Ecosystem-Based Management in the Arctic

ARCTIC COUNCIL

Report submitted to Senior Arctic Officials
by the Expert Group on Ecosystem-Based Management
May 2013



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Foreword by the co-chairs

The co-chairs of the Arctic Council Expert Group on ecosystem-based management (EBM) for the Arctic environment are pleased to present, for consideration by the Senior Arctic Officials (SAOs), the Expert Group's report on Arctic EBM. This report responds to the mandate from Ministers at Nuuk for the Expert Group to "recommend further activities in this field for possible consideration by the SAOs before the end of the Swedish chairmanship."

We hope that the SAOs will agree that the work of the Expert Group was extremely successful. In the course of three very substantive meetings in the United States, Sweden and Norway during 2011 and 2012, participants from Arctic Council Member States, the Permanent Participants and non-governmental organizations had valuable discussions about EBM in the Arctic and as a result produced the attached report, along with four annexes.

For purposes of its work, the Expert Group used the following definition:

EBM is 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.

Using this definition, the report puts forward a series of recommendations that the Expert Group hopes can be considered by Ministers, including the adoption of an explicit policy commitment by the Council to EBM, along with nine principles related to EBM that the Council could apply in its work in the Arctic region. The Expert Group also makes a series of recommendations for activities that could, as appropriate, advance EBM in the Arctic.

The recommendations are supported by annexes on definitions and principles for EBM in the Arctic; knowledge and process needs for EBM in the Arctic; advancing EBM in the work of the Arctic Council; and prior and ongoing EBM activities of the Arctic Council.

We wish to thank the many participants in the working group for their valuable and constructive input to the work which made it possible to progress and come up with sets of recommendations on the matter in good time. We would also like to pay a special tribute to Mr. Joel Clement (USA), Mr. Alf Haakon Hoel (Norway), Ms. Elizabeth McLanahan (USA) and Ms. Rita Cerutti (Canada) for their intersessional work and invaluable support to the co-chairs for our task.

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I. Introduction

The rapid changes taking place in the Arctic pose immense management challenges for Arctic nations as they endeavor to maintain the sustainability of the natural, cultural, and economic resources of the region. In addition to the highly accelerating impacts of climate change in the region such as loss of sea ice, coastal wave erosion, thawing permafrost, changes in wildlife movement patterns and cycles, and altered vegetation patterns – managers also face ocean acidification, substantially increased interest in resource extraction and tourism, prolonged stress on critical social needs such as food security, increased traffic in the maritime environment, and disintegrating transportation infrastructure in the terrestrial environment.

To address these challenges, there is a need for flexible and adaptive management approaches in the Arctic that recognize cultural, governmental/legal, and sub-regional differences, apply an integrated and interdisciplinary approach to understanding and managing these ecosystems, enable a more predictable operating framework for stakeholders, and ultimately maintain the resilience of Arctic ecosystems and communities.

Ecosystem-based management provides just such an approach. At a general level, EBM facilitates efficient and science-based decisions by providing a way of assessing and managing the effects of multiple stressors affecting the same ecosystem. Locally, through the design of inclusive stakeholder processes that reflect a broad range of scientific as well as traditional and local knowledge, EBM can help ensure that policy outcomes advance ecological, social and economic goals, and help Arctic residents adapt to changing ecological and socio-economic conditions.

Finally, because ecosystems and human activities are dynamic, our understanding of these systems and activities is constantly evolving; the flexible and adaptive nature of EBM is, therefore, suited to address the rapid changes occurring in the Arctic.

EBM provides a complement to single-sector or single-species approaches; it is not a set of conservation measures but rather an inclusive framework for balancing competing priorities and interests. EBM strives to integrate commercial, social, cultural, and ecological values, but the ecosystem aspect is "first among equals" because ecosystem failure would compromise all other values or goals; hence the term "ecosystem-based". The bottom-line of EBM is ecosystem sustainability, without which there is no means to assure sustainable economic or social systems.

The Arctic Council has a history of engagement with EBM. For example, EBM is a guiding principle informing the work of CAFF (Conservation of Arctic Flora and Fauna) and is reflected in the Arctic Marine Strategic Plan, the Arctic Marine Biodiversity Monitoring Plan and the approach taken by the Circumpolar Biodiversity Monitoring Programme (CBMP) to harmonize biodiversity monitoring efforts. Other relevant Arctic Council projects include PAME's work on Large Marine Ecosystems (LMEs), its expert group on the ecosystem approach, as well as the Best Practices in Ecosystem-based Oceans Management in the Arctic (BePoMAR) document that was endorsed at the 2009 Arctic Council Ministerial.

II. Mandate from the Arctic Council Ministers

Nuuk Declaration of the Arctic Council Ministers, May 12, 2011:

"Decide to establish an expert group on Arctic ecosystem-based management (EBM) for the Arctic Environment to recommend further activities in this field for possible consideration by the SAOs before the end of the Swedish chairmanship."

In May 2011, Arctic Council Ministers called for the establishment of an Expert Group on Arctic ecosystem-based management (EBM). Composed of government and non-governmental experts from Arctic States and representatives from the Arctic Council's Permanent Participants and Working Groups, the Expert Group on Arctic EBM (Expert 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. The task also called for recommendations for further Arctic Council activities related to EBM to be delivered in advance of the 2013 Arctic Council Ministerial meeting.

The Expert Group met three times and was chaired by representatives from Iceland, Sweden and the United States. This report provides the findings of the work of the Expert Group and a set of recommendations that includes a policy commitment; a definition of EBM in the Arctic; a set of principles tailored to EBM in the Arctic; and a set of high-priority activities for future work to advance EBM in the Arctic Council. The background documents developed and adopted by the Expert Group during its deliberations are attached as annexes.



Blanket Toss Festival. Photo: J. London, U.S. National Marine Fisheries Service/NOAA

III. Proposed Recommendations of the Expert Group on Arctic EBM

The Expert Group on Arctic EBM has developed the following recommendations for consideration by Senior Arctic Officials and Arctic Council Ministers:

1 It is proposed that the Arctic Council adopt a policy commitment to EBM, and that the following statement be considered as that commitment:

"We will work together to advance Ecosystem-Based Management in the coastal, marine and terrestrial environments of the Arctic and, where relevant, work through the Arctic Council structure to coordinate ongoing and prospective EBM approaches to maximize the benefits of such efforts within and across boundaries and for the Arctic as a whole."

2 It is proposed that the Arctic Council adopt a definition of EBM relevant to its work in the Arctic, as follows:

Ecosystem-based management is 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.

3 It is proposed that the Arctic Council adopt the following nine principles for its work in the Arctic:

1. EBM supports ecosystem resilience in order to maintain ecological functions and services.

2. EBM recognizes that humans and their activities are an integral part of the ecological system as a whole, and that sustainable use and values are central to establishing management objectives.

3. EBM is place-based, with geographic areas defined by ecological criteria, and may require efforts at a range of spatial and temporal scales (short-, medium- and long-term).

4. EBM balances and integrates the conservation and sustainable use of ecosystems and their components.

5. EBM aims to understand and address the combined, incremental effects (known as "cumulative impacts") that multiple human activities impose upon ecosystems, resources, and communities.

6. EBM seeks to incorporate and reflect scientific knowledge as well as expert, traditional, and local knowledge.

7. EBM is inclusive and encourages participation at all stages by various levels of government, indigenous peoples, stakeholders (including the private sector) and other Arctic residents.

8. Transboundary perspectives and partnerships can contribute significantly to the success of EBM efforts.

9. Successful EBM efforts are flexible, adaptive, and rely on feedback from monitoring and research because ecosystems and human activities are dynamic, the Arctic is undergoing rapid changes, and our understanding of these systems is constantly evolving.

4 It is proposed that the Arctic Council consider the following recommendations for activities to be undertaken by the Arctic Council, Permanent Participants, Arctic Council Working Groups, and Arctic States, as appropriate, to advance EBM in the Arctic:

Policy and Implementation

Advancing further EBM efforts across the Arctic will build upon existing EBM implementation and involve transboundary and sub-national or regional arrangements, integrated approaches, shared goals, and consideration of traditional knowledge as appropriate. The Expert Group on Arctic EBM recommends the following actions:

- Develop an overarching Arctic EBM goal, derived from established Arctic Council goals and visions, and provide guidance on how to develop and operationalize objectives supporting this goal.
- Explore ways in which Arctic States can cooperate to advance conservation and management of biologically, ecologically, and culturally significant areas.
- Develop and adopt a policy and best practices for incorporating traditional knowledge into EBM activities as appropriate.
- Encourage initiatives between two or more Arctic States to advance implementation of EBM in the Arctic and demonstrate how knowledge is collected, shared, processed and used to contribute to EBM in the Arctic.
- Review, update and adjust the Observed Best Practices in Ecosystem-based Ocean Management in the Arctic, endorsed by the 2009 Arctic Council Ministerial, to be applicable to all environments, including marine, coastal and terrestrial.

Institutional

Recognizing the important ongoing EBM work within the Arctic Council, particularly in the marine environment, sustaining and strengthening EBM will require building greater coordination and integration capacity across the Arctic Council and taking steps to further advance EBM in terrestrial environments. The Expert Group on Arctic EBM recommends the following actions:

- Identify a lead to assure coordination of a common approach to the work of the Arctic Council on EBM in the Arctic and ensure appropriate reporting of progress to the Senior Arctic Officials.
- Institute periodic Arctic Council reviews of EBM in the Arctic to exchange information on integrated assessment and management experiences, including highlighting examples from Arctic States.

Science and Information

Advancing Arctic EBM will require the identification of important coastal, marine, and terrestrial areas, improved data comparability and compatibility, enhanced information exchange and monitoring, and improvements in the development and use of integrated assessments. In order to achieve this, the Expert Group on Arctic EBM recommends the following actions:

- Encourage the use of the revised map of 17 Large Marine Ecosystems to inform EBM implementation; and explore the development of terrestrial assessment units (landscape equivalents to LMEs) based upon ecological criteria or existing ecoregions.
- Identify biologically, ecologically, and culturally significant areas in the coastal, marine and terrestrial environments, and consider EBM-related needs for these areas. Identify the coastal, marine and terrestrial areas most vulnerable to human impacts.

- Assess the value of significant Arctic ecosystem services relevant to the well-being of local communities and regional economies, and those of particular global significance.
- Enhance access to, and use of, the multi-disciplinary data required for the implementation of EBM by building upon ongoing work in the Arctic Council to contribute to an Arctic Council data portal.
- Exchange information and experiences with integrated assessments of ecosystem status, trends and pressures for coastal, marine, and terrestrial areas and provide guidance on approaches for integrating existing assessments.



Muskoxen defensive group. Photo: U.S. Department of the Interior

IV. Expert Group Methods, Meetings, and Outputs

In order to carry out the Nuuk mandate on EBM, Arctic States and Permanent Participants were invited to nominate individuals to participate in the Expert Group. In addition, invitations to participate were extended to the Arctic Council working groups, accredited observers, and other experts. The initiative was co-chaired by the United States, Iceland, and Sweden.

Meeting 1

The first meeting of the Expert Group was hosted by the United States at the U.S. Department of the Interior headquarters in Washington, D.C on October 18-19, 2011. Evan Bloom from the U.S. Department of State, Magnús Jóhannesson from the Iceland Ministry for the Environment, and Dr. Mia Dahlström of the Swedish Agency for Marine and Water Management co-chaired the meeting, which included nearly two dozen participants from seven of the eight Arctic countries, three permanent participant groups, and representatives from the CAFF and PAME working groups.

At the conclusion of the two-day meeting, the participating delegations agreed that this effort represents a timely and much-needed

convergence of EBM expertise to review the state of the art and best practices in Arctic EBM, and to recommend further Arctic EBM activities to the Arctic Council. In addition to an intersessional effort to adapt existing EBM definitions and principles to pan-Arctic needs, the delegations agreed to support an intersessional effort to compile an analysis of high-level knowledge and process needs for marine, coastal, and terrestrial EBM implementation across the Arctic.

Meeting 2

The second meeting of the Expert Group took place April 16-18, 2012 and was hosted by the Swedish Agency for Marine and Water Management in Gothenburg, Sweden. The meeting was co-chaired by Evan Bloom, U.S. Department of State; Magnús Jóhannesson, Iceland Ministry for the Environment; and Dr. Laura Píriz, Swedish Agency for Marine and Water Management. The meeting was attended by 32 participants, including seven Arctic States, one Permanent Participant, several experts and observer organizations, and representatives from the SDWG, PAME, AMAP and CAFF working groups.

The Expert Group revised and adopted the intersessional document on Definitions and Principles which contains a clear and succinct definition of EBM as well as a series of principles that represent key elements of a potential common EBM approach by the Arctic Council. At the conclusion of the meeting, delegations agreed to revise and finalize the knowledge and process needs document and development two additional intersessional documents -- a paper on advancing EBM in the Arctic, and one on best practices and conservation objectives.

Meeting 3

The third meeting was hosted by Norway in Tromsø October 5-7, 2012, and co-chaired by Magnús Jóhannesson (IC) and Dr. Laura Píriz (SE). The meeting was attended by 21 participants, including six Arctic States, several experts and observer organizations, and representatives from the SDWG and PAME. Russia, Denmark, and Permanent Participants were unable to attend the meeting.

The Expert Group used the two intersessional papers to translate key findings into potential activities for the Arctic Council to consider for advancing EBM implementation. These activities were classified according to three categories: Policy and Implementation, Institutional, and Science and Information. The Expert Group then agreed to the outline of a report to the SAOs and prepared a first draft. Following review and feedback from the SAOs and Permanent Participants at the SAO meeting in Haparanda, Sweden in November, 2012, the Expert Group revised and finalized this report.

ANNEXES

9 **1. Definitions and Principles for EBM in the Arctic**

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1 Definitions and Principles for EBM in the Arctic

BACKGROUND

In May 2011, Arctic Council Ministers called for the establishment of an expert group on ecosystem-based management (EBM) for the Arctic environment. Composed of government experts from Arctic States and representatives from the Arctic Council's Permanent Participants, the mandate of the Arctic EBM Experts Group (Experts Group) is to develop a common understanding of EBM and EBM principles relevant to work in Arctic marine and terrestrial ecosystems, and to recommend further Arctic Council activities related to EBM in advance of the 2013 Arctic Council Ministerial meeting.

The Experts Group met in October 2011 to review existing definitions and guidelines for the application of EBM, including those from within the Arctic Council as well as others drawn from relevant international processes. The group also reviewed connections to other Arctic Council working groups and initiatives, such as the Protection of the Arctic Marine Environment (PAME) working group, and the recently completed report on Best Practices in Ecosystem-based Oceans Management in the Arctic (BePOMAr).

While a sub-group of participating experts met to explore existing EBM definitions and principles, it was agreed that an inter-sessional effort would be required to adapt these to pan-Arctic needs. In framing this inter-sessional exercise, the group agreed to:

- Use existing definitions of EBM, rather than developing a new, Arctic-specific definition;
- Highlight why EBM is important for the Arctic; and
- Use existing principles (with a focus on those that are particularly relevant to the Arctic context), beginning with the BePOMAr conclusions and relevant principles from the Convention on Biological Diversity (the CBD). The group noted that it would be important to ensure that these principles apply equally to terrestrial and marine ecosystems.

The purpose of this document is to provide an initial draft of the Definition and Principles paper, for consideration at the Expert Group's April 2012 meeting in Gothenberg, Sweden. It reflects input received from Expert Group members, as well as the results of an analysis of relevant EBM-related principles.

1. WHY IS EBM IMPORTANT IN THE ARCTIC?

Challenges in the Arctic Context

The Arctic region consists of a number of distinct marine and terrestrial ecosystems, with significant ecological and demographic variability between them. For example, the Beaufort Sea and the marine environment surrounding northern Norway are extremely different in terms of both physical and biological characteristics.

Arctic ecosystems are inherently diverse, variable, and dynamic. Ecosystem components are constantly changing, making it sometimes difficult to assess between large natural fluctuations and changes due to human activities.[1] This underscores the importance of understanding the full breadth and nature of Arctic ecosystems at a variety of scales as part of efforts to ensure their long-term sustainability.

Some Arctic ecosystems are highly productive and provide critical ecological services that sustain the residents and communities

1 The Arctic Ocean Review, Phase I Report (2009-2011), produced by PAME (Protection of the Arctic Marine Environment).

of the Arctic. Arctic marine ecosystems also have pulses of seasonal productivity that provide subsidies to other, less productive ecosystems. Many species undergo extensive seasonal migrations to take advantage of this pulse of productivity. This marine-derived productivity is critical to the functioning of many terrestrial systems.

At the same time, Arctic ecosystems are vulnerable to a number of existing and potential pressures. For example, the Arctic climate is warming rapidly, and impacts on the region are already being documented as a result of climate change. These include thinning and reduced extent of sea ice, which in turn has significant implications for Arctic wildlife and human populations.

Other key stressors include pollution (transported primarily from sources outside the Arctic), as well as increased economic activities such as shipping, oil and gas development, commercial fishing and tourism.

These stressors – both individually and in combination – have the potential to affect both Arctic ecosystems and the communities that depend on them.

The Benefits of EMB in the Arctic

Many of the challenges described above are complex, in that they entail a number of ecosystem components that are affected by multiple drivers of change. Also, ecosystems sometimes span territorial boundaries, and often involve a broad range of stakeholders. To address these challenges, there is a need for flexible and adaptive management approaches in the Arctic that recognize cultural, governmental/legal and sub-regional differences, apply an integrated and interdisciplinary approach to understanding and managing these ecosystems, and ultimately maintain the resilience of Arctic ecosystems and communities.

Ecosystem-based management holds considerable promise in this regard. At a general level, EBM facilitates efficient and science-based decisions by providing a way of assessing and managing the effects of multiple stressors affecting the same ecosystem. Locally, through the design of inclusive processes that reflect a broad range of scientific as well as traditional and local knowledge, EBM can ensure that policy outcomes achieve not only ecological, but also social and economic goals, and help Arctic peoples adapt to changing ecological and socio-economic conditions.

Finally, because ecosystems and human activities are dynamic, our understanding of these systems and activities is constantly evolving. The flexible and adaptive nature of EBM is, therefore, well-suited to address the rapid changes occurring in the Arctic.

The Arctic Council has a history of engagement around EBM. For example, EBM is a guiding principle informing the work of CAFF (Conservation of Arctic Flora and Fauna) and is reflected in both the Arctic Marine Strategic Plan and the approach taken by the Circumpolar Biodiversity Monitoring Programme (CBMP). Other relevant Arctic Council projects include PAME's work on Large Marine Ecosystems (LMEs), its expert group on the ecosystem approach, as well as the Best Practices in Ecosystem-based Oceans Management in the Arctic (BePOMAr) project.

By informing common approaches within the Arctic Council, EBM can:

- Facilitate discussion among Arctic States on the appropriate management of ecosystems and/or species;
- Facilitate and integrate a range of planned and ongoing Arctic Council initiatives (such as, for example, the development of guidelines for EBM);
- Provide for the participation of indigenous peoples and northern communities;
- Establish the Arctic Council as a global leader in EBM and reinforce its role in addressing the sustainability of the Arctic environment;

- Enhance the efficiency and effectiveness of monitoring and assessment programs; and,
- Facilitate scientific cooperation, including the identification and resolution of data compatibility issues (i.e. differences in national scientific or planning standards or protocols that inhibit data sharing).

Regional EBM approaches can also enable collective consideration of major external forcing functions affecting Arctic ecosystems, such as persistent organic pollutants and climate change.

2. TOWARDS A COMMON ARCTIC COUNCIL DEFINITION

According to the Parties to the UN Convention on Biological Diversity, who adopted it as the primary framework for implementing the CBD in 1995, the ecosystem approach refers to a strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way. Implementing the ecosystem approach is intended to help balance conservation, sustainable use, and the fair and equitable sharing of the benefits arising out of the use of genetic resources.

As per the Nuuk SAO report to Ministers, the term ecosystem-based management will be used in this paper. Although the term ecosystem approach is sometimes used to describe the implementation of the ecosystem approach, most experts see the two as synonymous. For example, the Arctic Council's PAME working group uses the term ecosystem approach to describe the same concepts and activities described herein. Other similar terms include integrated ecosystem or landscape management, integrated resource management, integrated water resources management, and integrated coastal zone management.

There are many definitions of EBM however, in simple terms, it refers to an integrated, science-based approach to environmental management that aims to sustain the health, resilience and diversity of ecosystems while supporting sustainable and equitable use by humans of the services they provide.

A key feature of EBM is consideration of entire ecosystems, which involves assessing the total cumulative load on ecosystems from various pressures, and considering how the use of one element of the ecosystem is likely to affect another (for example, how siting an aquaculture facility in a particular area might affect its surrounding environment). A second important aspect of EBM is its recognition that humans are an essential part of ecosystems. A third aspect is that EBM can involve multi-sectoral processes engaging a broad range of participants in developing management options and reconciling conflicting uses.

The ecosystem approach and/or EBM have been referenced in a broad range of international fora, including in Agenda 21, the CBD, the Law of the Sea, the World Summit on Sustainable Development, UNEP, and others. As noted above, the concept has also been applied in the Arctic Council context, including through the Arctic Marine Strategic Plan, CAFF and the PAME Working Group. As such, it is not an ecosystem-specific concept, but rather one that applies equally to marine, terrestrial and coastal ecosystems.

Agreeing on a clear and succinct definition is the first step towards promoting a common approach to EBM within the Arctic Council. At its October 2011 meeting, the Expert Group confirmed that it would use the following definition, which is based on calls for the implementation of the ecosystem approach in the Action Plan adopted at the 2002 World Summit on Sustainable Development. It is also the definition used by the International Council for the Exploration of the Sea (ICES), which formed the basis of the definition subsequently adopted by PAME

and others, and represents a globally recognized and endorsed definition.

This definition states that ecosystem-based management is the: "...comprehensive integrated management of human activities based on best available scientific knowledge about the ecosystem and its dynamics, in order to identify and take action on influences which are critical to the health of ecosystems thereby achieving sustainable use of ecosystem goods and services and maintenance of ecosystem integrity..."



Boats at Savoonga, Alaska. Photo: R. Winfree, National Park Service, U.S. Department of the Interior

DEFINITIONS OF EBM

"The ecosystem approach is a strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way. Thus, the application of the ecosystem approach will help to reach a balance of the three objectives of the Convention: conservation, sustainable use, and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources." *CBD*	The ecosystem approach is defined as "the comprehensive integrated management of human activities based on the best available scientific knowledge about the ecosystem and its dynamics, in order to identify and take action on influences which are critical to the health of marine ecosystems, thereby achieving sustainable use of ecosystem goods and services and maintenance of ecosystem integrity". *OSPAR Commission*
"In ecosystem-based management, the associated human population and economic/social systems are seen as integral parts of the ecosystem. Most importantly, ecosystem-based management is concerned with the processes of change within living systems and sustaining the goods and services that healthy ecosystems produce. Ecosystem-based management is therefore designed and executed as an adaptive, learning-based process that applies the principles of the scientific method to the processes of management." *UNEP*	"Ecosystem-based management is a long-term, integrated approach that recognizes humans are part of and have significant influences on their environments. It is a shift away from conventional management paradigms that are often jurisdictional, short term and consider humans to be independent of nature. An ecosystem-based management plan includes adaptive management strategies and trade-offs, whether between ecosystem services, management strategies or other components of the plan, that are made as explicitly as possible." *Seaweb*
An approach that, "requires that development activities be coordinated in a way that minimizes their impact on the environment and integrates thinking across environmental, socio-economic, political and sectoral realms." *PAME*	"EBM looks at all the links among living and nonliving resources, rather than considering single issues in isolation…Instead of developing a management plan for one issue…EBM focuses on the multiple activities occurring within specific areas that are defined by ecosystem rather than political boundaries." *U.S. Commission on Ocean Policy*

3. PRINCIPLES[2]

In order to proceed with a common understanding of the core elements of EBM, an analysis was conducted of all relevant EBM-related principles that were identified by Expert Group members and Observers. Sources included:

- Convention on Biological Diversity, Principles of the Ecosystem Approach;
- United Nations Open-ended Informal Consultative Process on Oceans and the Law of the Sea, agreed consensual elements from its 7th meeting;
- Best Practices in Ecosystem-based Oceans Management in the Arctic (BePOMAr);
- World Wildlife Fund Principles for Eco system-based Management; and,
- Ecological Society of America (ESA)[3] .

Based on this assessment, a series of principles were identified that could represent common elements of a potential approach by the Arctic Council. These principles include:

1. EBM supports ecosystem resilience in order to maintain ecological functions and services.

2. EBM recognizes that humans and their activities are an integral part of the ecosystem as a whole, and that sustainable use and values are central to establishing management objectives.

3. EBM is place-based, with geographic areas defined by ecological criteria, and may require efforts at a range of spatial and temporal scales (short-, medium- and long-term).

4. EBM balances and integrates the conservation and sustainable use ecosystems and their components.

5. EBM aims to understand and address the cumulative impacts of multiple human activities (rather than individual sectors, species or ecosystem components).

6. EBM seeks to incorporate and reflect, to the extent it is relevant, expert knowledge including scientific, traditional and local knowledge.

7. EBM is inclusive and encourage participation at all stages by various levels of government, indigenous peoples, stakeholders (including the private sector) and other Arctic residents.

8. Transboundary perspectives and partnerships can contribute significantly to the success of EBM efforts.

9. Recognizing that ecosystems and human activities are dynamic, that the Arctic is undergoing rapid changes, and that our understanding of these systems is constantly evolving, successful EBM efforts are flexible and adaptive.

The analysis outlining the linkages and commonalities amongst the principles reviewed, as well as additional context on the rationale for their inclusion, is outlined in Table 1. A comprehensive listing of the principles reviewed is included in Annex 3.

2 The term "principles" is used to mirror that language in the Nuuk SAO report to Ministers. For the purposes of this paper, the term principles is synonymous with key / common elements.

3 As outlined in Christensen et al. 1996. The report of the Ecological Society of America Committee on the scientific basis for ecosystem management. Ecological Applications 6(3), 665-691.

Tables 1-9: Analysis of EBM Principles

1. EBM supports ecosystem resilience in order to maintain ecological functions and services.

PRINCIPLES REVIEWED	SOURCE	ADDITIONAL CONTEXT/ RATIONALE [4]
Conservation of ecosystem structure and functioning, in order to maintain ecosystem services, should be a priority target of the ecosystem approach.	CBD [5]	• Biodiversity conservation and the maintenance of human wellbeing depend on the functioning and resilience of natural ecosystems, which in turn depend on inter-relationships within and among species, between species and their abiotic environments and on the physical and chemical interactions within these environments. • Given this complexity, management must focus on maintaining and where appropriate restoring the key structures and ecological processes rather than just individual species. • Identification and protection of key areas, species and features helps set management priorities and ensure that ecosystem structure, function are maintained. • Management of ecosystem processes has to be carried out despite incomplete knowledge of ecosystem functioning.
Ecosystem must be managed within the limits of their functioning.		
Emphasize conservation of ecosystem structures and their functioning and key processes in order to maintain ecosystem goods and services	UN [6]	
Seek to restore degraded marine ecosystems where possible		
Maintaining the natural structure and function of ecosystems, including the biodiversity and productivity of natural systems and identified important species, is the focus for management	WWF [7]	
Ecosystem management is based on sound ecological principles and emphasizes the role of processes and interactions at all levels of organization	ESA [8]	
Biological diversity, structural complexity, and connectedness of ecosystems are important for ecosystem resistance and resilience		

4 The sources of these points are: Refinement and Elaboration of the Ecosystem Approach, based on Assessment of Experience of Parties in Implementation (CBD COP 7 Decision VII/11) and the BePOMAr report.
5 Convention on Biological Diversity, Principles of the ecosystem approach
6 United Nations Open-ended Informal Consultative Process on Oceans and the Law of the Sea
7 World Wildlife Fund Principles for Ecosystem-based Management
8 Christensen et al. 1996. The report of the Ecological Society of America Committee on the scientific basis for ecosystem management. Ecological Applications, 6(3), 665-691.

2. EBM recognizes that humans and their activities are an integral part of the ecosystem as a whole, and that sustainable use and values are central to establishing management objectives.

PRINCIPLES REVIEWED	SOURCE	ADDITIONAL CONTEXT/ RATIONALE
Humans are an integral ecosystem component	ESA	• The ecosystem approach recognizes that humans, with their cultural diversity, are an integral component of many ecosystems. • Human society is diverse in the kind and manner of relationships that different groups have with the natural world, each viewing the world around them in different ways and emphasising their own economic, cultural, and societal interests and needs. • Recognizing potential gains from management, there is usually a need to understand and manage the ecosystem in an economic context. Any such ecosystem-management programme should: a) Reduce those market distortions that adversely affect biological diversity b) Align incentives to promote biodiversity conservation and sustainable use; and c) Internalize costs and benefits in the given ecosystem to the extent feasible.
Human use and values of ecosystems are central to establishing objectives for use and management of natural resources.	WWF	
An integrated and multidisciplinary approach to management that takes into account the entire ecosystem, including humans	BePOMar [9]	
There is usually a need to understand and manage the ecosystem in an economic context	CBD	

9 Best Practices in Ecosystem-based Oceans Management in the Arctic

3. EBM is place-based, with geographic areas defined by ecological criteria, and may require efforts at a range of spatial and temporal scales (short-, medium- and long-term).

PRINCIPLES REVIEWED	SOURCE	ADDITIONAL CONTEXT/ RATIONALE
Area-based approaches … are necessary	BePOMAr	• It is critical to identify management units based on ecological criteria. • EBM operates in geographical units at various scales. • Ecosystem components and processes function at a range of spatial and temporal scales, as do human social and economic systems. • Management approaches/interventions need to take into account and transcend these scales. • Long-term ecological processes can be poorly accommodated in management systems, given that these systems tend to operate on relatively short time scales. • Awareness of long-term processes is important to consider explicitly in formulating management plans.
The geographical scope of ecosystems defined by ecological criteria		
Area-based management and use of scientific and other information on ecosystem changes to continually adapt management of human activities		
The ecosystem approach should be undertaken at the appropriate spatial and temporal scales	CBD	
Recognizing the varying temporal scales and lag-effects that characterize ecosystem processes, objectives for ecosystem management should be set for the long term		
Be applied within geographically specific areas based on ecological criteria	UN	
Processes operate over a wide range of spatial and temporal scales; there is no single appropriate scale or timeframe for management	ESA	
Ecosystem management assumes intergenerational sustainability as a precondition for management		

4. EBM balances and integrates the conservation and sustainable use ecosystems and their components.

PRINCIPLES REVIEWED	SOURCE	ADDITIONAL CONTEXT/ RATIONALE
The ecosystem approach should seek the appropriate balance between, and integration of, conservation and use of biological diversity	CBD	• Conservation and use need to be seen in context (i.e. a continuum from strict protection to human-altered, but functioning healthy ecosystems). • Management for conservation and sustainable use are not inherently incompatible and can be integrated. • Integration can be achieved at various scales and in various ways, including spatially and within a site.
Seek the appropriate balance between, and integration of, conservation and sustainable use of marine biological diversity	UN	
Emphasize the interactions between human activities and the ecosystem and among the components of the ecosystem and among ecosystems		
Seek to minimize adverse impacts of human activities on marine ecosystems and biodiversity, in particular rare and fragile marine ecosystems.		
Decision-making must be integrated and science-based	BePOMAr	

5. EBM aims to understand and address the cumulative impacts of multiple human activities (rather than individual sectors, species or ecosystem components).

PRINCIPLES REVIEWED	SOURCE	ADDITIONAL CONTEXT/ RATIONALE
The assessment of cumulative impacts of different sectors on the ecosystem, instead of single species, sectoral approaches	BePOMAr	• There are limits to the level of demand/disturbance that can be placed on an ecosystem while maintaining its integrity and capacity to provide goods and services. • Cumulative effects of interventions over time and space should be assessed when considering ecosystem limits. • Our current understanding is insufficient to allow these limits (thresholds) to be precisely defined; therefore a precautionary approach coupled with adaptive management is advised.
Development of scientific understanding of systems and the relationship between human actions and changes in other system components		
Assess the cumulative impacts of multiple human activities on marine ecosystems	UN	
Use integrated decision-making processes and management related to multiple activities and sectors		

6. EBM seeks to incorporate and reflect, to the extent it is relevant, expert knowledge including scientific, traditional and local knowledge.

PRINCIPLES REVIEWED	SOURCE	ADDITIONAL CONTEXT/ RATIONALE
Decision-making must be integrated and science-based	BePOMAr	• Information and perspectives of communities are important in designing and implementing management actions. • Different information sources can provide complementary perspectives. • Scientific, traditional, and local knowledge need to be integrated to ensure more informed, flexible decision-making.
The application of the best available scientific and other knowledge to understand ecosystem interactions and manage human activities accordingly		
Integrated and multidisciplinary approach that takes into account the entire ecosystem, including humans		
The ecosystem approach should consider all forms of relevant information, including scientific and indigenous and local knowledge, innovations and practices	CBD	
The ecosystem approach should involve all relevant sectors of society and scientific disciplines		
Be based on best available knowledge, including traditional, indigenous and scientific information and be adaptable to new knowledge and experience	UN	

7. EBM is inclusive and encourage participation at all stages by various levels of government, indigenous peoples, stakeholders (including the private sector) and other Arctic residents.

PRINCIPLES REVIEWED	SOURCE	ADDITIONAL CONTEXT/ RATIONALE
Stakeholder and Arctic resident participation is a key element	BePOMAr	• A multi-sector approach lies at the core of an EBM approach. • Objectives for EBM in particular areas should be determined through negotiations and trade-offs among stakeholders having different interests, intentions, and relationships with the natural world. • All relevant sectors of society need to have their interests equitably treated. • EBM approaches should be delivered in a manner consistent with Aboriginal and treaty rights. • It is important to provide for public participation that enables community voices to be heard.
The objectives of management of land, water and living resources are a matter of societal choices	CBD	
The ecosystem approach should involve all relevant sectors of society and scientific disciplines		
Natural resources are best managed within a management system that is based on a shared vision and a set of objectives developed amongst stakeholders	WWF	
Be inclusive, with stakeholder and local communities' participation in planning, implementation and management	UN	
Take into account ecological, social, cultural, economic, legal and technical perspectives		
Strive to balance diverse societal objectives		

8. Transboundary perspectives and partnerships can contribute significantly to the success of EBM efforts.

PRINCIPLES REVIEWED	SOURCE	ADDITIONAL CONTEXT/ RATIONALE
Area-based approaches and transboundary perspectives are necessary	BePOMAr	• It is important to consider linkages within and between both Arctic and non-Arctic ecosystems in applying EBM. • Increased international cooperation in shared ecosystems through regional management bodies, new collaborative efforts can help support implementation of effective EBM approaches.
Transboundary arrangements for resolution and handling of transboundary ecosystems and issues		
Ecosystem managers should consider the effects (actual or potential) of their activities on adjacent and other ecosystems	CBD	
Take into account factors originating outside the boundaries of the defined management area that may influence marine ecosystems in the management area	UN	
Strengthened and improved coordination and cooperation within, and, in accordance with international law, between and among States, intergovernmental organizations, regional scientific research and advisory organizations and management bodies		
Improved cooperation and collaboration among international organizations, including better linkages between regional fisheries management and marine-related organizations		

9. Recognizing that ecosystems and human activities are dynamic, that the Arctic is undergoing rapid changes, and that our understanding of these systems is constantly evolving, successful EBM efforts are flexible and adaptive.

PRINCIPLES REVIEWED	SOURCE	ADDITIONAL CONTEXT/ RATIONALE
Flexible application of effective ecosystem based management	BePOMAr	• Ecosystems (including species composition and population abundance) change, both naturally and as a result of human activities. • Furthermore, our understanding of these systems and their interactions is constantly evolving. • Adaptive and flexible management must therefore be used to anticipate and respond to such changes.
Decision making must be integrated and science based		
Adaptive management is critical		
An integrated and multidisciplinary approach to management that takes into account the entire ecosystem, including humans		
Management must recognize that change is inevitable	CBD	
Be based on best available knowledge, including traditional, indigenous and scientific information and be adaptable to new knowledge and experience	UN	
Ecosystems are dynamic, sustainability does not imply maintenance of the status quo	ESA	
Current models and paradigms of ecosystem function are provisional and subject to change		
Ecosystems are dynamic; their attributes and boundaries are constantly changing and consequently, interactions with human uses also are dynamic	WWF	
Successful management is adaptive and based on scientific knowledge, continual learning and embedded monitoring processes		

Sub-annex 1: Glossary of Relevant Terms

This glossary is intended to provide definitions for some of the technical terms used in this document. It is not intended to serve as a comprehensive or definitive listing of terms relevant to EBM and its use within the Arctic Council.

Biodiversity	The variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems (from Article 2, Convention on Biological Diversity)
Cumulative impact	The impact on the environment which results from the incremental impact of an action when added to other past, present, and reasonably foreseeable future actions … cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. (adapted from US National Environmental Policy Act)
Ecosystem	A dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit (Article 2 of the CBD)
Ecosystem services	Ecological or ecosystem processes or functions or products which have value to individuals or to society (Glossary of technical terms generated by the CBD)
Ecosystem-Based Management	Comprehensive integrated management of human activities based on best available scientific knowledge about the ecosystem and its dynamics, in order to identify and take action on influences which are critical to the health of ecosystems thereby achieving sustainable use of ecosystem goods and services and maintenance of ecosystem integrity (WSSD)
Interdisciplinary	Involving two or more academic disciplines (Collins English Dictionary)
Monitoring	The process of determining status and tracking changes in living organisms and the ecological complexes of which they are a part (Canadian Biodiversity: Ecosystem Status and Trends 2010)
Resilience	The ability of an ecosystem to maintain, recover or bounce back its diversity, integrity and ecological processes following stress or disturbance (Glossary of technical terms generated by the CBD)
Vulnerable ecosystem	An area under significant existing or anticipated environmental pressure. (Adapted from: Implementing an Ecosystem Approach in Environment Canada, internal document, Environment Canada 2009)

Sub-annex 2: Definitions of Ecosystem-Based Management

For the purpose of the OSPAR Convention, the ecosystem approach is defined as "the comprehensive integrated management of human activities based on the best available scientific knowledge about the ecosystem and its dynamics, in order to identify and take action on influences which are critical to the health of marine ecosystems, thereby achieving sustainable use of ecosystem goods and services and maintenance of ecosystem integrity".
— *OSPAR Commission for protecting and conserving the North-East Atlantic and its resources*

"EBM looks at all the links among living and nonliving resources, rather than considering single issues in isolation…Instead of developing a management plan for one issue…EBM focuses on the multiple activities occurring within specific areas that are defined by ecosystem rather than political boundaries."
— *U.S. Commission on Ocean Policy*

"In ecosystem-based management, the associated human population and economic/social systems are seen as integral parts of the ecosystem. Most importantly, ecosystem-based management is concerned with the processes of change within living systems and sustaining the goods and services that healthy ecosystems produce. Ecosystem-based management is therefore designed and executed as an adaptive, learning-based process that applies the principles of the scientific method to the processes of management."
— *United Nations Environment Programme (UNEP)*

"The ecosystem approach is a strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way. Thus, the application of the ecosystem approach will help to reach a balance of the three objectives of the Convention: conservation, sustainable use, and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources."
— *Convention on Biological Diversity*

"Ecosystem-based management is a long-term, integrated approach that recognizes humans are part of and have significant influences on their environments. It is a shift away from conventional management paradigms that are often jurisdictional, short term and consider humans to be independent of nature. An ecosystem-based management plan includes adaptive management strategies and trade-offs, whether between ecosystem services, management strategies or other components of the plan, that are made as explicitly as possible." — *Seaweb* (see: http://www.seaweb.org/resources/ebm/whatisebm.php)

Arctic Council uses of EBM

The Nuuk Declaration decision to establish an expert group on Arctic EBM was not the first time the importance of an ecosystem approach was highlighted by the Arctic Council. The Arctic Council has promoted EBM for a number of years, including endorsing its application to the marine environment in the 2004 Reykjavik Declaration and through a 2009 report to the Senior Arctic Officials (SAOs) elaborating on the benefits of EBM. The 2009 report stated:

"Integrated ecosystem-based management can provide a framework for the utilization of natural resources and goods, while at the same time maintaining the structure, functioning and productivity of the area. Many ecosystems and environmental impacts of human activities extend across state boundaries and it is also important to consider both offshore and onshore as well as atmospheric impacts of activities. The exchange and building of knowledge, with the aim of developing a common approach to ecosystem-based

management of natural resources of the Arctic, is therefore a natural priority for the Arctic Council."

Several Arctic Council working groups actively consider EBM in their work. For example, the Protection of the Arctic Marine Environment working group (PAME) has an ongoing project on advancing an ecosystem approach in the Arctic Ocean and has identified Large Marine Areas to facilitate cooperative research and decision-making.

Similarly, the Conservation of Arctic Flora and Fauna (CAFF) working group uses EBM as a guiding principle for its work. This is reflected in the work of the Circumpolar Biodiversity Monitoring Program (CBMP), the ongoing Arctic Biodiversity Assessment (ABA), and other CAFF projects. The Arctic Monitoring and Assessment Program (AMAP) working group is also using EBM in its proposal for an Arctic Change Assessment (ACA).

Arctic Council definitions of EBM

In promoting an ecosystem approach, some Arctic Council working groups have developed definitions for EBM.

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

According to CAFF's Strategic Plan for the Conservation of Arctic Biological Diversity, one of the guiding principles of CAFF is, "The use of a broad, ecosystem approach to conservation and management". This principle states: "Conservation goals cannot be achieved solely on a species-by-species basis, or by protecting small areas. The health of the Arctic environment depends on conserving the full range of flora, fauna and habitats. This can only be done effectively if we recognize that activities affecting one component or area of the ecosystem will in turn affect the rest of the ecosystem."

CAFF's CBMP also elaborates on an ecosystem approach in its implementation plan, which highlights the following elements:

Integrated Ecosystem-Based Approach to Monitoring :

The ecosystem-based approach to monitoring integrates information on land, water, and living resources and lends itself to monitoring many aspects of an ecosystem in a geographic region. In the context of Arctic biodiversity, the ecosystem-based approach implies the following conditions:

- Recognition that monitoring all elements of ecosystems—including species, habitats, ecosystem structure, processes, functions, and stressors to the ecosystems — is necessary to gain a meaningful picture of what is happening to biodiversity;
- A focus on trends, including recognition of the dynamic nature of Arctic ecosystems and the importance of identifying change that is outside the realm of natural variability;
- Recognition of the interplay between terrestrial, freshwater, and marine systems and the way it shapes Arctic ecology and the goods and services that Arctic biodiversity provides;
- Recognition of the dependence of Arctic biodiversity on conditions outside the Arctic;
- Recognition of humans and their cultural diversity as an integral component of many ecosystems; and,
- Monitoring the interactions between people and biodiversity, such as sustainable use and the ability of biodiversity to provide essential goods.

The ecosystem-based approach to monitoring considers the integrity of entire ecosystems and their interaction with other

ecosystems. Although the complexity and data/analysis requirements far exceed those of the species approach, the rewards of the ecosystem-based approach are significant. It identifies important relationships, providing a bridge between ecosystems, habitats, and species and the impacts of stressors on ecological functions. The resulting information contributes directly to adaptive management, thereby allowing for effective conservation, mitigation, and adaptation actions appropri-



Archeologists. Photo: Andrea Willingham, National Park Service, U.S. Department of the Interior

Sub-annex 3: Principles and Core / Consensual Elements of Ecosystem-Based Management

I. Best Practices in Ecosystem-Based Oceans Management in the Arctic (BePOMAr)

The conclusion section of the BePOMAr highlights the importance of the following considerations:

- Flexible application of effective ecosystem based management
- Decision making must be integrated and science based
- National commitment is required for effective management
- Area based approaches and transboundary perspectives are necessary
- Stakeholder and Arctic resident participation is a key element
- Adaptive management is critical

The following "core elements" of EBM are noted in the body of the document:

- The geographical scope of ecosystems defined by ecological criteria.
- The development of scientific understanding of systems and of the relationship between human actions and changes in other system components.
- The application of the best available scientific and other knowledge to understand ecosystem interactions and manage human activities accordingly.
- An integrated and multidisciplinary approach to management that takes into account the entire ecosystem, including humans.
- Area-based management and use of scientific and other information on ecosystem changes to continually adapt management of human activities.
- The assessment of cumulative impacts of different sectors on the eco-system, instead of single species, sectoral approaches.
- A comprehensive framework with explicit conservation standards, targets and indicators in order to facilitate responses to changes in the eco-system
- Transboundary arrangements for resolution and handling of transboundary ecosystems and issues.

II. Convention on Biological Diversity

Principle 1: The objectives of management of land, water and living resources are a matter of societal choices.

Principle 2: Management should be decentralized to the lowest appropriate level.

Principle 3: Ecosystem managers should consider the effects (actual or potential) of their activities on adjacent and other ecosystems.

Principle 4: Recognizing potential gains from management, there is usually a need to understand and manage the ecosystem in an economic context. Any such ecosystem-management programme should:

a) Reduce those market distortions that adversely affect biological diversity;
b) Align incentives to promote biodiversity conservation and sustainable use;
c) Internalize costs and benefits in the given ecosystem to the extent feasible.

Principle 5: Conservation of ecosystem structure and functioning, in order to maintain ecosystem services, should be a priority target of the ecosystem approach.

Principle 6: Ecosystem must be managed within the limits of their functioning.

Principle 7: The ecosystem approach should be undertaken at the appropriate spatial and temporal scales.

Principle 8: Recognizing the varying temporal scales and lag-effects that characterize ecosystem processes, objectives for ecosystem management should be set for the long term.

Principle 9: Management must recognize the change is inevitable.

Principle 10: The ecosystem approach should seek the appropriate balance between, and integration of, conservation and use of biological diversity.

Principle 11: The ecosystem approach should consider all forms of relevant information, including scientific and indigenous and local knowledge, innovations and practices.

Principle 12: The ecosystem approach should involve all relevant sectors of society and scientific disciplines.

III. Excerpt from the Report on the work of the United Nations Open-ended Informal Consultative Process on Oceans and the Law of the Sea at its seventh meeting

Agreed consensual elements

6. While there is no universally agreed definition of an ecosystem approach, which is interpreted differently in different contexts, it was proposed that the General Assembly, invite States to consider that an ecosystem approach should, inter alia:

a) Emphasize conservation of ecosystem structures and their functioning and key processes in order to maintain ecosystem goods and services;

b) Be applied within geographically specific areas based on ecological criteria;

c) Emphasize the interactions between human activities and the ecosystem and among the components of the ecosystem and among ecosystems;

d) Take into account factors originating outside the boundaries of the defined management area that may influence marine ecosystems in the management area;

e) Strive to balance diverse societal objectives;

f) Be inclusive, with stakeholder and local communities' participation in planning, implementation and management;

g) Be based on best available knowledge, including traditional, indigenous and scientific information and be adaptable to new knowledge and experience;

h) Assess risks and apply the precautionary approach;

i) Use integrated decision-making processes and management related to multiple activities and sectors;

j) Seek to restore degraded marine ecosystems where possible;

k) Assess the cumulative impacts of multiple human activities on marine ecosystems;

l) Take into account ecological, social, cultural, economic, legal and technical perspectives;

m) Seek the appropriate balance between, and integration of, conservation and sustainable use of marine biological diversity; and

n) Seek to minimize adverse impacts of human activities on marine ecosystems and biodiversity, in particular rare and fragile marine ecosystems.

7. It was suggested that the General Assembly propose that implementation of an ecosystem approach could be achieved through, inter alia:

a) Its inclusion in the development of national policies and plans;

b) Encouraging and supporting marine scientific research, in areas within and beyond national jurisdiction, in accordance with international law;

c) Understanding, through increased research, the impacts of changing climate on the health of marine ecosystems, and developing management strategies to maintain and improve the natural resilience of marine ecosystems to climate variations;

d) Understanding, through increased research, the impacts of underwater noise on marine ecosystems and taking into account those impacts;

e) Where appropriate, strengthening regional fisheries management organizations, adapting their mandates and modernizing their operations in accordance with international law;

f) Strengthened and improved coordination and cooperation within, and, in accordance with international law, between and among States, intergovernmental organizations, regional scientific research and advisory organizations and management bodies;

g) Effective and full implementation of the mandate of existing multilateral/ organizations, including those established under UNCLOS;

h) Application of the Rio Principles and the use of a broad range of management tools for the conservation and sustainable use of marine biodiversity, including sector specific and integrated area-based management tools on a case-by case basis, based on the best available scientific advice and the application of the precautionary approach and consistent with international law;

i) Identifying and engaging stakeholders to promote cooperation;

j) Sectoral approaches and integrated management and planning on a variety of levels, including across boundaries, in accordance with international law;

k) Effective integrated management across sectors;

l) Advancement of the Plan of Implementation of the World Summit on Sustainable Development, including, inter alia, the elimination of destructive fishing practices, the establishment of marine-protected areas consistent with international law and based on scientific information, including representative networks by 2012 and time/ area closures for the protection of nursery grounds and periods, proper coastal land use and watershed planning and the integration of marine and coastal areas management into key sectors; and

m) Conducting, in accordance with national legislation and international law, assessments in relation to marine activities likely to have a significant impact on the environment.

8. It was proposed that the General Assembly invite States to consider that improved application of an ecosystem approach will require, inter alia:

a) Capacity-building through technology, knowledge and skills transfer, particularly to developing countries, including small island developing States and coastal African States, as well as exchange of information, data and lessons learned, and capacity-building in support of science, information management and exchange, monitoring, control and surveillance, assessment and reporting as well as through public outreach and education;

b) Steps in the development of an ecosystem approach include identification of ecologically based management areas; assessment of ecosystem health; development of indicators; identification of the key environmental limits; monitoring, control, surveillance and reporting and adjustment of management measures, as appropriate;

c) Monitoring the state of ecosystems supported by the use of data collection systems, analysis, and modelling to inform future management approaches;

d) Addressing activities and pressures that lead to adverse impacts on marine ecosystems, including land-based pollution, overfishing, illegal, unreported and unregulated fishing, by-catch of threatened species, sea-based pollution, dumping, physical destruction and degradation of habitats, and introduction of invasive species;

e) An iterative development of an ecosystem approach with an emphasis on integrated management of human uses of the oceans, which could be achieved, inter alia, through the strengthening of cooperation and collaboration among existing instruments, bodies and scientific research and advisory organizations;

f) Targeted action to address root causes of activities that can undermine the conservation and integrity of marine ecosystems;

g) Filling critical knowledge gaps and addressing uncertainty;

h) Developing, raising and sustaining public awareness and institutional and political will;

i) Improved cooperation and collaboration among international organizations, including better linkages between regional fisheries management and marine-related organizations and by encouraging all States whose vessels participate in a fishery regulated by a regional fisheries management organization or arrangement to cooperate by becoming members of such organization or participants in such arrangement, and, to this end, establishing mechanisms to promote non-member participation;

j) Developing mechanisms to monitor and review ecosystem health and management effectiveness;

k) Dissemination of information to the public on activities that negatively affect ecosystems and the ocean environment and their associated products;

l) Improving, as appropriate, legal and policy frameworks to support and facilitate the application of the precautionary approach and ecosystem approaches; and

m) Compilation of scientific and ecological criteria, inter alia, for the identification of marine-protected areas.

9. It is suggested that the General Assembly take note of the possible options, approaches and timely follow-up process discussed by the Ad Hoc Open-ended Informal Working Group to study issues relating to the conservation and sustainable use of marine biological diversity in areas beyond national jurisdiction.

IV. WWF principles for ecosystem-based management

a) Maintaining the natural structure and function of ecosystems, including the biodiversity and productivity of natural systems and identified important species, is the focus for management.

b) Human use and values of ecosystems are central to establishing objectives for use and management of natural resources.

c) Ecosystems are dynamic; their attributes and boundaries are constantly changing and consequently, interactions with human uses also are dynamic.

d) Natural resources are best managed within a management system that is based on a shared vision and a set of objectives developed amongst stakeholders.

e) Successful management is adaptive and based on scientific knowledge, continual learning and embedded monitoring processes.

V. Ecological Society of America

- Ecosystem management assumes intergenerational sustainability as a precondition for management
- Goals must be explicitly stated in terms of specific desired future behaviors/conditions
- Ecosystem management is based on sound ecological principles and emphasizes the role of processes and interactions at all levels of organization
- Biological diversity, structural complexity, and connectedness of ecosystems are important for ecosystem resistance and resilience
- Ecosystems are dynamic, sustainability does not imply maintenance of the status quo
- Processes operate over a wide range of spatial and temporal scales; there is no single appropriate scale or tine frame for management
- Humans are an integral ecosystem component
- Current models and paradigms of ecosystem function are provisional and subject to change



Seal researchers. Photo: M. Cameron, U.S. National Marine Fisheries Service/NOAA

2. Intersessional Report: Knowledge and Process Needs for Arctic EBM

Introduction

Recap of agreements from the first EBM expert group meeting

The first meeting of the Arctic Council Ecosystem-based Management (EBM) Expert Group was hosted by the United States at the U.S. Department of the Interior headquarters in Washington, D.C on October 18-19, 2011. Evan Bloom, Director of the Office of Ocean and Polar Affairs, U.S. Department of State, Magnus Johannesson, Secretary General, Iceland Ministry for the Environment, and Dr. Mia Dahlstrom of the Swedish Agency for Marine and Water Management co-chaired the meeting, which included nearly two dozen participants from seven of the eight Arctic countries, three permanent participant groups, and representatives from the CAFF and PAME working groups.

At the conclusion of the two-day meeting, the participating delegations agreed that this effort represents a timely and much-needed convergence of EBM expertise to review the state of the art and best practices in Arctic EBM, and to recommend further Arctic EBM activities to the Arctic Council.

In addition to an intersessional effort to adapt existing EBM definitions and principles to pan-Arctic needs, the delegations agreed to support an intersessional effort to compile an analysis of high-level science and capacity needs for marine, coastal, and terrestrial EBM implementation across the Arctic. This paper represents the culmination of this latter intersessional effort, and will inform the Expert Group's articulation of guidelines and recommendations to the Senior Arctic Officials and Ministers prior to the 2013 Arctic Council Ministerial.

Scope of Knowledge, Information, and Tools Intersessional Effort

For this intersessional work, the Expert Group agreed that:

- There is a need for an analysis of needs in knowledge, information, and tools for marine, coastal, and terrestrial EBM implementation across the Arctic.
- This analysis would be conducted remotely rather than in-person, and focus on specific and accessible EBM needs rather than broader science issues, and consider ways to improve coordination of existing Arctic Council and member-state activities for the purpose of EBM.
- Topics to consider include access to and use of socioeconomic and traditional knowledge; international capacity for monitoring, developing baseline data, and forecasting; tool and data sharing needs; and Arctic ecosystem services.

Context for Arctic Ecosystem-Based Management

The rapid changes taking place in the Arctic pose unprecedented management challenges for Arctic nations as they endeavor to balance the many trade-offs associated with maintaining the sustainability of the natural, cultural, and economic resources of the region.

In addition to the highly uncertain but accelerating impacts of climate change in the region such as loss of sea ice, coastal wave erosion, permafrost decline, changes in wildlife movement patterns and cycles, and altered vegetation patterns – managers also face ocean acidification, substantially increased interest in resource extraction and tourism, prolonged stress on critical social needs such as food security, increased traffic

in the maritime environment, and disintegrating transportation infrastructure in the terrestrial environment.

In the face of these transformations, sector-based management strategies that focus on permitting activities and species-based management strategies that focus on protecting single populations or species are becoming increasingly untenable as stand-alone strategies – often leading to more frequent management conflicts and increased management rigidity.

In the absence of some transparent means for balancing trade-offs and distributing risk, such processes are increasingly likely to lead to a loss of resilience or system stability in the face of rapid change. Unstable systems are less likely to be sustainable, are less reliable in terms of the many ecosystem services they provide, and will impair the efforts of nations and agencies to meet management responsibilities.

Describing Ecosystem-Based Management

Ecosystem-based management offers a framework that allows for the distribution of risk – fairly striking compromises across distinct and sometimes conflicting values – when facing difficult decisions. EBM is not a set of conservation measures but rather an inclusive management framework for balancing competing priorities.

Although EBM integrates commercial, sociological, subsistence, and ecological values, the ecosystem aspect is "first among equals" because ecosystem failure would compromise all other values or goals; hence the term "ecosystem-based". The bottom-line of EBM is ecosystem sustainability, without which there is no means to assure sustainable economic or social systems.

While this intersessional effort was tasked with an analysis of the significant knowledge and tool needs for EBM in the Arctic, it was clear from the feedback we received on the initial outline that this effort would be incomplete without an assessment of both the knowledge and *process* needs of effective EBM in the Arctic.

KNOWLEDGE: EBM uses the best available scientific and traditional knowledge about a geographic area to identify key indicators of change and recommend actions that will help ensure the long-term health and resilience of ecosystems while achieving sustainable use of its goods and services. An EBM approach will usually start with the identification of significant ecological areas and the variables that define them, and will often require some means for addressing uncertainty and the complex interactions that drive the system.

For example, resilience assessment is an effective means for determining the thresholds, or tipping points, at which systems – be they ecological or social – are at risk of transformation to an uncertain future state. EBM does not rely on such knowledge "snapshots" alone; one of the most important principles of EBM is ensuring adequate monitoring protocols so managers can adjust practices if the results show that goals are not being met.

PROCESS: In addition to knowledge-based resources, EBM implementation depends upon a structure or process for integrating and balancing trade-offs. No amount of science will balance our values and make our decisions for us, so it is important to establish an adaptive framework for this difficult task.

The level of organization this requires will differ in every circumstance, but best practices call for a clear articulation of values from all stakeholders, a transparent means for balancing and fairly distributing risks to these values, and some means for changing course when conditions dictate, such as with adaptive management. A key advantage of EBM is that the difficult process of balancing values takes place in advance of the emergence of conflict, providing management alternatives that avoid the costs of conflict and litigation.

In most cases the missing piece for implementing EBM is not the science but an effective process or organizational structure; without some means to translate the science into a meaningful management approach that meets certain agreed-upon objectives, EBM is just a series of interesting reports.

The following sections reflect input from the Arctic Council EBM Expert Group as well as EBM experts from academia and non-governmental organizations. Phrases or paragraphs in italics indicate quoted comments from reviewers.

Needs: KNOWLEDGE

"Implementing EBM is possible based on existing knowledge, information, and tools."

"EBM will have benefits over purely sectoral or regulatory planning approaches at almost any level of information."

The EBM experts engaged in this effort made it clear that the knowledge and tools currently exist to implement EBM, and there is no need to postpone such work until further information is developed. Experts noted that it is important to start implementing such an integrated approach regardless of available information, that an inclusive and multidisciplinary approach such as EBM will improve natural resource stewardship regardless of the state of knowledge in a region.

There are important benefits to be derived by acquiring more complete information and diminishing the uncertainty associated with many Arctic conditions, predictions, and trends. However, given the place-based and scale-dependent nature of EBM efforts, it may not be particularly helpful to identify data gaps across the entire Arctic, as originally intended in this effort, but rather focus on the needs associated with crucial categories of information or knowledge. The following sections describe some of these important needs.

Traditional and Local Knowledge

One of the top-level needs identified by experts is some means to more effectively incorporate traditional and local knowledge into modern governmental decision-making processes. None of the experts identified gaps in the body of traditional knowledge, only the difficulties with which institutions examine, codify, or incorporate this knowledge.

In particular, modern scientific institutions that rely on quantified, cited, and peer-reviewed information struggle to develop practices that allow the incorporation of traditional knowledge while recognizing its fundamental differences and respecting the interests of the source. In some instances, traditional knowledge is recorded in published literature, but in most cases it exists in, and belongs to, the oral traditions of local communities.

There are, however, instances of modern science finding a way to incorporate traditional and scientific expert knowledge that provide meaningful guidance and respect indigenous concerns about the use of the information. There is also considerable room for improvement in simply including traditional and local knowledge holders in the analysis of information and development of policy responses.

Finding: A compilation of best practices for incorporating traditional and local knowledge would enable a more effective utilization of such resources in management decisions; such information has and will add considerable value to our understanding of a rapidly changing Arctic.

Ecosystem Services

At the local level, ecosystem services are at the heart of the subsistence economy in the Arctic, but work needs to be done to assess patterns of use, thresholds for harvest, and resource variability on land and at sea, where diminishing sea ice is negatively impacting important subsistence species and access to them. The changing hydrology of the terrestrial environment also poses challenges; melting permafrost and changing patterns of stream-flow are dramatically transforming the availability of freshwater resources in the Arctic, but our understanding of the impacts upon these resources is poor. The indirect services provided by permafrost, such as food storage and transportation systems, are also in jeopardy and continue to be difficult to assess and predict.

The Arctic is known as an important breeding and feeding ground for many species of birds and other wildlife, but the consequences of a transforming Arctic for biodiversity, particularly migratory species, remain murky. Changes in the Arctic cryosphere have significant impacts upon global ocean currents and atmospheric dynamics, impacts that are only now beginning to be described. The loss of sea ice has exposed the ice shelf's important role as a buffer from coastal erosion; the receding ice has left coastal zones frequently unprotected from storm surges and wave erosion, leading to culturally and financially costly relocations of villages and services.

Finding: There is an extensive body of literature describing the benefits of ecosystem services and the costs associated with their loss. There is not yet a thorough Arctic-specific articulation of these benefits and costs described in economic terms. In particular, documenting ecosystem services associated with sea ice and permafrost will be necessary to assessing the value of these services and the costs associated with losing them.

Monitoring and Data-Sharing

It is nearly impossible to assess change without a baseline, and the dearth of ongoing, standardized monitoring protocols has hobbled efforts to ground-truth predictions in the Arctic. There is an ongoing demand for resources to support continued Arctic ecosystem monitoring, and for tools to enhance the coordination and value of the monitoring that is currently taking place.

The Arctic Council's Circumpolar Biodiversity Monitoring Program (Conservation of Flora and Fauna Working Group - CAFF) and Trends and Effects Programme (Arctic Monitoring and Assessment Programme - AMAP) are two efforts that deserve ongoing support both at the international level and the national level, where the monitoring efforts that underpin these programs are largely under-funded.

One of the primary impediments to gaining insight from the baseline data that do exist is the diversity of standards used to collect and compile data. Supporting and strengthening efforts to increase the consistency and comparability of data and metadata are clear needs. Experts acknowledged the work of the CAFF and AMAP Working Groups to address these needs, and the potential role of the ArcticData data-sharing effort of the CAFF and Protection of the Arctic Marine Environment (PAME) Working Groups.

Finding: Mechanisms and standards to strengthen data and monitoring cooperation among Arctic Council Working Groups is a critical need. In addition to advancing the work of the Arctic Council described above, a circumpolar overview of Arctic monitoring programs could help to identify gaps and overlaps among the Arctic Council Working Groups. Inventories of monitoring have been initiated by the Arctic Council's Sustaining Arctic Observing Network (SAON) and several working groups.

Integrated Analyses, Risk Assessments, and Resilience

Assessing risk and tipping points in natural or social systems requires analyses that consider information from a variety of disciplines and perspectives. There are numerous means for conducting such cross-sectoral and cross-discipline analyses. One of the most promising means for assessing risk, while addressing issues of uncertainty and cumulative impacts, is the use of resilience analysis, which is a method for understanding how linked social, economic, and ecological systems are likely to respond to disturbance.

Resilience analysis identifies the controlling variables that determine a system's resilience and identifies tipping points at which that ecosystem or socio-economic system is more likely to transform into another state. This allows managers to more effectively plan management actions that enhance the ability of ecosystems or socioeconomic systems to undergo change while still retaining essential structures and functions. By identifying the strengths and weaknesses of a system and the factors that are driving change within that system, resilience analysis can provide the essential information necessary to effectively implement EBM. The Arctic Council Arctic Resilience Report (ARR) will advance management efforts in the region by providing this type of analysis and encouraging ongoing monitoring of resilience in key areas.

Finding: Integrated analyses are complex and by definition involve information and engagement from multiple sources. There are data available to support such analyses, but a limited capacity to share, process, and utilize these data, as noted above. Efforts to enhance cooperation among science organizations are needed, and would assist Arctic Council Working Groups as they endeavor to build scientific cooperation among Arctic Council members. An opportunity also exists to formalize the connections between the ARR and EBM efforts within the Arctic Council and among member states.

Understanding Ecosystem Interactions and Implications for EBM Approaches

One of the primary barriers to effective implementation of EBM in a rapidly transforming Arctic is a lack of understanding regarding the many interactions among marine, coastal, terrestrial, and aquatic ecosystems in the region. For example, it is well known that reductions in the extent of sea-ice and shore-fast ice are having dramatic effects on the exposure of coastal systems to rapid erosion and storm surge, but little is known about the effect of disintegrating permafrost and peat substrates upon benthic communities or the alteration of freshwater habitats from inundation due to erosion and sea-level rise.

These phenomena can strongly impact ecological and cultural resources system-wide but the degree or scope of these impacts is largely unknown. Considering any one of these systems in isolation will leave managers exposed to far greater uncertainty and unexpected impacts. The same is true of socio-economic systems; it will be problematic to manage the impacts of offshore activities without regard to the impacts of the shore-based infrastructure that will be needed to support such activities.

In implementing EBM, it is important to note that there are often significant governance differences between marine and terrestrial systems. For example, marine environments are often considered common patrimony, while terrestrial, coastal, and aquatic environments are not. Consequently, EBM implementation in the latter areas is more likely to be national than international. Also, while marine management tends to be sector-focused on resources such as fisheries or marine mammals, land management agencies are often responsible for multiple resources and uses within a specific area.

For this reason, terrestrial and aquatic management may already be highly interdisciplinary and inclusive of the some of the principles of EBM. It is notable, also, that as systems change, protected areas or areas

of special concern at sea may be moved to accommodate shifts in the resources under management. Boundaries and jurisdictions on land are unlikely to shift with changing biota or ecosystems.

Finding: The complex and little-understood interactions among Arctic ecosystems represent a significant knowledge gap that deserves attention in order to insure effective implementation of EBM across such systems. Increased coordination among Arctic Council Working Groups, in particular PAME and CAFF, will enhance our understanding of these interactions and further the development of cross-system best practices.

A set of EBM best practices for both marine and terrestrial environments that also describes the important differences in governance would also add considerable value. However, Arctic conditions and circumstances are constantly changing – new best practices may emerge or other practices may need to be adapted to these changes. Some formal and ongoing means to exchange information on both successful and unsuccessful implementation of Arctic EBM across systems, and to further develop the canon of knowledge and practice, is critical to the success of EBM in this highly interactive environment.

Ecologically and Culturally Significant Areas

The identification of areas of high ecological, social, or economic importance, in particular those areas essential for sustainability, is foundational to the concept of EBM. Identifying such areas must be based on the best available scientific and traditional information.

There have been a great many efforts to identify such areas at the regional, national, and international scales – for a variety of purposes and using a variety of methodologies. Some Arctic states are compiling such information at the regional and national level; for example, Norway has developed maps of sensitive marine areas in the Barents Sea, the United States has begun an initiative to compile information on ecologically significant areas for both marine and terrestrial environments in the Alaskan Arctic, Canada has identified Ecologically and Biologically Significant Areas (EBSA) in all of its Arctic waters, and Greenland has developed maps of sensitive marine areas based on strategic environmental impact assessments covering most of the marine environment in Greenland. The Arctic Marine Shipping Assessment 2009 Recommendation IIC (AMSA IIc) has endeavored to identify Arctic marine areas of "heightened ecological and cultural significance".

Perhaps the most exhaustive pan-Arctic effort to compile and map marine areas of ecological significance was completed under the auspices of the International Union for the Conservation of Nature, the Natural Resources Defense Council, and the Scripps Institution of Oceanography.

Though orchestrated by non-governmental organizations, the 34 experts that produced this compilation were representative of government agencies, academia, and indigenous organizations with deep expertise in the Arctic region. The fundamental criteria for consideration were derived from the international Convention on Biological Diversity. An Arctic Marine Synthesis for the Chukchi and Beaufort Seas, produced by Audubon Alaska and Oceana, is another example of an exhaustive resource that identifies and describes sensitive areas.

Finding: One of the most pressing needs for EBM in the Arctic is finding a way to appropriately collect and combine these sources to establish a suite of significant biological and cultural areas for marine and terrestrial environments Arctic-wide. Such a compilation, updated and endorsed by Arctic Council members, is an important missing piece for EBM implementation in the Arctic marine environment. To compile similar information for the Arctic's terrestrial ecosystems, experts suggested utilizing international fora such as the CAFF sub-working group on Arctic

biodiversity and the terrestrial circumpolar biodiversity monitoring expert group.

Cumulative Impacts and Uncertainty

The state of the environment is ultimately dependent on the overall pressures and impacts of all the different activities that take place both within and outside a given area. The impacts of all of these activities and conditions, and the interactions among them, are known as cumulative impacts.

To ensure successful integrated, ecosystem-based management, it is important to have ways of assessing these cumulative impacts. Such assessments are complicated by a number of factors. For example, the combined impacts of different pressures such as harvesting, unintentional damage, pollution and climate change will not necessarily be the same on different trophic levels. Cumulative effects can differ widely from individual effects in terms of their magnitude, significance, spatial extent, and temporal distribution (e.g. in the course of a single year, or between years). Gaps in knowledge at the species level or related to ecosystem function and structure can add further uncertainty.

With such high levels of complexity and uncertainty, it can be very difficult to accurately estimate overall impacts on an ecosystem. Uncertainty is normal when planning for the future but can result in very different understanding, expectation, or operational changes among various stakeholders. To address these differences uncertainty must be identified early in the ecosystem-based managment process to the extent possible[1].
One approach to assessing the overall pressure and impacts, or the way in which these pressures interact, is to identify the components of the ecosystem that are under the greatest overall pressure - an approach that can also aid in setting priorities.

Finding: In addition to the need for more information to reduce uncertainty and increase the effectiveness of management actions, methodological guidance should be developed, refined, and shared to better guide the assessment of cumulative effects. Consistent or regular cooperation and exchange of relevant knowledge among the Arctic Council working groups would help to reduce uncertainty and could serve as the basis for improving methodologies for assessing cumulative effects. The Arctic Council working groups and member states would also benefit greatly from regular opportunities for exchanging information on the components of various Arctic systems that experience the greatest overall pressure from cumulative impacts.



Light on the ice Photo: Linnea Nordström

1 To fully understand how uncertainty can lead to differing expressions it is necessary to differentiate between scientific uncertainty (i.e., risk as statistical probability) and uncertainty in the common sense of the word. Risk is an event with a known outcome (or at least a probability of a known outcome, statistically speaking) with the certainty of that outcome dictated by an understanding of the system in review and the precision of the data and analyses. Uncertainty (generally speaking) is an event with an unknown outcome, e.g. uncertainty can be very high when there is a limited understanding of the system and its thresholds of change. Many environmental issues have elements of both risk and uncertainty. An EBM approach accommodates both risk and uncertainty (as defined) as a basic component of decision-making at all levels.

Needs: PROCESS

"Such [knowledge] gaps are indeed important, but it is my view that gaps in process, in communications, and in practices for gathering, assuring quality, sharing, and utilization of information will prove more critical, and that addressing these process gaps through appropriate coordination of effort, institutional development, and guidance will have the greatest impact on the future success of EBM in the Arctic."

"The ecosystem approach and its application by management (e.g. EBM) requires a significant amount of capacity building, both individual and institutional, to create the necessary enabling environment. Stakeholders must learn to appreciate differing disciplines, perspectives and approaches and must be able to address cross-cutting issues. A key element for success anywhere is a recognition and appreciation for the time, complexity, and effort needed to design and establish programmes or projects which address the ecosystem approach and subsequent implementation via EBM."

As noted in the introduction, information does not make management decisions – implementing EBM requires a level of organization that can transparently translate the information into action in the face of uncertainty. Such frameworks must use the best available information to balance stakeholder values and identify means to distribute risk. The following sections highlight some of the top-level issues expressed by experts regarding the procedural elements of EBM implementation.

Integration and Trans-Disclipinarity

The difficulty of crossing disciplinary lines and integrating the efforts and knowledge of social and natural sciences is as true in the Arctic as elsewhere. To compound this challenge, the circumpolar Arctic features a particularly wide variety of governmental and non-governmental entities designed to meet ecological, commercial, and socio-economic needs. It is not common practice to integrate the work of these entities, and there are often legal structures that inhibit such integration, such as conflicting mandates.

Finding: Bringing organizational missions into harmony requires institutions to expand their capacity for interdisciplinary work and, where possible, to adopt or develop agreements or structures to allow such efforts. This is fundamental to EBM but a major challenge for rigid institutions. Formal EBM workshops and/or periodic information exchange among Arctic Council members and Working Groups, NGOs, and other Arctic stakeholders would advance efforts to integrate the efforts of the many disciplines involved in Arctic sustainability issues.

Scenario-Building

Targeting a single preferred outcome under a single presumed future is not an adequate management strategy in a rapidly-changing environment such as the Arctic. One means to help stakeholders envision the opportunities and barriers they face as they balance objectives is to build scenarios that describe a set of plausible futures for the system under consideration. This allows stakeholders to negotiate a favored, and more realistic, set of objectives or management strategies more easily.

Scenarios may be developed qualitatively using a narrative style to describe a suite of futures based on known trends and predictions; quantitatively using models and technical inputs; or in a hybrid of the two, in which models are used to "future-cast" the results of various management strategies and approaches. Scenarios have been used effective-

ly to help businesses and governments plan more effectively in the face of uncertainty.

Finding: EBM in the Arctic would be well-served by increasing the national and international capacity for scenario-building, providing formal opportunities to communicate these scenarios across boundaries and among stakeholders, and compiling best practices for maximizing such efforts.

Adaptive Management

Due to the level of uncertainty inherent to changing natural and socio-economic systems in the Arctic, and the difficulty associated with predicting how any system will react to a management intervention, EBM requires a capacity for adaptive responses. Adaptive management is a form of structured decision-making intended to reduce uncertainty and improve management. Essentially "learning by doing", adaptive management involves implementing an informed management action and carefully monitoring the impacts of the intervention or the changes in the system to determine if progress is being made toward goals. If the intervention is not adequately effective, adjustments can be made based on new information.

Adaptive management may be inappropriate for some applications, such as when dealing with highly sensitive or rare resources. It is most appropriate in situations where there is substantial uncertainty, and where there is some expectation that reducing uncertainty will improve management. Important component parts of the adaptive approach are stakeholder involvement, clear articulation of values, strong monitoring protocols, and institutional learning – all fundamental to EBM as well.

Finding: Adaptive management is one of the best-understood and described aspects of the EBM approach – abundant guidance and resources are available to advance such work in the Arctic. Adaptive management is reliant upon effective monitoring, however, so its implementation faces the same constraints described above regarding monitoring and data-sharing. Ongoing cooperation among the Arctic Council members and working groups regarding monitoring needs and best practices for adaptive responses in the case of scant data is essential.

Transboundary Coordination

Implementation of EBM is a scale-dependent veture. Objectives, stakeholders, and actions must be tailored to the context under consideration. Experts acknowledged that most EBM implementation would occur at the national or sub-national level, but also urged a cooperative approach among the Arctic nations, both bilateral and multi-lateral, to improve the likelihood of success in a highly interactive natural environment. Such approaches could be coordinated through the Arctic Council and its Working Groups to leverage information and maximize management efficiency and knowledge-sharing across all Arctic environments.

Experts suggested that sharing best practices at the Arctic Council level could add significant value to knowledge acquisition and management, establishment of transparency and accountability, definitions of standards and high-level guidelines, articulation of shared or common ecosystem management objectives, and identification of those ecosystems where transboundary cooperation is necessary for success.

Finding: The Arctic Council is in a unique position to encourage and advance transboundary efforts, and EBM provides a perfectly-suited framework for advancing such work. Suggested means for doing so included affirming the Council's institutional commitment to cross-boundary EBM and establishing or supporting structures, processes, or convenings for information-sharing and coordination of efforts.

CONCLUSION

As noted earlier in the document, this intersessional effort was intended to provide a compilation of data gaps and tool needs for implementing EBM in the Arctic. The team of experts involved in this effort determined that given the place-based and scale-dependent nature of EBM efforts, it may not be particularly helpful to generalize data gaps across the entire Arctic, as originally intended, but rather focus on the needs associated with crucial categories of information or knowledge. Additionally, it was clear from expert feedback that this effort would be incomplete without an assessment of both the knowledge and process needs of effective EBM in the Arctic.

The narrative in this document is intended to provide a summary of the high priority knowledge and process needs for implementing EBM in the Arctic. This document will be used by the EBM Expert Group as a starting point in the development of guidelines and recommendations to the Arctic Council Senior Arctic Officials and Ministers prior to the 2013 Ministerial.

In summary, the areas of EBM knowledge and process that arose as areas of particular need or importance are as follows:

KNOWLEDGE	PROCESS
Traditional Knowledge	Integration and Trans-Disciplinarity
Ecosystem Services	Scenario Building
Monitoring and Data- Sharing	Adaptive Management
Integrated Analyses and Resilience Assessments	Transboundary Efforts
Understanding Ecosystem Interactions	
Ecologically and Culturally Significant Areas	
Uncertainty and Cumulative Impacts	

3. Advancing Ecosystem-Based Management in the Arctic Council

This paper builds on the intersessional document "Definition and Principles of Ecosystem Based Management in the Arctic", the findings identified in the "Knowledge and Process Needs for EBM in the Arctic" intersessional document, and the "Compendium of key EBM-related activities by the Arctic Council Working Groups".

Within the context of a common definition for EBM in the Arctic, key findings related to knowledge and process requirements, and the existing work of the Arctic Council's Working Groups on EBM, the purpose of this paper is to identify potential areas where additional focus by the Arctic Council, including through its Working Groups, can serve to advance EBM and promote its implementation in the Arctic.

1. MEASURES TO ADVANCE EBM

Throughout the Arctic States there exist a varied set of practices for ecosystem-based management, diverse geographical scope and different administrative traditions and cultures. The ecosystems range from boreal to high Arctic, and the challenges countries face with regard to ecosystem-based management therefore vary considerably. The need to implement EBM also varies across the Arctic region.

The EBM definition that has been proposed for use within the Arctic Council includes four elements: integrated management, knowledge about ecosystems, addressing influences on ecosystems, and conservation and use objectives.

a) Integrated Management

An important element of EBM is the integrated management of ecosystems. EBM differs from conventional resource management in that it addresses entire ecosystems, rather than their individual components. Also, in the context of EBM it is important to address the socioeconomic aspects relating to the use of ecosystems and their resources. Integrated assessments of cumulative impacts provide a holistic picture of changes in the Arctic and what the impacts are – providing valuable information that can be used by policy makers. Successful EBM solutions are dependent upon this type of information.

Integrated analyses and assessments have not been the norm within the Arctic Council or the work of the Arctic Council's Working Groups. Arctic States have undertaken integrated assessments and face challenges in terms of sharing, processing and using the data. In addition, while data may be available either from Arctic States or through mechanisms such as SAON (Sustaining Arctic Observation Networks), challenges remain as to how to compare data,as well as how to define observation and monitoring programs so that available data is meeting the needs for EBM.

Within the Arctic Council Working Groups there are different approaches regarding how they collect, use, and make available the science for their work. Efforts to build scientific cooperation among Arctic Council members should also address the challenge of environmental baseline information and monitoring.

The following could therefore advance these issues in the context of the Arctic Council:

- Where appropriate, future assessments which Working Groups consider under-

taking should be integrated assessments.

- A "how to" manual for integrated analyses/assessments, or guidelines for undertaking integrated assessments, could be developed.
- Building scientific cooperation among Arctic Council members could be done through a pilot project between two or more Arctic Council states, and can demonstrate how data is collected, shared, processed and used to contribute to EBM in the Arctic.
- A cross-Working Group project on consistency and comparability of data could be undertaken.
- A workshop could be held to identify and discuss approaches to, and experiences with, integrated management and the design of assessments for this purpose, including the role of indicators.
- A workshop could be held to discuss experiences with previous Arctic Council assessments and to learn from those.
- An inventory of ecosystem status reports could be prepared.
- Data/information from all Working Groups could be identified and compiled, e.g., what type of information is available and how it can be accessed.
- Socio-economic and cultural data should be reflected in SAON.
- A common data framework that can be used across all AC working groups should be developed.
- A manual to be used as a guide for how to use integrated assessments to identify cumulative impacts should be developed.
- Regular reporting on high risk Arctic systems that are most threatened by cumulative impacts would help the Arctic Council focus its Working Group activities.

b) Knowledge

EBM is knowledge intensive. To manage an ecosystem, scientific knowledge about its properties, structure and function is fundamental. Also, knowledge about the pressures affecting the ecosystems and resulting vulnerabilities are critical to EBM. Scientific input has been important to the Arctic Council's assessment projects such as the Arctic Climate Impact Assessment or the Arctic Biodiversity Assessment. But the six Arctic Council working groups have different approaches to how they relate to and use science in their work.

There are a number of scientific bodies and programs relevant to the Arctic and ecosystem-based management, such as the International Arctic Science Committee, the SAON, and the International Polar Year and its follow-up. The need to establish baseline data of ecosystem properties at a pan-Arctic level has been raised in a number of these bodies and programs[1]. The ongoing work of the Arctic Council's Circumpolar Biodiversity Monitoring Program addresses some of these concerns.

Also, the complex and little-understood interactions among Arctic ecosystems represent a significant knowledge gap that deserves attention in order to ensure effective implementation of EBM across such systems.

The following could enhance EBM-related science and its use within the Arctic Council:

- Support should be given to dedicated EBM research programmes under, for example, IASC.
- A workshop could be developed on the design of EBM monitoring programmes.
- A workshop could be developed on methods for selection of valuable and vulnerable areas.

1. See, for example: http://www.arcticobserving.org/images/stories/files/Final_Updated_SAON_Brochure.pdf

- Support could be provided for pan-Arctic monitoring of ecosystems and pressures (SAON).
- The Arctic Council should adopt some means to compile and compare the results of ongoing scenario-building and predictive efforts in the Arctic. Such "future-casting" will advance the ability to implement effective EBM initiatives.
- A PAME/CAFF expert group could be established, with a one-time task of improving understanding regarding ecosystem interactions (between marine, coastal, terrestrial, aquatic in the Arctic Region).

Also, in many areas traditional knowledge is relevant to EBM. Arctic Council Working Groups and the Permanent Participants have relevant information and experiences which could be a useful contribution to a compilation of best practices for incorporating traditional and local knowledge.

The following could enhance the Arctic Council's ability to advance the incorporation of traditional knowledge and, in so doing, advance EBM within the Arctic:

- A compilation of existing/ongoing efforts to incorporate traditional and scientific expert knowledge would be useful. This would allow an examination of useful methods and best practices.
- An explicit Arctic Council Working Group policy or agreement could be developed focusing on the incorporation of traditional and local knowledge in Working Group activities, where relevant and appropriate.

c) Addressing Influences on Ecosystem

Some influences are more critical to the health of ecosystems than others, and some components of ecosystems are more valuable and vulnerable than others. In EBM it is therefore important to identify those pressures that are the most significant, as well as their cumulative effects. Identifying and defining valuable and vulnerable areas in ecosystems is critical in order to be able to protect those ecosystem properties that are vital for ecosystem structure and function.

For example, an important feature of large marine ecosystems is their vulnerable and valuable areas, where ecosystem properties are particularly important for the functioning of the ecosystem as a whole and the delivery of ecosystem services. This is an area where much can be gained by comparing notes across different EBM cases, to identify criteria, methods for arriving at them, and approaches to monitoring.

Both AMAP and CAFF have undertaken initiatives upon which assessing the value of ecosystem services could eventually be based. CBMP work on indicators of Arctic change could also contribute to this work. However, the working groups have not gone as far as articulating the benefits and costs of ecosystem services in the Arctic. Some formal and ongoing means to exchange information on both successful and unsuccessful implementation of Arctic EBM across systems, and to further develop the canon of knowledge and practice, is critical to the success of EBM in this highly interactive environment.

PAME has identified "large marine ecosystems", which could be used as a basis for ecosystem based management. There is nothing similar for terrestrial ecosystems. Through follow-up work on the Arctic Marine Shipping Assessment, AMAP, CAFF and SDWG are identifying ecologically and culturally significant areas in the Arctic.

Adaptive management is an important aspect of EBM. Adaptive management is reliant upon effective monitoring, however, so its implementation faces the same constraints described above regarding monitoring and data-sharing. Ongoing cooperation among the Arctic Council members and the Working Groups regarding monitoring needs and best practices for adaptive responses in the case of scant data is essential.

Also, the Arctic Council is in a position to encourage and advance transboundary efforts in EBM where relevant.

Possible actions in the Arctic Council regarding measures to address critical influences:

- A workshop could be held to address common issues in defining ecosystems, both marine and terrestrial.
- A workshop could be held to share experiences in identifying and monitoring valuable and vulnerable areas.
- Compilation of information on implementation of EBM across Arctic ecosystems would be useful.
- A joint Working Group project to assess the value of ecosystem services, perhaps associated with sea ice and permafrost could be value added.
- A terrestrial equivalent of "large marine ecosystems" (LMEs) should be developed, possibly by CAFF.
- Ecologically sensitive terrestrial areas should be identified (in addition to already identified marine areas) based on best available scientific and traditional information.
- Working Groups should all be engaged in helping to suggest ecological objectives for the marine and terrestrial areas identified.
- At the Working Group level, there could be a joint meeting of WG chairs to develop input for a common EBM work plan, from which specific activities would be reflected as an element in each of the Working Groups' ongoing two year work plans.
- Alternatively, or in addition to the above, a mechanism to coordinate a common approach to the work on EBM within the Arctic Council, focusing on both marine and terrestrial EBM and engaging representatives from all of the Working Groups, could be considered.
- A regular meeting/workshop on EBM in the Arctic could be organized – focusing on the integration of economic, social, ecological components of EBM and highlighting examples of how EBM is implemented in each of the Arctic States.
- Pilot projects between two or more Arctic States could be developed (ideally one with a marine focus and one with a terrestrial focus), which would showcase movement towards EBM implementation in the Arctic.

d) Conservation And Use Objectives

EBM is distinct from conventional management of nature in that the unit of management is the ecosystem as such, not its constituent parts. Therefore an overriding concern is the cumulative impacts of all pressures on the structure and functions of ecosystems.

Adding to the natural variability of ecosystems, which is very large in the Arctic, pressures from economic activities can affect ecosystem health. For most sectors, conservation and use objectives exist. Effective or not, such sectoral objectives have different metrics and do not easily add up to EBM objectives. In the context of EBM, it is therefore important to build on such sectoral objectives for conservation and sustainable use, adding a layer of EBM-related objectives that address the need to maintain ecosystem health.

In practice, the implementation of conservation standards in the context of EBM have been done through the continued development of Ecological Quality Objectives (EcoQOs) or some variation on that. Given the diversity of the ecosystems in the Arctic

and the different governance systems in the Arctic states, possible actions in the Arctic Council to address use and conservation objectives and develop ecological quality objectives include:

- Establish an inventory of conservation and use objectives relevant to EBM, including how they can promote and/or prevent the implementation of EBM.
- Hold a workshop to address examples of practical implementation of conservation standards in an EBM context, with a view to learning and dissemination of experiences.
- Hold a workshop to identify methods and criteria for developing Ecological Quality Objectives.

2. CONCLUSIONS

The Arctic Council is a "High-level forum"[2] for the promotion of cooperation and interaction among Arctic states and others, overseeing and coordinating its work programs, and disseminating information about Arctic-related issues[3]. Worldwide, substantial efforts are being committed to the development of ecosystem-based management; this paper has discussed the Arctic Council's potential role and activities to advance this work in the Arctic environment.

Specifically, on the basis of an understanding of ecosystem-based management as "...comprehensive integrated management of human activities based on best available scientific knowledge about the ecosystem and its dynamics, in order to identify and take action on influences which are critical to the health of ecosystems thereby achieving sustainable use of ecosystem goods and services and maintenance of ecosystem integrity...", we have discussed four elements of EBM: integrated management of human activities, best available knowledge, addressing influences on ecosystems, and conservation and use objectives. For each of these four elements we have identified a broad menu of EBM-related actions that the Arctic Council could pursue in order to further advance the implementation of EBM in the Arctic.

2 Ottawa Declaration, paragraph 1.

3 Bloom, E. T. (1999). Establishment of the Arctic Council. The American Journal of International Law, 93(3), 1–1712–722.

4. Compedium of EBM-Related Activities of the Arctic Council Working Groups

Purpose of this Intersessional Work

The purpose of this work is to identify the relevant EBM work that the Arctic Council working groups have completed or are currently undertaking. The objective is to assemble a compilation of the working groups' EBM-related activities. It is not meant to be a comprehensive overview of all of the work being undertaken by the working groups, but rather is meant to provide information on the key initiatives and projects related to EBM in which the working groups have been engaged, or are currently undertaking.

There are six Arctic Council Working Groups:

1. Conservation of Arctic Flora and Fauna (CAFF);
2. Protection of the Arctic Marine Environment (PAME);
3. Sustainable Development Working Group (SDWG);
4. Arctic Monitoring and Assessment Program (AMAP);
5. Emergencies Prevention, Preparedness and Response (EPPR); and
6. Arctic Contaminants Action Program (ACAP).

Of these six groups, and for the purposes of this intersessional paper, the focus will be on the four groups which have undertaken particularly significant work related to EBM:, and PAME, AMAP, SDWG and CAFF

Inventory/Catalogue of the Arctic Council Working Groups

Ecosystem-based management is not a new concept within the Arctic Council. Several of the Arctic Council's working groups have conducted work in this area or have, as one of their main functions, collected information that could be used in the application of EBM. What follows is a summary of the types of activities that the working groups have been engaged in which is either directly related to EBM, or which could contribute to the implementation of EBM in the Arctic. A brief description of the initiative is provided, along with the relationship to EBM, the outcome, and information on whether a database or other information exists related to the initiative.

Protection of the Arctic Marine Environment (PAME)

PAME's mandate is to address policy and other measures related to the protection of the Arctic marine and coastal environment from both land and sea-based activities. These measures include coordinated strategic actions, programs, assessments and guidelines, all complementing existing international arrangements. PAME provides a unique forum for collaboration on a wide range of activities directed towards protection of the Arctic marine environment.

THE ARCTIC MARINE STRATEGIC PLAN

Description: The Arctic Marine Strategic Plan (AMSP) was initiated at the meeting of the Arctic Council in Inari, Finland, in 2002. Arctic Council Ministers signed a declaration recognizing that "…existing and emerging activities in the Arctic warrant a more coordinated and integrated strategic approach to address the challenges of the Arctic coastal and marine environment…" The AMSP was prepared by PAME in collaboration with other Arctic Council working groups and endorsed by the Arctic Council Ministers in 2004. This Strategic Plan covers all Arctic marine areas and relates to all key activities affecting Arctic marine ecosystems; therefore it also considers coastal zones, river basins

and other areas that are connected to the marine ecosystem.

Relation to EBM: The AMSP is consistent with the rights and obligations covered under applicable regional and international agreements. It is acknowledged that the UN Convention on the Law of the Sea is the recognized legal framework for implementing this Strategic Plan and is based on widely recognized principles and approaches of which the adoption and application of an integrated, ecosystem approach to managing the Arctic marine environment is highlighted. Furthermore, 3 of the 39 strategic actions identified in AMSP provide a direct contribution to further development of the ecosystem approach to marine management.

Outcome/Output: The AMSP was endorsed in 2004 and is a policy document on the Arctic marine environment. The PAME working group and other Arctic Council working groups have been implementing its strategic actions as relevant to their respective mandates.

Most of the strategic actions in the AMSP 2004 have been or are in the process of being completed. Thus PAME is initiating an updating of the AMSP which will be done in collaboration with other Arctic Council working groups working on marine-related issues. The bulk of this work will take place after the 2013 Ministerial meeting in an effort to better align the process with other relevant Arctic Council products and follow-up recommendations.

The update of the AMSP will provide a platform for more coordinated and integrated actions and can support decision making at international, regional, national and local levels. The update also responds to commitments by the global community to sustainable development and protection of marine biodiversity and environment through the application of the ecosystem approach and integrated coastal and ocean management.
Database: No database available as AMSP is a policy document based on findings and outcomes of relevant national, regional and international work.

WORKING MAP OF ARCTIC LARGE MARINE ECOSYSTEMS

Description: One of the strategic actions of the AMSP was to identify the large marine ecosystems (LMEs) of the Arctic based on the best available ecological information.

Relation to EBM: A working map of 17 Arctic LMEs was prepared under PAME and adopted by the Arctic Council in 2006. The working map is currently under revision with suggested adjustments of some of the boundaries. The revision is planned to be finalized by the end of this year and presented for adoption by the Arctic Council in spring 2013.

Outcome/Output: The output is a working map of the 17 Arctic LMEs, which is currently under revision.

Database: There is no central database as the boundary information is provided by the Arctic Council member states, but the endorsement of the revised map of the 17 Arctic LMEs could assist the Arctic Council in organizing data and information from marine assessments.

ECOSYSTEM APPROACH EXPERT GROUP

Description: PAME established in 2007 an Expert Group (EG) on the Ecosystem Approach and LMEs, led by the USA and with Norway as co-lead country from 2009. The work of the EG has followed a work plan agreed by PAME. At an EA workshop in Tromsø in January 2011 it was suggested that the EG should be broadened with participation also by AMAP, CAFF and SDWG. PAME invited these other AC WGs and they agreed to take part in a broadened EG.
A second workshop was held in Stockholm in March 2012 focusing on the topic of integrated assessment, and a third workshop is being planned in spring 2013 addressing the broad

topic of 'data issues' in relation to integrated assessment and EA to management

Relation to EBM: Terms of Reference for the EA expert group for the period 2011-2013 provides the work plan for this group and includes the following items:

- Complete the revision of the working map of Arctic LMEs for consideration at PAME II-2011.
- Prepare an inventory of existing or planned reports relevant to ecosystem status reporting based on the information compiled at the workshop and additional information supplied by members of the expert group.
- Further development of ecosystem status reports and integration of monitoring and assessment.
- Review methods and progress in determining ecological objectives for species and habitats that can serve as a part of the management objectives for the ecosystem approach to management of Arctic LMEs.
- Review of the Arctic marine strategic plan
- Taking into account previous and ongoing work by Arctic Council working groups
- EA concept paper

Outcome/output: This initiative is ongoing, as a part of PAMEs work plan.

Database: Information/data based on submissions by Arctic Council member states and the scientific-based working groups of the Arctic Council, as relevant.

AMSA - ARCTIC MARINE SHIPPING ASSESSMENT

Description: The AMSA is a circumpolar study which details a broad range of Arctic shipping issues and concerns, and outlines a framework for marine safety and marine environmental protection, which is consistent with the Arctic Council's mandates of environmental protection and sustainable development.

The AMSA is rooted in one of the strategic actions identified in the AMSP, and reaffirms the Arctic state view that the United Nations Convention on the Law of the Sea (UNCLOS) remains the legal framework that influences and guides current and future governance of the Arctic Ocean. The AMSA also acknowledges that the International Maritime Organization (IMO) is the lead and appropriate UN body that can focus on marine-safety and environmental-protection measures for the global maritime industry, including operations in the Arctic.

The AMSA consists of an extensive shipping activity database; 8 chapters with findings and research opportunities linked to each chapter. There are a number of regional studies. The AMSA includes 17 recommendations which are grouped into the following three broad, inter-related themes that are intended to influence policy makers and future Arctic planning:

- enhancing Arctic marine safety
- protecting Arctic people and the environment
- building Arctic marine infrastructure

Relation to EBM: LMEs were used in the AMSA (2009) to summarize information on shipping activities and to examine relations to sensitive ecological features and species and vulnerable areas. The information compiled and used in the Oil and Gas Assessment for the various Arctic LMEs were used as a general basis for the environmental chapter of AMSA.

Outcome/output: PAME produced proposals for action on all 17 recommendations on which the AMSA Report requires follow-up. This proposal was approved by SAOs in Nov 2009 and has since been an integral part of PAME's work. Furthermore, PAME prepares an AMSA implementation progress report every two years for submission to Arctic

Council ministers in which the status of the 17 recmomendations is recorded.

Database: The AMSA database can be found at: www.arcticdata.is

ARCTIC OCEAN REVIEW

Description: The overall objective of the Arctic Ocean Review (AOR) is to provide guidance to Arctic Council ministers on strengthening governance in the Arctic through a cooperative, coordinated, and integrated approach to the management of Arctic marine environment.

The AOR will also play an important role in demonstrating Arctic States' stewardship efforts in the Arctic. The AOR is not a new assessment, but will produce a review of the status and trends of pressures on the Arctic marine environment and relevant instruments, and in this final phase of the AOR advise on options to strengthen the conservation and sustainable use of the Arctic marine environment.

Relation to EBM: The AOR Report has a separate chapter on Integrated Oceans Management (IOM)/ Ecosystem Based Management (EBM), as well as reflecting these concepts throughout the report as relevant. Considering the range of pressures on the Arctic marine environment, the AOR aims to reveal the range of issues/challenges for the Arctic marine environment and takes full account of the usefulness of an ecosystem-based management approach as an organizing framework, and the priority to conserve sensitive areas in the face of rapid changes and development trends.

Outcome/output: The AOR final report will be submitted to the 2013 Arctic Council Ministerial meeting and will contain a number of EBM-specific recommendations.

Database: (no information)

BEST PRACTICES FOR ECOSYSTEM BASED OCEAN MANAGEMENT IN THE ARCTIC (BePoMar Report 2009)

Observed Best Practices in Ecosystem-based Oceans Management in the Arctic Countries (4 page document endorsed by the Arctic Council in 2009).

Description: The Best Practices in Ecosystem-based Oceans Management Report was welcomed by the Arctic Council ministers in 2009. This work was carried out by the working groups on Sustainable Development and Protection of the Arctic Marine Environment, and observed a number of Best Practices in this regard for consideration by the Arctic Council member states. These practices have proved useful and may be relevant also to other Arctic countries as well as in the world beyond, in order to provide for sustainable development and protection of the marine environment.

Relation to EBM: BePOMAr focused on how Arctic countries defined ecosystems-based oceans management, the types of objectives that are formulated, the choice of policy instruments and organization of the work. Although definitions may differ, some core elements were identified as being essential to ecosystems based oceans management:

- The geographical scope of ecosystems defined by ecological criteria.
- The development of scientific understanding of systems and of the relationship between human actions and changes in other system components.
- The application of the best available scientific and other knowledge to understand ecosystem interactions and manage human activities accordingly.
- An integrated and multidisciplinary approach to management that takes into account the entire ecosystem, including humans.

- Area-based management and use of scientific and other information on ecosystem changes to continually adapt management of human activities.
- The assessment of cumulative impacts of different sectors on the eco-system, instead of single species, sectoral approaches.
- A comprehensive framework with explicit conservation standards, targets and indicators in order to facilitate responses to changes in the eco-system.
- Transboundary arrangements for resolution and handling of transboundary ecosystems and issues.

Outcome/output: In reviewing the practices countries have established in developing and implementing ecosystem-based oceans management, the following have been found useful: 1) flexible application, 2) integrated and science based decision-making, 3) commitment to ecosystem-based oceans management, 4) area-based approaches and transboundary perspectives, 5) stakeholder participation, and 6) adaptive management.

Database: The information/data in the report is based on submissions by Arctic Council member states.

Arctic Monitoring and Assessment Program (AMAP)

AMAP's mandate is to monitor and assess the status of the Arctic region with respect to pollution and climate change issues by documenting the levels and trends, pathways and processes, and effects on ecosystems and humans, and to propose actions to reduce associated threats for consideration by governments. AMAP produces sound science-based, policy-relevant assessments and public outreach products to inform policy and decision-making processes.

AMAP recently focused on a scientific report on Snow, Water, Ice and Permafrost in the Arctic (SWIPA); a scientific report on short lived climate forcers; a 2011 Mercury Assessment; and the Sustaining Arctic Observing Networks (SAON). AMAP's current focus is on the Adaptation Actions for a Changing Arctic (AACA) and Arctic Ocean Acidification (AOA). More information is provided at: www.amap.no

ARCTIC CLIMATE IMPACT ASSESSMENT (ACIA, 2005)

Description: ACIA is the first comprehensive, integrated assessment of climate change and ultraviolet (UV) radiation across the entire Arctic region. The assessment had the objective to provide a comprehensive and authoritative scientific synthesis of available information about observed and projected changes in climate and UV radiation and the impacts of those changes on ecosystems and human activities in the Arctic. The synthesis also reviews gaps in knowledge and the research required to fill those gaps.

Relation to EBM: The assessment methodologies and information/data presented in the assessment support EBM principles and contribute to the scientific information and foundation upon which EBM is based.

Outcome/Output: The project produced three reports:

- Impacts of a Warming Arctic – a 140-page synthesis report of the Arctic Climate Impact Assessment
- Scientific Report
- Policy Report
- The products can be found at http://www.acia.uaf.edu/

Database: The reports contain the data that forms the basis for the assessment. AMAP data on contaminants and radionuclides are held at the AMAP Thematic Data Centers (TDCs). The most important TDCs are ICES (www.ices.dk) and NILU (www.nilu.no).

HUMAN HEALTH IN THE ARCTIC (AMAP Assessment, 2009)

Description: This assessment report updates the information presented in the AMAP 1997 and 2002 assessment reports with respect to three subject areas: persistent organic pollutants, contaminants and human health, and radioactivity. The POPs update has a particular emphasis on 'emerging' and current use POPs. The human health update addresses health effects of POPs, mercury, and lead exposure, but also the presence of new, emerging compounds in the Arctic environment. These compounds include the polybrominated diphenyl ethers, fluorinated compounds, polychlorinated naphthalenes and endosulfan.

Studies on diets indicate a movement away from traditional foods to store-bought food, with important health implications. Recommendations for further research include continued monitoring for new compounds in the Arctic system, international agreements to reduce and eliminate pollutants entering the Arctic, research on the toxicological properties of legacy and new compounds and more information on the combined effects of pollutants and other stressors, such as climate change.

Relation to EBM: The assessment methodologies and information/data presented in the assessment support EBM principles and contribute to the scientific information and foundation upon which EBM is based.

Outcome/Output: The project produced the report[1] AMAP Assessment 2009: Human Health in the Arctic. Arctic Monitoring and Assessment Programme (AMAP), Oslo, Norway.

Database: The report contains the data that forms the basis for the assessment. AMAP data on contaminants and radionuclides are held at the AMAP Thematic Data Centers (TDCs). The most important TDCs are ICES (www.ices.dk) and NILU (www.nilu.no).

1 The report can be found at http://amap.no/documents/index.cfm?action=getfile&dirsub=&filename=HH2009Sci.pdf&CFID=5361&CFTOKEN=1943A651-1323-144A-E7A-2D9EA7A44DD17&sort=datelastmodified.

ASSESSMENT OF OIL AND GAS ACTIVITIES IN THE ARCTIC (2007/2012)

Description: In the Oil and Gas Assessment (OGA), the geographical breakdown of 17 Large Marine Ecosystems (LMEs) have been used as units for describing the marine ecosystems and summarizing information on species of fish, birds and mammals that use habitats within each LME during their life and annual migratory cycles. Information is given for all species of water associated birds (seabirds, waterfowl, shore birds) and marine mammals, including subspecies and populations where appropriate. This information has been used to identify vulnerable areas within each of the 17 Arctic LMEs in relation to oil spills and disturbances, based on the use of the areas by these species. The detailed information is contained in Chapter 6 (Volume 3) of the assessment, 'Status and vulnerability of Arctic ecosystems', which is now prepared for final publication.

Relation to EBM: The assessment methodologies and information/data presented in the assessment support EBM principles and contribute to the scientific information and foundation upon which EBM is based.

Outcome/Output: The project produced the report Arctic Oil and Gas 2007[2]. The 2012 report is still in draft phase.
Database: The reports contain the data that forms the basis for the assessment. AMAP data on contaminants and radionuclides are held at the AMAP Thematic Data Centers (TDCs). The most important TDCs are ICES (www.ices.dk) and NILU (www.nilu.no).

2 The report can be found at http://www.amap.no/workdocs/index.cfm?action=getfile&dirsub=%2FOGA%20Overview%20Report&filename=FINAL%20OGA%20OVERVIEW%20-%20ALL%20-%20240408.pdf&CFID=1441&CFTOKEN=131F247E-18B4-BE40-DD2618F-96C12285F&sort=default

PERSISTENT ORGANIC POLLUTANTS (POPs) IN THE ARCTIC (AMAP Assessment, 2009)

Description: This assessment includes five review articles covering a number of new or emerging chemicals in the Arctic, including perfluorinated compounds, current use pesticides (CUPs), new brominated flame retardants, endosulfan and polychlorinated naphthalenes (PCNs). This series of articles was very timely given that in May 2009, nine chemicals were added to the Stockholm Convention on POPs includingα- andβ-HCH, lindane, pentachlorobenzene, penta- and octaBDEs, hexabromobiphenyl, chlordecone and PFOS.

Several of the compounds reviewed in these articles were also currently proposed or under review as candidate POPs under the UN ECE LRTAP Protocol in 2008–09 (endosulfan, dicofol, pentachlorophenol, trifluralin and hexabromocyclododecane (HBCD) and in 2007–08 (Penta- and octaBDE, PFOS and PCN) or were at various stages of assessment under the Stockholm Convention (HBCD and endosulfan). Also included are two reviews of the temporal trends of legacy POPs in air and in biota as part of AMAP's contribution to the global monitoring and first follow-up of the UNEP Stockholm POPs convention. The issue also includes a review of biological effects in Arctic organisms in relation to current contaminant levels.

Relation to EBM:
The assessment methodologies and information/data presented in the assessment support EBM principles and contribute to the scientific information and foundation upon which EBM is based.

Outcome/Output: The project was published as 11 articles[3] in Science of the Total Environment:

- Acknowledgements
- Preface
- Atmospheric monitoring of organic pollutants in the Arctic under the AMAP - 1993-2006
- Brominated flame retardants in the Arctic environment - trends and new candidates
- Polychlorinated naphthalenes in polar environments - a review
- Levels and trends of poly- and perfluorinated compounds in the arctic environment
- Endosulfan, a global pesticide: A review of fate in the environment and occurrence in the Arctic
- Current use pesticides in Arctic media - 2000–2007
- Exposure and effects assessment - persistent organohalogen contaminants in arctic wildlife and fish
- Trends of legacy and new POPs in the circumpolar arctic: Overview, conclusions, and recommendations
- Colophon

Database: The articles contain the data that forms the basis for the assessment. AMAP data on contaminants and radionuclides are held at the AMAP Thematic Data Centers (TDCs). The most important TDCs are ICES (www.ices.dk) and NILU (www.nilu.no).

SNOW, WATER ICE AND PERMAFROST IN THE ARCTIC (SWIPA, 2011)

Description: The objectives of the SWIPA Project was to provide timely, up-to-date, and synthesized scientific knowledge about the present status, processes, trends, and future consequences of changes in Arctic snow cover, permafrost, lake and river ice, mountain glaciers and ice caps, the Greenland Ice Sheet, and sea ice conditions, and related hydrological conditions in the Arctic.

The six years (2005-2010) prior to the assessment have been the warmest ever recorded in the Arctic and the higher temperatures are driving changes in the cryosphere. Two components of the cryosphere, snow and sea ice, are interacting with the climate system to accelerate warming.

3 They can be found at http://amap.no/documents/index.cfm?dirsub=%2FAMAP%20Assessment%202009%20-%20POPs%20in%20the%20Arctic&CFID=1477&CFTOKEN=15CFFFE6-1787-146D-4FF47F-67440D53ED&sort=default

The extent and duration of the snow cover and sea ice have decreased across the Arctic and the largest and most permanent bodies of ice (multi-year sea ice, mountain glaciers, ice caps and the Greenland Ice Sheet) have all declined faster since 2000 than in the previous decade.

Changes in the cryosphere cause fundamental changes to the characteristics of Arctic ecosystems and in some cases loss of entire habitats. The observed and expected future changes to the Arctic cryosphere impact Arctic society on many levels.

Loss of ice and snow in the Arctic enhances climate warming by increasing absorption of the sun's energy at the surface of the planet. It could also dramatically increase emissions of carbon dioxide and methane and change large-scale ocean currents.

Relation to EBM: The assessment methodologies and information/data presented in the assessment support EBM principles and contribute to the scientific information and foundation upon which EBM is based.

Outcome/Output: The project was published as four reports and a series of videos. The reports are:

- Overview Report
- Scientific Assessment Report
- Executive Summary
- Educational Summary

The material can be found at http://amap.no/swipa/.

Database: The reports contain the data that forms the basis for the assessment. AMAP data on contaminants and radionuclides are held at the AMAP Thematic Data Centers (TDCs). The most important TDCs are ICES (www.ices.dk) and NILU (www.nilu.no).

MERCURY IN THE ARCTIC (Arctic Pollution, 2011)

Description: Previous AMAP assessments of mercury in the Arctic published in 1997 and 2002, reported that a substantial amount of the mercury in the Arctic arrives via long-range transport from human sources at lower latitudes and that, owing to their traditional diet, some Arctic populations receive high dietary exposure to mercury, raising concern for human health. The previous AMAP assessments also identified fundamental questions regarding what controls mercury levels in the Arctic, and how (and when) these levels are likely to fall in response to controls on emissions. The cycling of methylmercury is paramount in this respect. The human health components of this assessment reflect information on mercury and human health that was presented in the 2009 AMAP Assessment of human health in the Arctic.

Risk communication and dietary advice have been used to reduce human mercury exposure in some regions of the Arctic; however, solutions that are more effective over the longer term still need to be found. Reducing human and environmental exposure to mercury in the Arctic will ultimately depend on global action to reduce the quantities of mercury entering the 'environmental reservoirs', in which mercury has already been accumulating as a result of human activities for several hundred years.

Relation to EBM: The assessment methodologies and information/data presented in the assessment support EBM principles and contribute to the scientific information and foundation upon which EBM is based.

Outcome/Output: The project produced the report AMAP Assessment 2011: Mercury in the Arctic[4].

Database: The report contains the data that forms the basis for the assessment. AMAP

4 It can be found at http://amap.no/documents/index.cfm?action=getfile&dirsub=&filename=86253%5Fmercury%5FLO%5FFINAL-SEC.pdf&sort=default

data on contaminants and radionuclides are held at the AMAP Thematic Data Centers (TDCs). The most important TDCs are ICES (www.ices.dk) and NILU (www.nilu.no).

SUSTAINING ARCTIC OBSERVING NETWORKS (SAON, 2012)

Description: Climate change, contamination, biodiversity loss and changes to the physical environment of the Arctic have serious impacts both inside and outside the Arctic. Trends indicate that the severity of the impacts is projected to increase in the near future, subjecting Arctic countries and their people with new environmental, economic and societal challenges. Global activities affect the Arctic environment while changes in the Arctic environment have global consequences. Hence, the broader global community must be engaged in improved monitoring of the Arctic to better understand the changes and their effects, and must address the social and economic issues in Arctic observations.

The need for comprehensive, sustained and interdisciplinary Arctic observations and data management was recognized at the initiation of the Arctic Council, and stressed again in more recent documents, such as the Arctic Climate Impact Assessment (ACIA). Although the International Polar Year 2007-2008 (IPY) provided an opportunity to implement new observing activities in the Arctic, most of those activities were of short duration, and many have already concluded.

The SAON Vision is that users should have access to free, open and high quality data that will realize pan-Arctic and global value-added services and provide societal benefits. To attain that vision, SAON's goal is to enhance Arctic-wide observing activities by facilitating partnerships and synergies among existing 'building blocks', and promoting sharing and synthesis of data and information.

To achieve that goal, SAON is a resource for a broad community that includes governments and operational agencies, scientific researchers, indigenous peoples and northern residents, other stakeholders and the general public. The Arctic Council through AMAP has taken the lead in implementing the SAON process together with the International Arctic Science Committee (IASC) and the World Meteorological Organization (WMO).

Relation to EBM: The projects and data organized through SAON support EBM principles and contribute to the scientific information and foundation upon which EBM is based.

Outcome/Output: The SAON projects (Tasks) and their outcome can be found at the SAON web site (http://www.arcticobserving.org/tasks).

Database: SAON maintains a database of national networks. It can be queried from the SAON web site (http://www.arcticobserving.org/networks).

ARCTIC OCEAN ACIDIFICATION (AOA) 2013

Description: Perturbations in the global carbon cycle and climate change are causing the Arctic Ocean to rapidly accumulate CO2. This is resulting in an associated decline in pH, so-called ocean acidification. The majority of the ocean acidification is due to increases in anthropogenic carbon. However, changes in freshwater balance, heat budgets and land-ocean exchange may also play a significant role. Warming of the ocean and increasing ocean acidification will change the nature of the Arctic Ocean's ecological and biogeochemical coupling. Reduction in seawater pH and changes to carbonate system speciation and calcium carbonate saturation state will influence the Arctic Ocean system at all scales.

The Arctic Ocean is an important climate regulator and the implications of a changing role of the Arctic on the global carbon cycle are unknown. Receding ice cover will open up potentially enormous marine resources. Therefore, improved knowledge of the

resilience of the system to changing carbon dioxide is necessary. Ocean acidification is expected to affect fish stocks, marine ecosystems and the commercial, subsistence and recreational fisheries in the Arctic. However, knowledge of all of these questions is limited.

Relation to EBM: The assessment methodologies and information/data to be presented in the assessment support EBM principles and contribute to the scientific information and foundation upon which EBM is based.

Outcome/Output: An assessment report will be produced in 2013. It will be presented at the International Conference on Arctic Ocean Acidification in Bergen, 6-8 May 2013. More information is found here: http://www.amap.no/MiscTempFiles/AOAConference-FlyerFinal.pdf.

Database: The report will contain the data that forms the basis for the assessment. AMAP data on contaminants and radionuclides are held at the AMAP Thematic Data Centers (TDCs). The most important TDCs are ICES (www.ices.dk) and NILU (www.nilu.no).

AMSA IIC - IDENTIFICATION OF AREAS OF HEIGHTENED ECOLOGICAL AND CULTURAL SIGNIFICANCE

Description: The compiled information on the 17 Arctic LMEs and identified vulnerable areas within them was used as a basis for identifying 'areas of heightened ecological significance' in the follow-up of AMSA Recommendation IIC. Additional national information was used for this purpose for some parts of the Arctic (Canada and Greenland). The identified areas of heightened ecological significance serve important ecological functions for fish, birds and mammals and comprise a layer of habitat information for each of the 17 Arctic LMEs.

Relation to EBM: The assessment methodologies and information/data presented in the assessment support EBM principles and contribute to the scientific information and foundation upon which EBM is based.

Outcome/Output: The Arctic Council's report Status on Implementation of the AMSA 2009 Report Recommendations was published in May 2011[5].

Database: (No information)

ADAPTATION ACTIONS FOR A CHANGING ARCTIC (AACA), Part C

Description: Various stressors and drivers are impacting the Arctic ecosystems, societies and humans due to climate change and the global need for more resources to feed and support the growing global human population and the call for a better living standard. The melting of the sea ice and thawing of the permafrost are occurring much faster than assessed a few years ago; therefore, the Arctic countries and their people have to prepare for a future that may look very different from what we have today. People and the living environment will have to adapt to the changing situation and for some peoples and ecosystems this change and adaptation may happen rather rapidly.

The goal is to consider Arctic-focused climate and integrated environmental frameworks/models that can improve predictions of climate change and other relevant drivers of Arctic change. This project aims to predict what may happen due to interactions among some of the most significant drivers/stressors on Arctic ecosystems, societies and humans, and to provide recommendations for possible actions and adaptation activities.

Relation to EBM: The assessment methodologies and information/data to be presented in the assessment support EBM principles and contribute to the scientific information and foundation upon which EBM is based.

5 It can be found here: http://www.pame.is/images/stories/AMSA_Status_on_Implementation_of_the_AMSA_2009_Report_Recomendations-May_2011_copy_copy_copy_copy.pdf

Outcome/Output: The outcome of the project is still to be determined, but will most likely be one or more assessment reports and other outreach products.

Database: (No information)

Sustainable Development Working Group (SDWG)

The goal of the SDWG is to propose and adopt steps to be taken by the Arctic States to advance sustainable development in the Arctic, including opportunities to protect and enhance the environment, the economies, culture and health of Indigenous Peoples and Arctic communities.

The guiding tenet running throughout the work of the SDWG is to pursue initiatives that provide practical knowledge and contribute to building the capacity of Indigenous Peoples and Arctic communities to respond to the challenges and benefit from the opportunities emerging in the Arctic Region. The SDWG is currently working on the following initiatives that have, or will, inform decision-makers on the important human dimensions of EBM.

ADAPTATION ACTIONS FOR A CHANGING ARCTIC (AACA)

Description: In the AACA, SDWG will compile and synthesize the work of all the AC's working groups. Each Working Group will "consider the key findings and recommendations from existing AC assessments and other relevant national and international reports over the past ten years to determine how these can contribute to and inform adaptation options for Arctic countries."

Relation to EBM: AACA will probably set the basis for further work in other fields, which will be EBM related.

Database: Information not yet available

ARCTIC HUMAN DEVELOPMENT REPORT (AHDR)

Description: The first AHDR report was completed in 2004. The second evaluation will be completed by 2014 and will provide an important evaluation of the change that has occurred over the ten year period. This initiative provides a comprehensive overview of the human dimension of the Arctic and it will include chapters such as the political systems, resource governance, community development, cultures and identities etc.

Relation to EBM: The 2014 AHDR report will contribute to our increased knowledge and understanding of the consequences and interplay of physical and social global change processes for human living conditions and adaptability in the Arctic. All this information would be a value added to the broader understanding of the human development and quality of life in the Arctic and an important input to the overall work of the EBM.

Output/Outcome: The AHDR offers an accessible overview of the state of human development in the Arctic that can serve as a point of departure for assessing progress in the future. It identifies critical gaps in knowledge that require attention on the part of the scientific community. The AHDR also provides a framework and help to establish priorities for the activities of the Sustainable Development Working Group. More generally, the AHDR sheds light on the concept of human development itself, highlighting dimensions of human well-being that are not prominent in mainstream discussions of this topic.

The work being completed in the AHDR II report will assess the changes in Human Development in the Arctic over the past ten years. Specifically it will focus on the following main themes: Arctic Populations and Migration, Cultures and Identities, Economic Systems, Legal Systems, Resource Governance, Community Viability & Adaptation, Human Health & Well-Being, Education & Knowledge, Political Systems & Geopolitics, Globalization, and Measuring Arctic Human

Development.

Database: The AHDR published in 2004 can be accessed through: http://www.svs.is/AHDR/AHDR%20chapters/English%20version/Chapters%20PDF.htm

ARCTIC SOCIAL INDICATORS

Description: While the first phase of the ASI identified a set of Arctic specific indicators to monitor human development and quality of life in the Arctic, the second and implementation phase aims to implement the identified indicators, through testing, validating and refining the indicators across the Arctic, and then measuring and performing analyses of select cases. Its ultimate goal is providing Arctic governments and the Arctic Council with a set of robust indicators for adoption, for the purpose of long-term monitoring of human development.

Relation to EBM: The focus on indicators and monitoring contributes to our increased knowledge and understanding of the consequences of global change for human living conditions in the Arctic.

Output/outcome: The current output is a set of Arctic specific indicators to monitor human development and quality of life.

Database: The Arctic Social Indicators I report can be accessed through: http://www.svs.is/asi/Report%20Chapters/Report%20Chapters.htm

ASSESSING, MONITORING, AND PROMOTING ARCTIC INDIGENOUS LANGUAGES

Description: This initiative is a comprehensive program of research, communications, networking, advocacy and action. Its purpose is to further the languages goals of the Arctic Indigenous Communities. Its stated objectives are to: reinforce the importance of indigenous languages; assess the state of Arctic indigenous languages, lead and facilitate inter-regional, international, and intergovernmental activities in support of languages, enhance language exchange and youth engagement.

Relation to EBM: The 'use' level of a language could serve as an index to assess the state of a culture. A language component could be included into the EBM approach.

Expected Output/outcomes: The expected output/outcome is increased connections and awareness of the importance, status and activities related to Arctic indigenous languages. This will be based on activities such as: a synthesis of prior relevant assessments of Arctic indigenous languages; a series of research development workshops; a communications strategy; a pan-Arctic languages assessment; a field-based assessment of pilot communities; a series of youth and elder workshops; and a final report.
Database: Information not yet available.

ARCTIC MARINE SHIPPING ASSESSMENT (AMSA) (IIc)

Description: The SDWG is responsible for the identification of heightened cultural significant areas and their vulnerability towards marine shipping in light of changing climate condition and increasing multiple marine use in the Arctic. This initiative is a cross-cutting activity involving four Arctic Council Working Groups, PAME, SDWG, AMAP, and CAFF. The SDWG will contribute the Cultural chapter which will be integrated into the Ecological segment of the report.

Relation to EBM: This information should be seen as a value added to the cultural aspects of the EBM work.

Outcome/output: This initiative examined the available information to determine areas of heightened Cultural significance that may be affected by increased shipping in the Arctic. The initiative will be completed by the Ministerial of 2013. The assessment has indicated that just has much has been learned from the gaps of information as has been from the information available. Due to these

information gaps from the various circumpolar regions further data collection will be required.

Database: There is no data base from this assessment however the report is expected to be available through the SDWG website after May 2013: http://portal.sdwg.org/

A CIRCUMPOLAR-WIDE INUIT RESPONSE TO THE AMSA

Description: This ICC-led project will communicate the AMSA findings to Inuit and seek guidance to move AMSA forward. It will also carry out an expanded survey in Inuit communities to assess their current use of the sea.

Relation to EBM: These actions build on ICC's 2008 "The Sea Ice is Our Highway" report which focused on the human dimension of shipping.

Expected output/outcome: The expected outcome is additional information on use of the sea.

Database: Data/information not yet available

FUTURE WORK

Initiatives currently under development, which have links to EBM include:

Arctic Social, Economic and Cultural Expert Group: In addition to contributing to the work of the SDWG, and the Arctic Council more broadly, the information provided by a social, economic and cultural expert group could be considered as an important input for EBM.

Corporate Social Responsibility and Sustainable Business in the Arctic: Sustainable economic development is essential for the livelihoods of the Arctic peoples. Sweden, through the SDWG, intends to initiate a discussion with the private sector on how business, as a primary driver of globalization, can help ensure that markets, commerce, technology and finance advance in ways that benefit economies and societies in the Arctic. The project will draw on existing Corporate Social Responsibility Frameworks such as the UN Global Compact, the Extractive Industries Transparency Initiative and the OECD Guidelines on Multinational Enterprises

Food and Water Security:A literature review on food and water security in the Arctic in being undertaken under the auspices of AHHEG, and will influence further work in this area.

Enhancing the Use of Traditional Knowledge : Traditional Knowledge is identified by stakeholders and results by many reports as one key component for a deeper insight to the state of the Arctic. Irrespective of the project that is finally approved, it is an accepted position that Traditional Knowledge should be integrated into all the activities of the Arctic Council. The definition of the procedure and process of accomplishing this task has been identified as a priority. The integration of Traditional Knowledge of the Arctic residents is an important input to the EBM process.

Conservation of Arctic Flora and Fauna (CAFF)

CAFF serves as a vehicle to cooperate on species and habitat management and utilization, to share information on management techniques and regulatory regimes, and to facilitate more knowledgeable decision-making. It provides a mechanism to develop common responses on issues of importance for the Arctic ecosystem such as development and economic pressures, conservation opportunities and political commitment

To successfully conserve the natural environment and allow for economic development, comprehensive baseline data is required, including the status and trends of Arctic biodiversity, habitats and ecosystem health. CAFF is developing the framework and tools necessary to create a baseline of current

knowledge, and to provide dynamic assessments over time. This evolving, sustainable and responsive approach can produce more regular, timely and flexible analyses.

CAFF is a science-based program that focuses primarily on ecosystem, habitat and species conservation, utilization and management (CAFF 1991). The Arctic Council's Cooperative Strategy for the Conservation of Biological Diversity in the Arctic Region (1997) developed by CAFF adopts an explicit Ecosystem Approach. The use of a broad, ecosystem based approach to conservation and management is inherent in all of CAFF's work and was established with its formation under the Arctic Environmental Protection Strategy in 1992.

Given that the ecosystem approach is integral to all CAFF activities, all CAFF products are relevant to EBM. Of special importance are two key products: the Arctic Biodiversity Assessment (ABA) and the Circumpolar Biodiversity Monitoring Program (CBMP).

The ABA will provide a much needed description of the current state of the Arctic's ecosystems and biodiversity, create a baseline for use in global and regional assessments and provide a basis to inform and guide future Arctic Council work on Arctic biodiversity. It will provide up-to-date scientific and Traditional Ecological Knowledge (TEK), identify gaps in the data records, identify key mechanisms driving change and produce recommendations regarding Arctic biodiversity. The CBMP will coordinate Arctic monitoring and feed into the baseline created by the ABA.

The unprecedented changes being experienced in the Arctic emphasize the importance and urgency of getting information to decision-makers in a timely manner. To do so requires easily accessible, comprehensive data, coordinated and consistent monitoring, up-to-date assessments of trends and informed responses. CAFF is responding by working to shorten the time between detection of changes, reporting and effective policy responses. CAFF's activities (including its EBM-related activities) fall within the following areas:

- Data management
- Monitoring
- Assessment
- Conservation strategies
- Cooperation
- Communication/outreach

Below is a list of some of the CAFF activities relevant to EBM over the last decade. Key publications will include a short description, including their outcomes/outputs, and information on how they connect to EBM, as well as a link to the publications and associated section on CAFFs Arctic Biodiversity Portal.

1. DATA MANAGEMENT

All CAFF projects produce data in various forms, scales and formats. Consolidating this large and diverse amount of disaggregated data across all Arctic sub-regions and biomes is a challenging task. Once complete it will help improve access to biodiversity status and trends information and promote a deeper understanding of inter-relationships at the local, regional, circumpolar and global scale – a task implicit in the EBM approach.

CAFF is in the process of developing the Arctic Biodiversity Data Service (ABDS – www.abds.is). The ABDS is the data mangement framework for CAFF including the Circumpolar Biodiversity Monitoring Program (CBMP). It is an online, interoperable and circumpolar data management system that will access, integrate, analyze and display biodiversity information for scientists, practitioners, managers, policy makers and others working to understand, conserve and manage the Arctic's wildlife and ecosystems. It will provide a dynamic source for up-to-date Arctic biodiversity information and emerging trends, and serve as a focal point and common platform for all CAFF programs and projects. This system will allow for the combination of geo-referenced data at various spatial, temporal, and taxonomic scales (e.g.,

populations, regions, nations, circumpolar, biomes, habitats) allowing users to explore relationships and factors driving change.

All information within the web-based data portal will be in the public domain. Data management will be in accordance with the Conservation Commons and the International Polar Year (IPY) data policies. The ABDS is currently accessible online and is under continual development. It can be seen at http://www.abds.is. The request to identify whether a CAFF product has accompanying data can be answered in that each CAFF product contains data in various forms and formats and work is ongoing to transfer this data into a form that is more accessible and useable.

2. MONITORING

The Circumpolar Biodiversity Monitoring Program (CBMP) is the vehicle via which CAFF conducts it's monitoring activities. The CBMP is an international network of scientists, government agencies, Indigenous organizations and conservation groups working together to harmonize and integrate efforts to monitor the Arctic's living resources. It has been endorsed by the Arctic Council and the UN Convention on Biological Diversity. It is the biodiversity component of the Sustaining Arctic Observing Networks (SAON) and the official Arctic Biodiversity Observation Network of the Global Earth Observation´s Biodiversity Observation Network (GEO-BON).

The CBMP organizes its efforts around the major ecosystems of the Arctic. It coordinates marine, freshwater, terrestrial and coastal monitoring activities while establishing international linkages to global biodiversity initiatives. The CBMP emphasizes data management, capacity building, reporting, coordination and integration of Arctic monitoring, and communications, education and outreach.

It operates under an ecosystem based approach, which considers the integrity of entire ecosystems and their interaction with other ecosystems. It provides a bridge between ecosystems, habitats, species, and the impacts of stressors on ecological functions. Results contribute to adaptive management, allowing for effective conservation, mitigation, and adaptation actions appropriate to the Arctic. In the context of Arctic biodiversity, the ecosystem based approach recognizes:

- Monitoring all the key elements of ecosystems—including species, habitats, ecosystem structure, processes, functions and stressors—is necessary to track biodiversity;
- Focusing on trends which incorporate the dynamic nature of Arctic ecosystems and identify changes that fall outside the realm of natural variability;
- The interplay between terrestrial, freshwater, and marine systems shape Arctic ecology and the "goods and services" that Arctic biodiversity provides;
- Geographically external conditions influence Arctic biodiversity;
- Humans and their cultural diversity are an integral component of many ecosystems and,
- The importance of monitoring the interactions between people and biodiversity, such as sustainable use and the ability of biodiversity to provide essential goods.

The CBMP is in the process of developing and implementing a series of ecosystem monitoring plans representing each of the Arctic's ecosystems (freshwater, marine, terrestrial and coastal).

In order to facilitate effective and consistent reporting, the CBMP has also chosen a suite of indices and indicators that provide a comprehensive picture of the state of Arctic biodiversity – from species to habitats to ecosystem processes to ecological services. These indices and indicators are being developed in a hierarchical manner, allowing users to drill down into the data from the high-

er-order indices to more detailed indicators. These are being developed through an expert consultation process. The CBMP developed 22 indicators for the Arctic Biodiversity Trends 2010: Selected Indicators of Change report. Current indicators developed include protected areas, Arctic species tend index, linguistic diversity. Further information can be found here - http://caff.is/indices-and-indicators2.

Relevant monitoring publications include:

CBMP Circumpolar Biodiversity Monitoring Program Framework Document (2004)
The CBMP Framework document outlines the goals of the CBMP and conveys the importance of EBM as a holistic approach towards sustainable use of the Arctic environment. The Arctic's size and complexity represents a significant challenge towards detecting and attributing changes in biodiversity. This demands an integrated, pan-Arctic, ecosystem-based approach that can effectively identify important trends in biodiversity and identify their underlying causes.

CBMP Five Year Implementation Plan: Developing an Integrated and Sustained Arctic Biodiversity Monitoring Network (2008)
The five year implementation plan further outlines goals of the project and provides direction from 2008 to 2013. The delivery of an ecosystem-based approach involves monitoring that bridges ecosystems, habitats, species and processes. It requires information not only on the status and trends in Arctic biodiversity, but also on their underlying causes. It is critical that this information be collected and made available in order to generate effective strategies for responding and adapting to the changes now taking place in the Arctic - a process that ultimately depends on rigorous, integrated, and efficient monitoring programs that have the power to detect change within a reasonable time frame.

CBMP Monitoring Plans
The key goal of the CBMP is to coordinate Arctic monitoring and this is being done through the development of four Arctic monitoring plans focussing on the marine-, freshwater-, terrestrial- and coastal ecosystems. Two of these plans are finalized. The marine monitoring plan was published in 2010 while the Freshwater monitoring plan is expected to be published at the end of December. The Terrestrial Monitoring plan is scheduled for completion in 2013.

1. Arctic Marine Biodiversity Monitoring Plan (2011)
The Arctic Marine Biodiversity Monitoring Plan (CBMP-Marine Plan) is the first of the CBMP's four pan-Arctic biodiversity monitoring plans. The overall goal of the CBMP-Marine Plan is to improve our ability to detect and understand the causes of long-term change in the composition, structure and function of Arctic marine ecosystems, as well as to develop authoritative assessments of key elements of Arctic marine biodiversity (e.g., key indicators, ecologically pivotal and/or other important taxa).

The CBMP-Marine Plan integrates existing marine biodiversity monitoring efforts (both traditional scientific and communitybased) from across the Arctic and represents an agreement between six Arctic coastal nations and a great number of national, regional, Indigenous and academic organizations and agencies in all six countries on how to monitor Arctic marine ecosystems. Further information can be found here - and in the Arctic Marine Biodiversity Monitoring Plan: Background Paper (2009).

2. Arctic Freshwater Biodiversity Monitoring Plan
This plan was approved and preparation is underway for implementation. The plan is provides for being prepared for publication meanwhile further information can be found here - http://caff.is/freshwater and in the Arctic Freshwater Biodiversity Monitoring Plan: Framework (2011)

3. Arctic Terrestrial Biodiversity Monitoring Plan
This plan is in the final phases of development and is scheduled to be completed for the May 2013 Minsiterial. Further information can be found here - http://caff.is/terrestrial and in the Terrestrial Expert Monitoring Group: Background Paper (2011)

Community Based Monitoring (CBM)

CBM has significant contributions to make to circumpolar monitoring efforts and is EBM relevant. The Arctic Council's Permanent Participants and other Indigenous and local organizations desire a strong CBM element within the CBMP. The communities of the Arctic region will directly benefit from the powerful information gathering and dissemination approach that the CBMP offers. Maximizing the contributions of circumpolar peoples to the CBMP will help ensure that the program is relevant and responsive to local needs. Indigenous and other Arctic peoples wish to impart their environmental understanding to scientific discourse, not only because they have a great deal to offer but also because this exchange represents an important step towards full participation in resource management activities as well as having an intergrated EBM approach.

Accompanying the Arctic Biodiversity Assessment (May 2013) a Traditional Eckological Knowledge compendium will be released which focues on observations of change from an indigenous perspcetive. The document is currently under development and is scheduled for compeltion by May 2013. It is of interest reagrding EBM due to its focus on integrating and considering all sources of knwoledge as we work to better understand the Arctic and its processes.

Relevant CAFF CBM publications include:

Community Based Monitoring Framework: Lessons from the Arctic and Beyond (2010)
A broad assessment of community based monitoring for diverse audiences that explore different community based monitoring programs in an effort to highlight the best and most successful practices of each. It is also designed for use as a framework for custom-tailoring specific community-based monitoring projects, and as an application to monitoring efforts in non-Arctic regions.

Community-based Monitoring Discussion paper (2004)
A discussion for the development of a community-based monitoring component to the CBMP and examination of monitoring programs under development by the Permanent Participants of the Arctic Council.

The Conservation Value of Sacred Sites of Indigenous People of the Arctic: A Case Study in Northern Russia(2004)
Working with Indigenous communities, organizations and researchers in the Yamal and Koryak Autonomous Okrugs to address conservation and cultural heritage on a large scale. The report offers a general introduction, a Russian context, research findings, an overview of international instruments for protection of cultural heritage and a thematic analysis and recommendations.

ECORA: An Integrated Ecosystems Management Approach to Conserve Biodiversity and Minimise Habitat Fragmentation in Three Selected Model Areas in the Russian Arctic
The ECORA project aimed to secure the integrity of some of the world's last remaining pristine areas and support the livelihoods of indigenous and local peoples. The development objective of the project was the conservation and sustainable use of biodiversity in the Russian Arctic. The immediate objective was the adoption and initial implementation of integrated ecosystem management strategies and action plans in three Model Areas representing different ecosystems and anthropogenic pressures. Further information can be found here:

- ECORA(2009)
- ECORA: Lessons Learned (20011)

Some other monitoring publications of relevance include:

- Development of a Pan-Arctic Monitoring Plan for Polar Bears: Background paper (2011)
- Circumpolar Protected Areas Monitoring: Arctic Protected Areas Monitoring Background Paper (2011)
- Community Based Monitoring Framework: Lessons from the Arctic and Beyond (2010)
- Developing Integrated and Sustained Arctic Terrestrial and Freshwater Biodiversity Monitoring Networks (2008)
- Framework for a Circumpolar Arctic Seabird Monitoring Network (2008)
- A Strategy for Facilitating and Developing Community-based Monitoring: Approaches in Arctic Biodiversity Monitoring (2008)
- A Framework for Monitoring Arctic Marine Mammals (2007)
- AMAP CAFF Coordinated Monitoring Effort (2007)
- Bering Sea Sub-Network Pilot Phase Final Report (2011)
- Bering Sea Sub-Network (2008)
- Aleut Ethnobotany (2006)
- A Strategy for Coordination of Monitoring Activities Between CAFF and AMAP (2000)
- Expert Network Monitoring Plan: World Reindeer Husbandry (2006)
- Community-based Monitoring Discussion paper (2004)
- Expert Network Monitoring Plan: Rangifers (2004)

3. ASSESSMENT

CAFF assessments work to describe the current state of Arctic ecosystems and wildlife using the best available scientific and Traditional Ecological Knowledge (TEK). They follow the ecosystem approach inherent in CAFF‘s work. They contain baseline data that can be used in regional and global assessments and are fully referenced and independently reviewed collaborative efforts of hundreds of scientific and TEK experts/data holders from across the circumpolar region.

Arctic Biodiversity Assessment (ABA)
The ABA is a major circumpolar effort to provide a much needed description of the current state of Arctic biodiversity. The ABA will (1) provide a description of the current state of Arctic ecosystems and biodiversity, (2) create a baseline for use in global and regional assessments of biodiversity, (3) provide a basis to inform and guide future Arctic Council work, (4) provide up-to-date scientific knowledge, (5) identify gaps in the data record, (6) identify key mechanisms driving change and (7) produce scientific and policy recommendations.

Endorsed by the Arctic Council in 2006, the Arctic Biodiversity Assessment (ABA) is the Arctic Council´s response to global conservation needs. Over 300 scientists and Traditional Ecological Knowledge experts from around the world have been involved to date. A full scientific assessment is scheduled for release in Spring 2013, accompanied by a suite of policy recommendations. Learn more about the ABA project, the ABA steering committee, the latest developments, and ABA publications.

The first phase of the project was completed in May 2010 with the release of the Arctic Biodiversity Trends 2010: Selected Indicators of Change. The Arctic Biodiversity Trends report contains twenty-two indicators that were selected to provide a snapshot of the trends being observed in Arctic biodiversity today. The indicators were selected to cover major species groups with wide distributions across Arctic ecosystems. Special consideration was given to indicators closely associated with biodiversity use by indigenous and local communities, as well as those with relevance to decision-makers. Indicators were also selected on the basis of what was achievable in terms of existing data and in the timeframe available.

Each indicator chapter provides an overview of the status and trends of a given indicator, information on stressors, and concerns for the ecosystem. In spring 2013 the following ABA products will be released

- Scientific Report
- Synthesis Report
- Summary for Policy Makers
- Status and Trends in Arctic Biodiversity film
- Traditional Ecological Knowledge Compendium

The Arctic Biodiversity Assessment will set the stage for many of the future activities of CAFF. It will include scientific and policy recomendations, identify gaps. Following the release of the Arctic Biodiversity Assessment in 2013 a series of strategic documents and workplans will follow addressing recomendations and knowledge gaps in a continued effort to ensure the sustainable management of the Arctic's biodiversity.

Arctic Flora and Fauna: Status and Conservation (2001)
This was the first truely circumpolar overview of the status of Arctic biodiversity and provides a clear understanding of the importance of the Earth's largest ecoregion and its status in the face of a rapidly changing world. It observes that while much of the Arctic was in its natural state and that the impacts of human activity were relatively minor, individuals, species and ecosystems throughout the Arctic faced threats from many causes, and that the long-term consequencies of human impacts were unknown. It particularly noted that the information necessary to determine status and trends of Arctic fauna was fragmentary and almost non-existent for flora.

Sea-ice associated biodiversity
In response to key findings from the Arctic Biodiversity trends 2010 report the first product from the ABA CAF is in the final stages of completing a report on with sea ice associated biodiversity and will release the Arctic sea ice associated biodiversity report in 2013. Further information can be found here - and in the following reports:

- http://caff.is/sea-ice-associated-biodiversity
- Arctic Sea ice Ecosystem: A Summary of Species that depend on and Associate with Sea ice and Projected Impacts from Sea Ice Changes (2010)
- Experts Workshop on Sea Ice Associated Biodiversity: Vancouver, Canada (2011)

Protected areas

Protected areas can be considered as a critical aspect of ecosystem-based management and CAFF products of relevance include:

Arctic Protected Areas Monitoring Background Paper (2011)
Background paper for an Arctic protected areas monitoring scheme that would identify a suite of biodiversity monitoring measures that would be commonly monitored across the Arctic and implemented in a standardized way by each agency. This initiative is intended to enable coordinated reporting of biodiversity in Arctic protected areas and to provide a circumpolar understanding of change occurring within protected areas around the Arctic region.

Arctic Biodiversity Trends 2010: Indicator #21, Changes in Protected Areas (2010)
Protected areas have long been viewed as a key element for maintaining and conserving Arctic biodiversity and the functioning landscapes upon which species depend. Arctic protected areas have been established in strategically important and representative areas, helping to maintain crucial ecological features, e.g., caribou migration and calving areas, shorebird and waterfowl staging and nesting sites, seabird colonies, and critical components of marine mammal habitats.

Protected Areas of the Arctic: Conserving a Full Range of Values (2002)
This document discusses this multitude of values found in Arctic protected areas. It presents case studies that demonstrate how protected areas conserve such values. The case studies also show that protected areas in the Arctic generate positive spinoff effects and add considerable value to societies that are often far wider and diverse than the direct conservation benefits for which the areas were originally established.

Values of Arctic Protected Areas: A Summary (2002)
Descriptions of the natural physical, natural ecological, economic, cultural, subsistence use, educations, landscape, societal, scientific and recreational values of Arctic protected areas.

Other asessment Publications of relevance

- Arctic Species Trend Index 2010: Tracking Trends in Arctic Wildlife
- Arctic Climate Impact Assessment (ACIA) Scientific Report
- Arctic Climate Impact Assessment: Policy Document
- Arctic Species Trend Index: Tracking Trends in Arctic Marine Populations
- Arctic Species Trend Index: Tracking Trends in Arctic Vertebrate Populations Through Space and Time
- Experts Workshop on Sea Ice Associated Biodiversity: Vancouver, Canada (2011)

4. STRATEGIES

To help fulfill its mandate, CAFF produces a range of strategies that provide scientific and conservation recommendations on how to implement plans intended to directly conserve species. Strategies develop a framework to ensure the most effective management response. These strategies are developed via intensive international cooperation between countries and scientists across the Arctic region.

The Circumpolar Boreal Vegetation Map (CBVM)
CBVM is a project within the CAFF Flora expert Group and the International Association for Vegetation Science (IAVS) devoted to mapping the vegetation of the boreal region. Currently, vegetation maps of the circumboreal region exist at a wide variety of scales using many legend approaches. These maps have been developed by numerous authors for a wide variety of disparate applications but are not integrated into a unified system.

To fully address the consequences of these conservation and management issues, a CBVM map is needed with a unified legend approach. The development of the CBVM is an attempt to understand the boreal in a new way that that takes into account administrative regions and regional approaches. In this respect it will form an important information, assessment and planning basis for solving nature and environmental protection problems at a global level. And as such will provide a tool for use in development and application of EBM in the Arctic. Further information can be found here:

- http://caff.is/flora-cfg/circumboreal-vegetation-map
- Circumboreal Vegetation Map (CBVM): Mapping the Green Halo Concept Paper (2011)

Arctic Spatial Data Infrastructure (Arctic SDI)
The Arctic SDI will allow for the creation of a harmonised map, common standards and integration of data for the entire Arctic Region. This will facilitate a more robust management and manipulation of data for both research and management purposes. Provides a framework within which EBM efforts can be analysed and data compared and analysed – a management tool

- Arctic Spatial Data Infrastructure (ASDI): Concept Paper (2011)
- Arctic Spatial Data Infrastructure (ASDI): Project Plan (2011)

Seabird Information Network: Concept Paper 2011
One means to enhance seabird conservation is by viewing the seabird resources in the circumpolar region as a single resource rather than a series of seabird colonies divided by countries. To facilitate this broad-scale approach it is necessary to know where seabird colonies exist in the Arctic countries. The Seabird Information Network collects views and analyzes such information. Some countries have national databases of seabird colony locations, but these databases have never been joined to allow a cohesive view of the seabird resources.

Arctic Flora and Fauna Status and Trends: Recommendations for Conservation (2001)
In the context of Arctic Flora and Fauna Status and Conservation , conservation means the preservation of wild plants and animals and the natural processes that sustain them while accommodating sustainable use of these resources and of the environment. Conserving biodiversity , therefore, requires an understanding of the ways in which people use the resources of the Arctic. It also recognizes that both the natural and the human components of the Arctic ecosystem are constantly changing and adapting and that conservation measures must also adapt to these changes. Conservation acknowledges that a healthy environment depends on compatible human uses, for humans are part of every ecosystem in the world.

The Arctic Council advocates an ecosystem approach to conservation, acknowledging the ecological processes that support species and landscapes and the social systems that are themselves supported by a healthy environment. The ecosystem approach recognizes that humans, with their cultural diversity , are an integral component of ecosystems. Therefore, lasting conservation depends on a strong commitment to the principles of environmental protection and sustainability , including appropriate human uses.

A Strategy for Developing Indices & Indicators to Track Status & Trends in Arctic Biodiversity (2008)
The document outlines the CBMP's strategy in developing indices and indicators to facilitate targeted and consistent reporting, the CBMP has chosen a suite of indices and indicators that provide a comprehensive picture of Arctic biodiversity, from species and habitats to ecosystem processes and ecological services. The suite of indices and indicators can be used to report on the current state of Arctic biodiversity at various scales and levels of detail.

5. COOPERATION

CAFF cooperates with other organizations, NGOs, etc, and as a result of this cooperation, work related to EBM is advanced. Below are some of the more relevant initiatives:

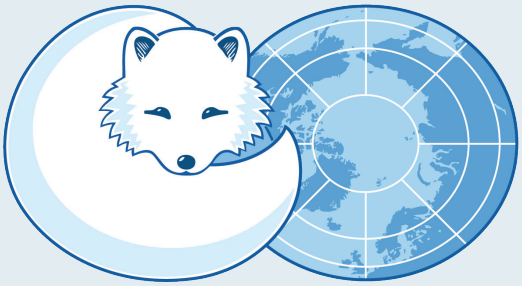
UNEP WCMC-Sub Global Assessment Network
CAFF has cooperated with UNEP WCMC on various projects, a cooperation that has been mutually beneficial. CAFF is participating The Sub-Global Assessment Network which seeks to create a common platform for practitioners (individuals and organizations) involved in ecosystem assessments at the sub-global levels (regional, sub-regional, national, sub-national) with the intention of: share knowledge regarding ecosystem assessments as well as a reporting platform to the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES).

Global Earth Observation's Biodiversity Observing Network (GEOBON)
The CBMP is the Arctic component of the Global Earth Observation's Biodiversity Observing Network (GEOBON).

SAON
The CBMP is the biodiversity component of the Arctic Council's Sustaining Arctic Observing Networks initiative (SAON).

6. OUTREACH/COMMUNICATION

CAFF's mandate is to address the conservation of Arctic biodiversity, and to communicate the findings to the governments and residents of the Arctic, helping to promote practices which ensure the sustainability of the ecosystem, including ecosystem based management. Providing target audiences with timely, accurate, clear and complete information on biodiversity issues for use in policy and scientific decision-making is particularly important. A full list of all CAFFs publications can be accessed at: http://caff.is/publications



ARCTIC COUNCIL