provisions, for example, hydrographic surveys, exploration and exploitation of natural resources (including fish), and underwater cultural heritage.

While the UNCLOS protects freedom of MSR on the high seas (Article 87) and MSR in the Area (Article 143), subject to certain conditions, a coastal state may exclusively regulate, authorize and conduct MSR within its territorial seas and internal waters. With respect to the exclusive economic zone (EEZ) and continental shelf, a coastal State shall, in normal circumstances, grant their consent to MSR. In addition, states have a duty to promote and facilitate the development and conduct of marine scientific research.

"International Cooperation" is specifically dealt with in the MSR provisions (s.2 of Part XIII) of the Convention but this provision does not create obligations in relation to regional cooperation. Other provisions of the Convention (Part XII) do create obligations to cooperate, on a global and regional basis, in respect of marine environmental protection, but do not specify the form of cooperation (Molenaar 2012).

The International Hydrographic Organization Convention contains objectives that encourage regional cooperation (Article II) and the Arctic Region Hydrographic Commission (ARHC) was accordingly established in 2010.

The OSPAR Commission was established by the 1992 Convention for the Protection of the Marine Environment of the North-East Atlantic. In 2008, the OSPAR Commission adopted a Code of Conduct for Responsible Marine Research in the Deep Seas and High Seas of the OSPAR Maritime Area that includes an Arctic marine region adjacent to the northeast Atlantic. In view of the potential impact of scientific activities on the marine environment, the OSPAR Commission requests scientists working in the deep seas and high seas of the OSPAR maritime area to adhere to the code of conduct when planning and carrying out their research.

In addition to the instruments already mentioned, several multilateral bodies can help coordinate activities relevant to Arctic marine science (e.g., IASC, IASSA, ICES, PICES, IOC). For example, through memoranda of understanding, the IOC cooperates with the ICES in the North Atlantic, and with the PICES in the North Pacific region. UN agencies that work closely with the IOC on programs of mutual interest include the World Meteorological Organization (WMO), the United Nations Environment Programme (UNEP), the International Maritime Organization (IMO), the Food and Agriculture Organization (FAO), and the International Atomic Energy Agency (AOR-I, 2011). Additionally, there are several non-governmental organizations already associated with the Arctic Council that have played a significant role in cooperative initiatives relating to Arctic marine science.

While it is not uncommon to see statements in the literature that lament the lack of baseline information or data in many sectors of Arctic science, there seems to be no lack of bodies and organizations - governmental and non-governmental – at work on Arctic science and regulation. Some of these organizations are already observers within the Arctic Council system, while others, such as ICES and PICES, count Arctic states among their members. Provisions in the UNCLOS, OSPAR, and the PICES and ICES Conventions, as well as other instruments, present opportunities for better coordination, cooperation and management in relation to Arctic marine scientific research. However, there is no comprehensive or readily available "network map" that identifies relevant Arctic research and science organizations, and governance organizations, on an integrated or multi-sectoral basis. In order to foster cooperation and build linkages, a better understanding of the machinery underlying these organizations is required within the Arctic Council and among officials and scientists. Some effort could be made to better represent the wide range of players in the field and their relationship to various instruments.

8.5 Cooperation and Coordination on Science-based Instruments

Promoting cooperation and improved coordination of reporting between science-based instruments are not new proposals for the Arctic. A 2006 UNEP/Grid-Arendal workshop studied the effectiveness of Multilateral Environment Agreements (MEAs) in the Arctic, and recommended that Contracting Parties, governing bodies and secretariats of multilateral MEAs "Work to improve communication among secretariats of related MEAs and together look at opportunities for more effective division of labour and increased collaboration on consultation, implementation, reporting and outreach" (UNEP/GRID-Arendal et al. 2006, para. 2.5.3). It also suggested a survey of the "status of co-operation between MEA secretariats and between the Contracting Parties to MEAs on addressing Arctic issues at Meetings and Conventions of the Parties (*ibid*. para. 3.3.6).

> Provisions in the UNCLOS, OSPAR, and the PICES and ICES Conventions, as well as other instruments, present opportunities for better coordination, cooperation and management in relation to Arctic marine scientific research.
>
> However, there is no comprehensive or readily available "network map" that identifies relevant Arctic research and science organizations and governance organizations on an integrated or multi-sectoral basis.

A 2010 assessment of Arctic Biodiversity, prepared by CAFF and UNEP/GRID-Arendal, and part of the ongoing ABA process, recommended that "[m]ore work and greater attention needs to be directed at the harmonization of national reporting among MEAs" (Johnsen et al. 2010). The report was limited to biodiversity and environmental agreements, but many of its conclusions are directly relevant to instruments applicable to other sectors discussed in this AOR Final Report. Referencing an earlier UNEP study, the 2010 report suggested closer cooperation between "core" MEAs (Johnsen 2010, 28, referencing UNEP 2001).

By extension, closer cooperation among Arctic states that are parties to the agreements discussed in this AOR Final Report, on matters relating to those instruments, could bring improved implementation, and information gathering and distribution.

Increasingly scientists and policy-makers recognize that today's Arctic is a tightly-coupled component of highly dynamic global biophysical, geopolitical and socio-economic systems. Such systems can involve shifts that may be both non-linear and abrupt (ICSU, 2010). Modeling of key environmental and socio-economic processes will be required to strengthen management institutions and achieve practical outcomes (Turner 2000).

Integrated oceans management and EBM have as their cornerstones development and application of scientific knowledge. While these developing fields of management provide new approaches to ensure the protection and sustainable use of the Arctic's marine legacy, there are still many challenges to overcome before they become effective management tools on a sufficiently large scale. However, as indicated in most other chapters of the AOR Final Report, there is a need for more research to generate adequate baseline information for decision-makers and to fuel the field of scientific inquiry itself.

Ultimately, Arctic marine and terrestrial systems must be understood in the context of global systems, because, as many Arctic Council assessments have noted, non-Arctic activities are drivers of some of the most fundamental changes taking place in the Arctic today, including production of greenhouse gases, trans-boundary pollutants, demand for natural resources, interests in new transportation routes, Arctic tourism, and so on. While climate change and globalization have potentially profound impacts on the ecosystems and peoples of the Arctic, changes in the Arctic also have significant implications for non-Arctic regions that are poorly understood. The interest of non-Arctic actors in Arctic affairs, and the existence of a number of instruments and organizations that could foster greater trans-regional cooperation, present significant opportunities for scientific cooperation and collaboration for the Arctic Council.

8.6 Opportunities for Cooperative Action

Several Arctic Council activities and the structure of the Council itself are directed at finding ways to bring the science and policy disciplines together in meaningful ways. The Arctic Council provides a high-level forum for consideration and better integration of Arctic sciences and Arctic state policies. Joint projects and cooperation among the working groups are the main processes for this integration of natural and social sciences, including indigenous and local knowledge. Discussions in the Arctic Council among Ministers, Senior Arctic Officials, Permanent Participants, Working Groups and Observers, provide a mechanism for consideration of science and indigenous/local knowledge in a policy-relevant context.

Scientific input has been critically important to Arctic Council assessment projects. Based on their mandates, the six Arctic Council working groups use science and indigenous/local knowledge in their work in different ways. The need to establish baseline data relating to ecosystem properties, at a pan-Arctic level, has been raised in a number of these bodies and programs. In addition, there is a growing need for research and analysis of the economic and socio-cultural dimensions of the Arctic in the context of global and regional change.

Factors such as political priorities, enforcement capability, the state of Arctic infrastructure, budgetary resources for monitoring and carrying out implementation and compliance measures, all affect the conduct of Arctic marine science. Based on the preceding discussion, numerous opportunities for cooperation in Arctic marine science exist. These include:

(1) **The Arctic states should promote coordination and collaboration in providing for access to marine scientific research** in their marine areas, and the Arctic states should consider developing an Arctic science instrument, inter alia, to facilitate marine scientific cooperation and promote data sharing.

(2) **Enhance scenario-building capacity within the Arctic Council:** Consideration could be given to ways to develop appropriate scenario-building capacity

within the Arctic Council to integrate natural and social sciences, economics, and other matters relating to the human dimension as these relate to Arctic marine areas.

(3) **Promote scientific cooperation:** The Arctic Council could encourage its working groups to explore opportunities to develop stronger linkages with ICES and PICES on matters of Arctic marine science. (Three Arctic states are members of PICES; all eight Arctic states are members of ICES). This cooperation with sub-Arctic organizations in the "gateway" regions of the North Pacific and North Atlantic might provide avenues for the development of trans-regional mechanisms within the Arctic Council to allow observers such as IASC and relevant non-Arctic states to improve their contributions to the Council.

(4) **Identify research priorities relating to Arctic-relevant instruments:** The Arctic Council could consider directing its working groups to collaborate on developing a list of research gaps and priorities, taking into account the knowledge and process needs for the Arctic EBM intersessional document, as well as key global and regional instruments.

(5) **Strengthen shared infrastructure and platforms for research and monitoring:** Given the broad need for Arctic marine science and monitoring identified in this Report, the Arctic states should examine the potential for sharing of infrastructure and platforms for these scientific activities and develop appropriate policies and agreements to implement this approach.

(6) **Improve scientific cooperation and coordination** by increasing linkages with relevant organizations, sharing infrastructure and platforms, and facilitating the gathering and exchange of information under relevant agreements. The improvements could be supported by:

- ✓ developing a network map that identifies the relationships of research/science organizations and governance organizations to Arctic-relevant instruments;
- ✓ building on science, local and traditional knowledge, and other information gathered to fulfill reporting or assessment obligations;
- ✓ informing ecosystem-based management approaches;
- ✓ improving communication between science and policy arms of existing treaties; and, moving toward coordinated assessment, monitoring and reporting, where appropriate; and
- ✓ improving data and information management, interoperability and accessibility through mechanisms such as the Arctic Spatial Data Infrastructure and the Sustained Arctic Operating Network (SAON).

References

Allard, M. and Lemay, M., 2012. Nunavik and Nunatsiavut: From science to policy. An Integrated Regional Impact Study (IRIS) of climate change and modernization. ArcticNet Inc., Quebec City, Canada.

Baker, B., 2012. Common Precepts of Marine Scientific Research Access in the Arctic, in: Legal Aspects of Marine Science in the Arctic Ocean. Series: Beiträge zum ausländischen öffentlichen Recht und Völkerrecht, Vol. 235, Wasum-Rainer, S.; Winkelmann, I.; Tiroch, K. (Eds.), 209-232.

CIEL. 2002. Clarifying the Relationship Between Economic and Environmental Governance: Some Key Challenges (Center for International Environmental Law. August-September 2002).

Corell, H. 2006. Reflections on Possibilities and Limitations of a binding legal regime for the Arctic (Speech delivered to Seventh Conference of Arctic Parliamentarians of the Arctic Region, Kiruna, Sweden, 3 August 2006).

De Roo, C. 2008, Cavalieri, S., Wasserman, M., Knoblauch, D., Bausch, C, Best, A. Environmental Governance in the Marine Arctic. (Ecologic Institut, Berlin/Arctic Transform, Sept. 2008).

Dickson, R.R. 2008. The integrated Arctic Ocean Observing System (iAOOS). Arctic Ocean Sciences Board.

European Commission. 2012. Developing a European Union Policy towards the Arctic Region: Progress since 2008 and next steps: Joint Communication to the European Parliament and the Council (June, 2012).

Hoel, A.H. (ed.) 2009. Best Practices in Ecosystem-based Oceans Management in the Arctic. The Norwegian Polar Institute, Report Series 129, 2009.

Hoel, A.H. 2009. Do We Need a New Legal Regime for the Arctic Ocean (International Journal of Maritime and Coastal Law (2009:24) p. 443-456.

ICSU. 2010. Earth System Science for Global Sustainability: The Grand Challenges. International Council for Science, Paris.

Johnsen, K. I., Alfthan, B., Hislop, L., Skaalvik, J.F. (Eds.). 2010. Protecting Arctic Biodiversity: Limitations and Strengths of Environmental Agreements. UNEP/GRID Arendal.

Koivurova, T. and Molenaar, E. J. 2009. International Governance and Regulation of the Marine Arctic: Overview and Gap Analysis. WWF International Arctic Programme.

Krupnik, I et al, (eds.), 2011. Understanding Earth's Polar Challenges: International Polar Year 2007-2008. University of the Arctic, Rovaniemi, Finland/CCI (Printed version), Edmonton, Alberta, Canada and ICSU/WMO Joint Committee for International Polar Year 2007-2008.

Molenaar, E.J. 2012.Current and Prospective Roles of the Arctic Council System within the Context of the Law of the Sea. The International Journal of Marine and Coastal Law. 27: 553–595.

Mikkelsen, Aslaug and Langhelle, Oluf. 2008. Arctic Oil and Gas: Sustainability at Risk, Routledge.

Oberthür, Sebastian. 2002. Clustering of Multilateral Environmental Agreements: Potentials and Limitations, in International Environmental Agreements: Politics, Law and Economics 2: 317–340.

PEW Environmental Group. 2011. Addressing Major Gaps in Arctic Science, (September 2011).

Rasmussen, Rasmus Ole (ed.). 2011. Megatrends. TemaNord 2011: 527 (Nordic Council of Ministers).

Turner, R. K. 2000. Integrating natural and socio-economic science in coastal management, in Journal of Marine Systems, (July 2000).

UNEP/GRID Arendal. 2006. Overview report: Multilateral Environmental Agreements and their relevance to the Arctic (September 2006).

UNEP/GRID Arendal. 2006. Recommendations of the Arendal Seminar on multilateral environmental agreements and their relevance to the Arctic (September 2006).

UNESCO. 2009. Climate Change and Arctic Sustainable Development: scientific, social, cultural and educational challenges. UNESCO, Paris.

M. Elfa Jónsdóttir

Chapter 9 – Recommendations

Overview

Each of the preceding chapters identifies a number of opportunities for cooperative action to provide guidance for a coordinated and integrated approach to the management of activities within the Arctic marine environment. This concluding chapter presents certain key recommendations for consideration by the Arctic Council. The recommendations were developed by considering the full range of opportunities for action, and choosing or modifying the most important and timely actions.

The majority of chapters of this AOR Final Report highlight the importance of integrated or ecosystem-based approaches for advancing sector governance or management and for addressing cross-cutting issues. Altogether, this emphasizes the importance of ecosystem-based management (EBM) for a coordinated and integrated approach for Arctic Ocean governance. EBM is recognized to achieve all four goals of the Arctic Council Arctic Marine Strategic Plan, namely: reduce and prevent pollution in the Arctic marine environment; conserve Arctic marine biodiversity and ecosystem functions; promote the health and prosperity of all Arctic inhabitants; and advance sustainable Arctic marine resource use.

The AOR Final Report reveals similar opportunities have been identified among the different sectoral chapters, again highlighting this interconnectedness of ecosystems and management actions, and emphasizing their importance. The five recurrent opportunities include: Finalizing and implementing the Polar Code; Addressing Special, Protected or Critical Areas; Better monitoring of the Arctic marine environment; Increasing understanding of the Cumulative Effects; and Implementing Ecosystem-based Management to address stressors in an integrated manner.

While the recommendations are organized by sector, as a general observation, they could also be categorized under the following five broad types of cooperative activity:

- ✓ Coordination across Institutions
- ✓ Cooperation on Knowledge
- ✓ Amending Existing or Developing New Instruments
- ✓ Improving Implementation and Compliance
- ✓ Investing in Infrastructure

There are qualitative differences among these five types of cooperative activity and the ways they are carried out. For example, cooperative activities to improve knowledge of the Arctic engage different processes than actions to amend or create new legal instruments. However, all five types of cooperative activity are imperative for the improved implementation or functioning of legal instruments.

Recommendations

The following recommendations are considered important actions in light of the dynamic changes occurring in the Arctic marine environment.

Chapter 2: Indigenous Peoples and Cultures

(1) The Arctic states in cooperation with the Arctic Council should assist, as appropriate, the Permanent Participants with the documentation of current and historical a) timing and geographical extent of local uses of the marine environment, and b) levels of traditional marine resources harvests, taking into account the differing documentation needs and capacities of Arctic states.

(2) The Arctic states should work with Arctic residents to identify and promote effective models for enabling inclusion of traditional knowledge and input into decision-making processes for marine development and sustainable resource management.

Chapter 3: Arctic Marine Operations and Shipping

(3) The Arctic states should support work at the IMO and other international organizations with recognized competence to promote and advance safe, secure, reliable and environmentally sound shipping, including through: timely completion and implementation of the Polar Code; efforts regarding training requirements for officers and crew of ships operating in polar waters; adoption as appropriate of ship routing and reporting measures (including vessel traffic services); and discussions regarding enhancement of weather and ice forecasting and nautical charts to aid navigation. Arctic states should also encourage ratification to enable entry into force and implementation of the Ballast Water Management Convention and research into ballast water management systems that are effective in colder settings of polar regions.

(4) Arctic states should explore the possibility of developing voluntary guidelines and, if appropriate,

best practices in implementing such guidelines for sustainable tourism. Moreover, that the role the cruise industry plays in facilitating tourism in the region and the impacts of this industry on Arctic peoples, ecosystems and the environment should be acknowledged. The Arctic Council should also give consideration towards the development of a broader sustainable tourism initiative.

(5) Arctic states should explore, within an appropriate time after the mandatory Polar Code has been adopted, collaborative approaches to encourage effective implementation of any future related IMO measures for the Arctic, including the possible development at IMO of port state control guidelines and/or initiatives within existing port state arrangements.

(6) Arctic states should support ongoing work at the IMO to address black carbon emissions from international shipping in Arctic waters including considering amendments to MARPOL or other IMO instrument.

(7) Arctic states could consider approaches, including at IMO, to address safety and environmental concerns with respect to other types of vessels that, due to their size, routes, and nature of activity, may not be subject to the Polar Code.

Chapter 4: Marine Living Resources

PART A: FISHERIES RESOURCES

(8) Fisheries resources should be managed in accordance with the law of the sea, relevant fisheries agreements and modern principles of fisheries management, including the precautionary and ecosystem approaches, also being mindful of the interests of the indigenous peoples of the Arctic.

(9) Fisheries resources should be managed based on the best scientific knowledge available, and necessary scientific understanding should be enhanced, including on changes in fish stocks.

(10) Fisheries resources in areas beyond national jurisdiction should be managed based on cooperation in accordance with international law to ensure long term sustainability of fish stocks and ecosystems.

PART B: MARINE MAMMALS AND SEABIRDS

(11) The Arctic Council should increase collaboration with IMO, IWC and NAMMCO for information sharing and cooperation between their respective working groups and sub-groups on cetacean-related issues such as ocean noise and ship strikes and consider Ecosystem-based Management (EBM). Additionally, Arctic states should consider taking more proactive efforts in the IMO, IWC and NAMMCO on these issues such as by contributing to the IWC ship strike database.

(12) Arctic states, to the extent practicable, should continue to create and/or share seabird and marine mammal density and distribution maps, including through common databases such as the National Oceanic and Atmospheric Administration (NOAA) CetMap for Cetaceans (http://cetsound.noaa.gov/index.html) and CAFF's CBird online tools for timely tracking of seabird populations (www.caff.is/seabirds-cbird/seabird-information-network).

(13) Arctic states should advance conservation of Arctic marine ecosystems by considering management measures in ecologically significant areas of the Arctic Ocean that Arctic states might pursue at the IMO, building on the results of the AMSA Recommendation II(D) Report on Specially Designated Arctic Marine Areas.

Chapter 5: Arctic Offshore Oil and Gas

(14) The Arctic Council should urge its members to support, as appropriate, efforts in the ISO and other processes to develop standards relevant to Arctic oil and gas operations.

(15) Arctic states should move toward circumpolar policy harmonization in discrete sectors such as, e.g., environmental monitoring based on existing studies such as the Arctic Council's Arctic Offshore Oil and Gas Guidelines and the EPPR Recommended Prevention Practices report.

(16) Arctic Council should promote interactions with the appropriate international treaty bodies on offshore oil and gas issues that address for example discharges, oil spill preparedness and response, and environmental monitoring. This could include coordinating information exchange on reporting, monitoring, assessment and/or other requirements under relevant entities, encouraging inclusion of science and traditional knowledge, and keeping abreast of Arctic-specific developments relevant to the appropriate instruments.

(17) Arctic states should further engage industry and regulator involvement, as appropriate, in PAME and EPPR initiatives on offshore oil and gas activity by utilizing existing industry forums, or by convening an Arctic-specific oil and gas dialog for industry and contractor groups.

Chapter 6: Arctic Marine Pollution

(18) Arctic states should continue to identify, monitor and assess the combined effects of multiple stressors – inter alia climate change, ocean acidification, shipping, living marine resource use, regional and long-range pollution, and offshore oil and gas exploration and extraction – on Arctic marine species and ecosystems. Support the on-going work under EBM, AMAP and CAFF including the initiative "Adaptation Actions for a Changing Arctic" to achieve this endeavor and strengthen the link between the current known status and future management of Arctic marine species and ecosystems.

(19) Arctic states should reaffirm the importance of their engagement in the UNFCC to reduce global greenhouse gas emissions as a matter of urgency, recognizing the significant potential threats posed to Arctic marine ecosystems and Arctic biodiversity from climate change and ocean acidification identified by AMAP and CAFF. Arctic states should also increase their leadership role in the study of ocean acidification in Arctic waters

Chapter 7: Ecosystem-based Management in the Arctic

(20) Arctic states should recognize, in accordance with the recommendations from the Arctic Council EBM Expert Group and the PAME lead Ecosystem Approach expert group, the importance of the following elements when implementing marine Ecosystem-based Management in the Arctic Council Working Groups: identification of the ecosystem, description of the ecosystem, setting ecological objectives, assessing the ecosystem, valuing the ecosystem and managing human activities.

(21) The Arctic Council should promote common understanding and the mutual exchange of lessons learned by periodically convening Arctic Council-wide meetings on EBM to:

- ✓ share knowledge and experiences with respect to management and science across Large Marine Ecosystems; and
- ✓ review information on integrated assessments.

Chapter 8: Arctic Marine Science

(22) The Arctic states should promote coordination and collaboration in providing for access to marine scientific research in their marine areas, and the Arctic states should consider developing an Arctic science instrument, inter alia, to facilitate marine scientific cooperation and promote data sharing

(23) The Arctic Council could consider directing its working groups to collaborate to developing a list of research gaps and priorities, taking into account the knowledge and process needs for the Arctic EBM intersessional document as well as key global and regional instruments.

(24) The Arctic states should improve scientific cooperation and coordination by increasing linkages with relevant organizations, sharing infrastructure and platforms, and facilitating the gathering and exchange of information under relevant agreements. The improvements could be supported by:

- ✓ developing a network map that identifies the relationships of research/science organizations and governance organizations to Arctic-relevant instruments;
- ✓ building on science, local and traditional knowledge, and other information gathered to fulfill reporting or assessment obligations;
- ✓ informing ecosystem based management approaches;
- ✓ improving communication between science and policy arms of existing treaties; and, moving toward coordinated assessment, monitoring, and reporting, where appropriate; and
- ✓ improving data and information management, interoperability and accessibility through mechanisms such as the Arctic Spatial Data Infrastructure and the Sustained Arctic Operating Network (SAON).

Appendix 1 – The Marine Area covered by the AOR

The Marine Area covered by the AOR*

"There is no agreed definition of the geographical extent of the Arctic. In the PAME working group and for the purposes of this Report, the Arctic countries define their Arctic as a component of their territory (e.g., the United States bases theirs on the Arctic Research and Policy Act of 1984).[13]"

"There are other approaches to defining the Arctic as well such as: by using the 10º C in July isotherm (see Map**), or by using latitude (the region north of which one experiences at least one day 24 hour sunlight or at least one day with the sun below the horizon ("the Arctic Circle"][sic], at 66° 33' 39" (or 66.56083°) north)."

"The geographic area being applied in this report is wider than the isotherm or latitude definitions given above. This approach reflects that the Arctic is affected by natural and human-driven processes in the south, while processes in the Arctic affect nature and societies to the south."

"For the purpose of this project the latter understanding of the Arctic is used as the basis for our work. In the marine area the project covers the central Arctic Ocean, and in addition, the surrounding seas: the Bering Sea, the East Siberian Sea, the Chukchi Sea, the Beaufort Sea, the Davis Strait, Baffin Bay and Labrador Sea, the Greenland Sea, the waters around Iceland and the Faroe Islands, and northern parts of the Norwegian Sea, the Barents Sea, the Kara Sea, and the Laptev Sea. The oceans and seas included in this definition comprise an area of 20 million km2 and are referred to as the 'Arctic marine environment.' The Baltic Sea is not included here."

*From Arctic Ocean Review Phase I Report (2011) discussion of definitions of the Arctic, pages 3-4. Notations [sic] and emphases were added by Phase II editors.

**The Map is not included in this appendix but may be accessed at page 5 of the AOR Phase I Report: http://www.aor.is/images/stories/AOR_Phase_I_Report_to_Ministers_2011.pdf

[13] The Arctic Council Arctic Offshore Oil and Gas Guidelines, annex A. p. 77

Appendix 2 – Contributors

The AOR Final Report is a negotiated document that drew upon the work of experts across the Arctic, and engaged all Member States and Permanent Participants, as indicated in the Foreword.

The lead authors, Betsy Baker and Bernie Funston, were responsible for overall coordination of the document. Chapter authors prepared each initial draft chapter which was subsequently negotiated to produce this final report. Special acknowledgement and thanks are extended to the following individuals for their contributions:

Chapter 1: **Introduction**
Betsy Baker and Bernard Funston

Chapter 2: **Indigenous Peoples and Cultures**
Henry Huntington

Chapter 3: **Arctic Marine Operations and Shipping**
Lawson W. Brigham (lead author) with contributions from John Falkingham, Drummond Fraser, David Jackson, Brad Spence, Dennis Thurston, David VanderZwaag

Chapter 4: **Marine Living Resources**
Part A: Fisheries Resources, Ted McDorman
Part B: Marine Mammals and Seabirds, A.J. Gaston and Allison Reed

Chapter 5: **Arctic Offshore Oil and Gas**
Betsy Baker (lead author) with contributions from Jay Eidsness, Elena Mihaly, Sophia Kruszewski, Sarah Mooney, Roman Sidortsov, Dennis Thurston, Danielle Changala

Chapter 6: **Arctic Marine Pollution**
Russel Shearer, and Lars-Otto Reiersen (lead authors) with contributions from Christine Daae Olseng, Simon Wilson, David Vanderzwaag, Jason Stow

Chapter 7: **Ecosystem-based Management in the Arctic**
Alf Håkon Hoel (lead author) with contributions from Cecilie von Quillfeldt, Hein Rune Skjoldal, Tom Laughlin, Betsy Baker, David Fluharty, Silje Rem

Chapter 8: **Arctic Marine Science**
Bernard Funston (lead author) with comments from John Calder, David Hik, Tom Laughlin, and Hein Rune Skjoldal

In addition, acknowledgement and thanks are extended to

Stephanie Altman
Tom Barry
Chris Cuddy
Grantly Galland
Siv-Christin Gaalaas
Soffia Gudmundsdottir
John Karau
Karen Lambert
Tom Laughlin
Peter Oppenheimer
Robin Kipping
Bob Steinbock

Acknowledgements
Lead countries
Canada, Iceland, Norway, United States and the Russian Federation.

Acknowledgement of funding and support
Acknowledgement is hereby recognized for both financial and in-kind support as provided by the lead countries and the Nordic Council of Ministers. Appreciation is conveyed to all PAME countries, other Arctic Council Working Groups, Permanent Participants of the Arctic Council and intived experts for their support and contributions to this workshop.

PAME
Protection of the Arctic Marine Environment

norden
Nordic Council of Ministers

PAME

Protection of the Arctic Marine Environment

Borgir, Nordurslod / 600 Akureyri / ICELAND
Tel: +354 461 1355 / Fax: +354 462 3390
Email: pame@pame.is / Homepage: www.pame.is