"Our future is now"
Fred Phillip

Second International Science and Policy Conference on Implementation of the Ecosystem Approach to Management in the Arctic

The Ecosystem Approach to Management of Arctic Marine Ecosystems: Integrating information at different scales in the framework of EA implementation

Conference Report

Bergen, 25-27 June 2019

PAME
Protection of the Arctic Marine Environment

ARCTIC COUNCIL

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Background and introduction

The Ecosystem Approach to management (EA) (or Ecosystem-based management, EBM) was adopted as a key principle for the work of the Arctic Council as part of the Arctic Marine Strategic Plan (AMSP) in 2004. The Arctic Council (AC) is an intergovernmental forum promoting cooperation, coordination and interaction among eight Arctic States, six organizations representing Arctic indigenous peoples (Permanent Participants), and many observer States and organizations, on issues of sustainable development and environmental protection in the Arctic.

The working group Protection of the Arctic Marine Environment (PAME) has been leading work within the AC on developing and promoting the use of the EA to the management of Arctic coastal and marine environments. PAME established in 2007 an EA expert group (EA-EG) that was broadened in 2011 to include also other AC working groups (Arctic Monitoring and Assessment Program (AMAP), Conservation of Arctic Fauna and Flora (CAFF), and Sustainable Development Working Group (SDWG)). The EA-EG has arranged six workshops on various topics related to the EA between 2011 and 2018.

The AC ministers, in the Kiruna Declaration in 2013, called for periodic reviews of the EA in the Arctic to exchange information on integrated assessment and management experiences, including highlighting examples from Arctic States. To this effect, a first international policy and science conference was held in Fairbanks, Alaska, in August 2016 to review status of implementation of the EA to management of Arctic ecosystems. Here we report the outcome of a second policy and science conference to review EA implementation for Arctic marine ecosystems. We hope this is the beginning of a sequence of conferences every third year or so, to carry out periodic reviews of implementation of the EA in the Arctic, as called for by the ministers in Kiruna in 2013.

Definition and principles

The AC ministers agreed a definition of the EA (or EBM) in Kiruna in 2013 as:

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

The definition makes it clear that the EA is about integrated management of human activities (across sectors) to achieve the dual objectives of sustainable use while maintaining the integrity of the ecosystem. The ministers in Kiruna also agreed to a set of nine principles for EA (see report from the EBM expert group from 2013).

EA framework and guidelines

The Arctic Council has developed a framework for implementation of the EA to management of human activities in Arctic marine and coastal environments. The EA framework consists of six related elements:

1. Identify the geographic extent of the ecosystem;
2. Describe the biological and physical components and processes of the ecosystem including humans;
3. Set ecological objectives that define sustainability of the ecosystem;
4. Assess the current state of the ecosystem (Integrated Ecosystem Assessment):
5. Value the cultural, social and economic goods produced by the ecosystem; and
6. Manage human activities to sustain the ecosystem.

Figure 1 illustrates how the framework is related to the EA definition.

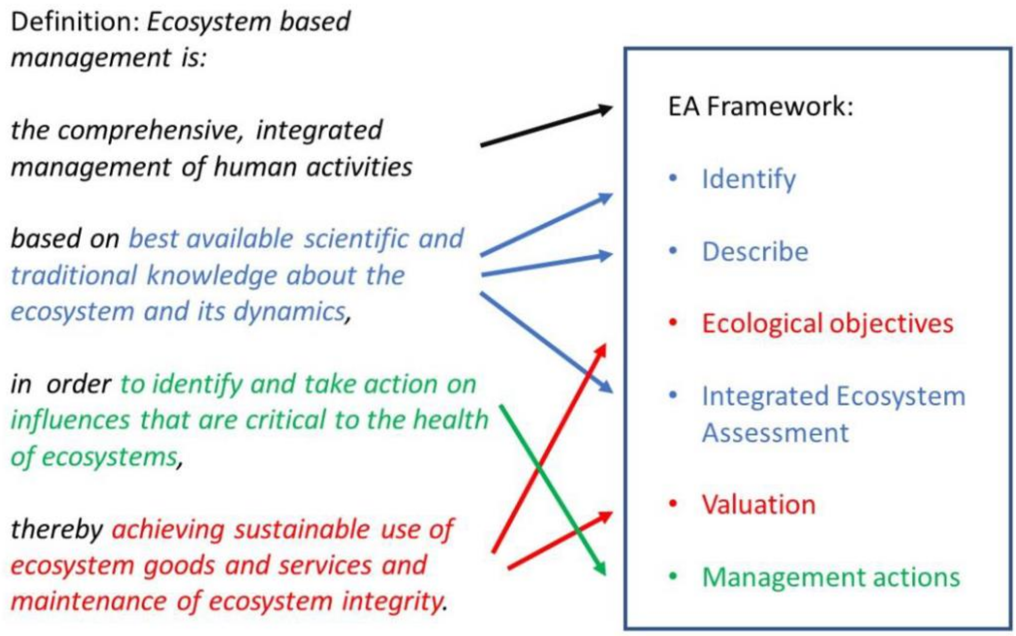

Figure 1. *How the 6-element EA Framework (on the right) is related to the definition of Ecosystem Approach to management (on the left).*

In Iqaluit 2015 and again in Fairbanks 2017, the AC ministers requested and encouraged development of guidelines for implementing the EA in the Arctic. A first set of guidelines for EA implementation to Arctic marine ecosystems was developed (by the EA-EG) and approved by the ministers at the meeting in Rovaniemi in May 2019. The guidelines are based on the EA framework and provide general guidance both at the overall framework level as well as for the separate framework elements.

Large Marine Ecosystems

The Arctic marine area has been divided into 18 Large Marine Ecosystems (LMEs) for the purpose of using the EA (Figure 2). This is seen as the first element in the EA framework (identifying the ecosystem to be managed). The Arctic LMEs are considered the appropriate scale and units for applying the EA to management. They are defined by ecological criteria (bathymetry, hydrography, productivity, and trophic (food-web) linkages). They are often transboundary, with nine of the LMEs including waters under national jurisdiction of two or more Arctic states. Some of them also contain areas beyond national jurisdiction, e.g. in the Bering Sea, the Norwegian Sea, and most notably in the Central Arctic Ocean which includes a large area of High Seas. See the Arctic LME report.

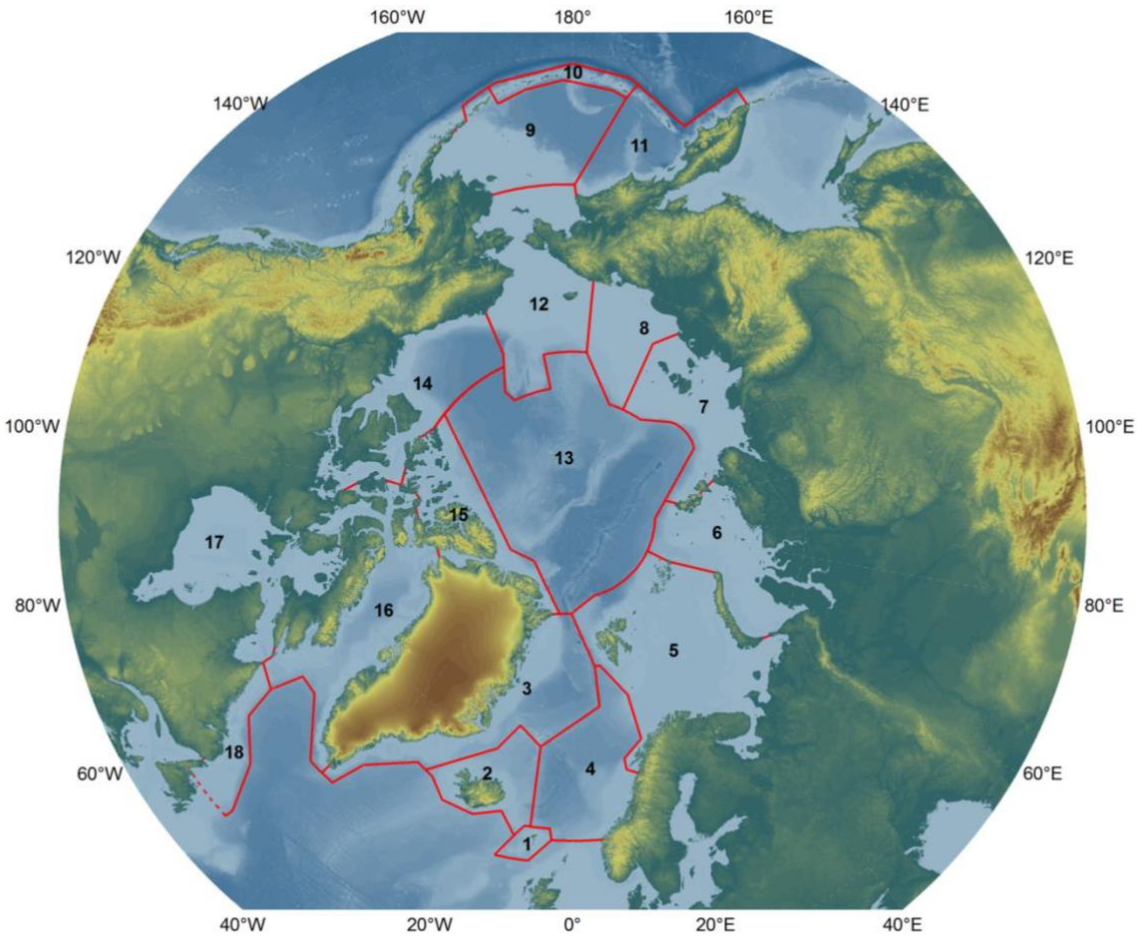

Figure 2. *The 18 Large Marine Ecosystems: 1 – Faroe Plateau, 2 – Iceland Shelf and Sea, 3 – Greenland Sea, 4 – Norwegian Sea, 5 – Barents Sea, 6 – Kara Sea, 7 – Laptev Sea, 8 – East Siberian Sea, 9 – East Bering Sea, 10 – Aleutian Islands, 11 – West Bering Sea, 12 – Northern Bering-Chukchi Seas, 13 – Central Arctic Ocean, 14 – Beaufort Sea, 15 – Canadian High Arctic-North Greenland, 16 – Canadian Eastern Arctic-West Greenland, 17 – Hudson Bay Complex, 18 – Labrador-Newfoundland.*

The 2nd EA Bergen Conference

Conference program and participants

The conference program is in Annex 1. It was prepared with input from a planning group with members from AC countries and the EA-EG, AC working groups (AMAP, CAFF, PAME, SDWG), and ICES, PICES, and WWF. The program was developed as a combination of solicited and openly invited presentations.

The conference was attended by 54 participants from 9 countries (Canada, Kingdom of Denmark, Germany, Iceland, Japan, Netherlands, Norway, Russian, and USA), including several international organizations (AMAP, PAME, ICES, WWF). We were fortunate to have strong representation of participants from indigenous communities and organizations in Alaska, Canada, Greenland, and Norway (Sápmi) (14 in total). The list of participants is included as Annex 2.

Conference sessions

The program was structured with five sessions, bracketed by an introductory session on the first day and a concluding session by the end of the meeting on the third day:

Session 1: Integrated Ecosystem Assessment
Session 2: MPAs and other special areas
Session 3: Voices from the North – a conversation about people, nature, and sustainability
Session 4: National EA implementation
Session 5: Central Arctic Ocean

The main topic for the conference was scale and scale integration, and we sought to illuminate this important but broad issue in each of the five sessions. The sessions were structured with a sequence (or sequences) of presentations followed by discussions recorded by appointed rapporteurs.

All sessions (except session 3) were held in plenary, moderated by a session chair. Session 3 was an exception where, after introductory presentations, there were three parallel breakout groups that reported back in plenary at the end of the session.

All in all, there were 45 presentations in the five sessions plus the opening session. All presentations are available at the conference site, while summaries are included in Annex 4 which also provides links to the presentations.

In the next section, we provide a summary of the conference organized by subheadings which highlight topics within but also across the conference sessions. In particular, session 3 with the ‘conversation on people, nature, and sustainability’ is reflected in the first part of the summary with the more holistic and overarching topics at the EA framework level. The more detailed minutes from the discussions in each of the sessions, which have informed the conference summary, are included in Annex 3.

Conference summary

A holistic concept

The Ecosystem Approach to management (EA), also known as Ecosystem-based management (EBM), is a holistic concept. We now have a definition, principles, a framework, and guidelines for implementation of the EA in the Arctic marine environment, which have been agreed by Arctic Council ministers. The definition states that it is 'comprehensive, integrated management of human activities' to achieve the dual objectives of 'sustainable use of ecosystem goods and services and maintenance of ecosystem integrity', and that it should be based on the 'best available scientific and traditional knowledge about the ecosystem and its dynamics'.

The EA is holistic in two ways: it requires attention to the dynamics and overall well-being of the ecosystem with all its intricate connections and complexities, and it requires coordinated management of all human activities that occur in an ecosystem or influences it from outside. 'Ecosystem' and 'ecosystem integrity' are by their very nature holistic concepts.

The dual objectives of using the ecosystem while maintaining its integrity represent the core principle for sustainable development, which is where we as the present generations meet our needs without compromising the ability of future generations to meet their own needs. The EA is a practical mechanism to deliver 'sustainability' for Arctic marine ecosystems and the Arctic peoples that depend on them for their nutritional and spiritual well-being.

Humans are part of the ecosystem

This is a general truth. However, the ways in which we are parts of the ecosystem varies a lot. Industrial activities such as petroleum developments, mining operations, or commercial fisheries, use natural resources while affecting the ecosystem to varying degree through environmental impacts and 'foot-prints' left behind. The personnel who take part in such activities and enterprises are often 'visitors' to the ecosystem from outside, and the revenues and economic benefits generated by the resource exploitation are often reaped by investors and others that may live in big cities far from the Arctic and who may be seen as not being really part of the exploited ecosystem.

Indigenous peoples and other local residents who live traditional lives where subsistence harvesting is a main basis for their food supply and their cultural and spiritual well-being, are part of the ecosystem in a different and more direct way. If we with being part of the ecosystem means being an ecosystem component, then indigenous and local residents could be depicted as a human component that acts as a predator on fish, birds, seals, and whales in an ecological sense. Commercial fisheries could be seen in a similar manner, although as a component they might be depicted more as an external forcing than a true part of the ecosystem.

We should note in this context that the Arctic region as defined for the use in the Arctic Council is wide and includes permanently ice-free and open boreal waters such as around the Aleutian Islands, around Iceland, and in the Norwegian Sea. These open waters of the southern part of the Arctic area support large commercial fisheries. Moving north into the seasonally ice-covered waters, the situation changes very much to one where commercial fisheries play little or no role, while subsistence harvesting takes over as the dominant use of living resources. While this is true as a broad general pattern, there are transition areas where commercial fisheries and subsistence harvest overlap, such as in the northwestern Bering Sea and western Greenland.

An indigenous perspective – "The sea is our garden"

This quote from the Bering Sea Elders Group illustrates a situation where indigenous residents from villages along the coasts of western and northern Bering Sea depend on subsistence harvest of fish, shellfish, birds, and mammals from coastal waters and connecting rivers and lakes. The resources are local in extent, although many (like salmon or beluga whales) are migratory and occur in the areas on a seasonal basis. The residents in the coastal villages live in the ecosystem and see the coastal waters as their 'garden'. They are concerned that others from outside may come into their garden and use the resources there.

This and other indigenous perspectives were presented at the conference. Harry Brower Jr., mayor of Utqiagvik (formerly Barrow) and the North Slope Borough in northern Alaska, provided an Inuit perspective on their lives and dependency on living resources for their nutritional and cultural well-being. He stressed the importance of subsistence harvesting and noted that new and expanding industrial activities represented a threat where humans could be seen as an 'invasive species' from their northern and indigenous perspective.

More indigenous views were presented in the session 'Voices from the North: A Conversation about People, Nature, and Sustainability'. Nicole Kanayurak spoke about the Inuit 'ecological clock', which represents the accumulated experiences and knowledge which the Inuit people possess about nature and the ecosystem of which they are an intimately integrated part. Gerry Inglangasuk and Alan Kennedy spoke about the co-management arrangements and experiences from the Inuvialuit region of Arctic Canada. From Canada we also learned about a collaborative project on establishing offshore Marine Protected Areas (MPAs) in the eastern Arctic. The video 'Guardians of Tariug' ('tariug' means the sea) was a nice example of public outreach featuring school children and local artists (musicians) from the Iqaluit area.

In other sessions, Ole Anders Turi presented Sámi perspectives on resource use in relation to the EA, while Bjarne Lyberth presented local perspectives of fishers and hunters on wildlife management in Greenland.

Integrated Ecosystem Assessment

Integrated Ecosystem Assessment or IEA is a core component of the EA. It is the stage where the overall state and changes in the ecosystem are evaluated. This includes assessing whether the ecosystem 'health' and 'integrity' are ok or fine. This may sound simple, but it is not. It is challenging and requires the best use of knowledge, both scientific and indigenous, traditional and local. One reason why it is challenging is the large natural fluctuations and changes, and the need to separate out effects of human activities (both separately and cumulatively) against the backdrop of the natural variability.

At the 6th EA workshop in Seattle in January 2018, it was noted that there is a diversity of approaches and methods used in doing IEAs, and that we are still on a learning curve as a community of IEA practitioners. This is still the case.

At the conference we learned about the work in working groups of the International Council of the Exploration of the Sea (ICES). Anne-Christine Brusendorff in her keynote address described the extensive and broad work of ICES to better our understanding of marine ecosystems and to promote the development and use of the EA. Elena Eriksen and Per Arneberg described the work of the two ICES IEA groups for the Barents Sea (WGIBAR) and the Norwegian Sea (WGINOR). Hein Rune Skjoldal described the work of WGICA for the Central Arctic Ocean, which is a joint group by ICES, PICES (North Pacific Science Organization), and PAME.

From Canada, we learned about the work on IEA for the offshore part of the Beaufort Sea LME in a presentation by Andrea Niemi. Elisabeth Logerwell described the work in the USA in the IEA program of US National Oceanic and Atmospheric Administration (NOAA). While this is a broader program (presented in the National implementation session), it has IEA as the core component and entry point for implementing EA. At a smaller spatial scale, Judith Rossellon-Druker described development of socio-ecological models as a basis for IEA in Southeast Alaska.

Monitoring and supporting research for IEA

There were several presentations that addressed monitoring and research which could support and improve our ability to assess and produce IEAs. Tom Christensen presented the Circumpolar Biodiversity Monitoring Program (CBMP) of CAFF which includes a network of experts for various ecosystem compartments for the marine component. CBMP produced the State of the Arctic Marine Biodiversity Report (SAMBR) in 2017. Hein Rune Skjoldal presented descriptions of Arctic species and Large Marine Ecosystems (LMEs), which had been used in earlier assessments (e.g. Arctic Oil and Gas 2007 by AMAP, and the AMSA IIC report by AMAP, CAFF and SDWG) and now were being edited and prepared for publication.

Sue Moore described the system of Distributed Biological Observatory (DBO), which is a set of geographical 'boxes' (rectangular areas) located in the Pacific Arctic from the Bering to the Beaufort Sea and visited by research vessels on an opportunistic basis to provide information on changes over time. Lisa Eisner presented information on integrated ecosystem research in the same geographical area in the North Bering and Chukchi Seas. Sue Moore also described results from research on underwater sound in the Pacific Arctic and elsewhere. The Arctic has been a relatively quiet environment but is becoming noisier with increased shipping related to more transport and industrial developments, including tourism. The increased noise level may interfere with the communication (by sound) of whales and other marine mammals and is a factor which should be included in IEAs and the EA.

EIA, SEA, and IEA

The acronyms were used on purpose in the subtitle. The 'A' stands for assessment in all three cases, while 'EI' in EIA is Environmental Impact and 'IE' in IEA is Integrated Ecosystem. S (in SEA) stands for 'Strategic'. The three types of assessments are related.

Environmental Impact Assessment (EIA) is generally project-specific and is carried out (often legally mandated) for industrial developments such as an oil or gas field or a transport system for a mining project. Gunn-Britt Retter presented the outcome of a project on EIA carried out under the Finnish chairmanship of the AC, with focus on engagement of indigenous peoples. Daniel Van Vliet described recent and ongoing work on Strategic Environmental Assessments (SEAs) in the Arctic Canada. The SEAs are done on a regional scale (such as the Canadian portion of Baffin Bay). The strategic aspect of a SEA is by providing an overview of the overall situation in a region as a basis for evaluating the potential and possible impacts of future developments.

There is a clear scale issue for the three types of assessments. An EIA is typically at a relatively small scale for a given development project, a SEA is at larger regional scale, while an IEA (as a component of the EA) is at the scale of an LME. While having different purposes and being carried out at different geographical scales, the three types of assessments are clearly related and the synergies among them should be promoted. The information collected, compiled and used in project specific EIAs can be valuable contributions to SEAs and IEAs. Conversely, the information in an IEA can form a valuable context for an EIA and/or a SEA.

Knowledge is knowledge

The definition of the EA states that it should be '*based on best available scientific and traditional knowledge about the ecosystem and its dynamics'*. The dynamic and changing ecosystems confront us with challenges when it comes to assessing and managing them (indirectly through regulation of human activities). The best available knowledge therefore importantly includes Indigenous/Traditional and Local Knowledge (TLK), which complements scientific knowledge.

Ecosystem science is still not a fully mature discipline, and examples of recent ecological events and experiences from the conduct of IEAs of northern ecosystems show that we often struggle in explaining what goes on in our ecosystems, e.g. what are the causes behind observed changes and events. Science is also far from homogenous but applies a wide multitude of approaches and methods, from purely observational to theoretical and modelling studies. Science has, however, a core principle of documentation of facts and applies 'peer review' as a standard quality assurance procedure. It operates on all scales from subcellular biochemistry to global views from satellites. For instance, scientific surveys with research vessels provide semi-synoptic views (3-D maps) of oceanography and fish stocks, while satellites help us track migrations of tagged animal individuals.

TLK are the accumulated knowledge of people that have lived for a long time in the northern ecosystems. This knowledge is largely gained from observations, and it is particularly valuable in that it provides complementary observations on the behavior, abundance, and conditions of animals in relation to their environment.

Working together in mutual respect

This was a clear message coming out from the discussions in session 3 (Voices from the North). Communication is required, e.g. between scientists and indigenous, traditional and local knowledge holders. It was recognized that communication takes time, and that listening with an open mind was an important part of the communication. It was also recognized that trust and respect are prerequisites for effective communication. Respect needs to go both ways and be mutual, and respect can perhaps best be fostered by working together in common projects.

EA, and particularly the IEA component, can provide a context for working together in ways which can help develop trust and mutual respect. A good example was from the Inuvialuit Settlement Region in

Canada where scientists had worked with locals for 20-30 years on seals and beluga studies. The Northern Bering-Chukchi Sea LME is one arena where collaboration between indigenous, traditional, and local knowledge holders and scientists could take place. At the PICES meeting in October this year (in Victoria, BC), there is a scoping workshop about the possible establishment of a working group to do IEA of this LME. Conservation and subsistence harvest of marine mammals in relation to climate change and Arctic marine shipping would be key topics for an IEA of the Northern Bering-Chukchi Sea LME, and the work could potentially include indigenous peoples from both Alaska and Chukotka.

Many different types of special areas

An LME, such as the Northern Bering-Chukchi Seas or the Barents Sea, har a varied bathymetry and topography with shallower banks and deeper depressions or 'valleys' in between. The underwater landscape (or 'seascape') steers ocean currents and influences the distribution of water masses. It provides a large variation in conditions for life forms, both in the water column and at or into the seafloor substrates. Every square meter of the seafloor is part of a habitat, and the seafloor constitutes a mosaic of habitats for bottom-dwelling organisms. The scale issue comes very much into play here. Finer-scale features can be seen by zooming in to have a close-up look, while larger scale features become apparent when zooming out to have a 'birds-eye' view from a distance.

Habitat classification needed for habitat mapping is a complex issue by itself and was not considered at the conference. However, independent of habitat classification, areas can be identified based on their importance (which must be understood in a relative and not absolute sense). There are criteria to identify Ecologically and Biologically Significant Areas (EBSAs) developed by the CBD. The set of EBSA criteria was based on existing criteria for identifying Marine Protected Areas (MPAs) developed by the International Union for Conservation of Nature (IUCN). There is therefore a high degree of similarity between areas identified as EBSAs and as potential MPAs. The difference in practice is that all EBSAs require special management attention (because they for some reason are important), while MPAs are established as protected areas with stated conservation objectives.

Establishment of MPAs is one possible management tool which can be used to address a conservation concern for a specific area. However, there are many other spatial measures that can be taken to address a conservation need short of a formal designation as an MPA, e.g. closing an area to bottom trawling if that is the threat to bottom habitats. An example of the latter was given by Lis Jørgensen who described collaborative work between scientists and managers in consultation with the fishing industry that led the Norwegian government to close areas with sensitive benthic fauna to bottom trawling in the Northern Barents Sea. Elisabeth Logerwell presented a related study where information on benthic organisms collected in scientific bottom trawl surveys and their assessed sensitivity to bottom trawls were used to identify vulnerable areas in different parts of the Arctic (Canada, Greenland, Iceland, Norway, Russia and USA).

Networks of priority conservation areas and MPAs

In the session 'MPAs and other special areas', several presentations addressed the concept of networks of MPAs, or more generally, priority conservation areas. Lauren Wenzel presented the work and outcome of a project on MPAs and MPA networks carried out by PAME, partly in collaboration with CAFF. The project had provided an overview of existing or planned MPAs in the Arctic and consideration of principles of developing networks of MPAs, including the complex and demanding issue of ecological connectivity. Building on the PAME MPA project, WWF Arctic is now conducting the study 'Pan-Arctic Marine Protected Areas Network (PAMPAN)', described by Martin Sommerkorn. PAMPAN uses an algorithm (Marxan) to find solutions to meet conservation objectives for a network of areas based on input data on distribution of many conservation features (species and habitats). PAMPAN is carried out jointly with WWF Canada and WWF Russia. Martine Giangioppi described a similar activity in the project 'Marine Ecological Conservation in the Canadian Eastern Arctic (MECCEA)' to identify priority areas for conservation.

Boris Solovyev described joint work between the Russian Academy of Sciences and WWF Russia to identify priority conservation areas (PCAs) in the Russian Arctic. Using a systematic conservation planning approach including the Marxan decision support tool and GIS, 47 PCAs were identified across the Russian Arctic from the White Sea in the west to the Bering Sea in the east. Solovyev presented a case study from the Pechora Sea where information on conservation features were used on a finer geographical scale to inform management in relation to shipping, petroleum, and other human activities. In a third presentation (in the session on national implementation), Solovyev provided examples of how the information on PCAs resulting from the systematic conservation planning approach was used in establishment of MPAs in the Russian Arctic, such as the Novosibirskie Islands Federal Preserve established in March 2018. He also provided information on legal instruments in the Russian Federation related to marine spatial planning, including a new law on marine planning which is under development.

EA is spatial planning – and more

Marine spatial planning (MSP) is closely related to EA. In fact, MSP for a geographical area is an integral part of the EA and should not be seen as anything different. EA is about spatial planning and management of the area within the identified ecosystem (an LME), which is in effect MSP. EA in addition involves a wide suite of non-spatial management measures related e.g. to use of chemicals, release of contaminants, fish quotas, etc. Gerold Janssen provided an example of the relation between EA and MSP in the European marine policy context.

The presentations in session 2 on MPAs and other special areas provided many examples of identified areas within larger LMEs. These areas are variously called PCAs, EBSAs, valuable and vulnerable areas, potential candidate MPAs, and designated MPAs. MPAs are generally more strictly protected than other types of areas, but it should be noted that there is a variety of types of MPAs with different conservation purposes and degree of restrictions. IUCN operates with six categories of protected areas (including MPAs), of which category VI, 'Protected area with sustainable use of natural resources', aims to conserve ecosystems and habitats together with associated cultural values and traditional natural resource management systems.

Existing and planned MPAs and other special areas provide an important layer of information at smaller spatial scale within the Arctic LMEs. The areas have been identified based on their ecological importance, and they represent significant connections between species (both resident and migratory) and habitats (which the areas basically are). The layer of information on these areas is therefore especially important in a functional ecological context which is at the core of the EA.

National implementation – progress is slow

National or federal governments have the management authority of the marine areas within the zones of national jurisdiction. Implementation of EA at the scale of LMEs is therefore primarily a responsibility at the government level, with international collaboration among Arctic states for those LMEs which span the Exclusive Economic Zones (EEZs) of two or more countries.

At session 4 on national EA implementation we heard reports from Canada, Kingdom of Denmark, Norway, Russia, and the United States of America.

Cecilie von Quillfeldt presented an update on the work on the integrated management plans (IMP) for the Norwegian sectors of three sea areas in Norway - the Barents Sea, Norwegian Sea, and North Sea. The IMPs are made at the Norwegian government level and are revised and updated at a rotating schedule. A steering group with members from many ministries oversees the plan which is implemented by two groups with membership from relevant government agencies and scientific institutions. Norway is probably the country which has progressed the furthest in implementing the EA to management led by the national government.

Daniel Van Vliet described work in Canada with focus on Strategic Environmental Assessment (SEA). The SEAs provide an overview of conditions and pressures in broader regions of the Canadian Arctic and is used as a background for identifying and establishing MPAs.

Anders Mosbech described work in Greenland to identify important areas based on ecological information on species and habitats. This provides a layer of information which is relevant in relation to EA (as described in a previous section) and is seen as a step on the road to EA implementation in Greenland. Bjarne Lyberth provided more information on wildlife management in Greenland with a local perspective from fishers and hunters.

Elizabeth Logerwell described the IEA program of NOAA, which is a way of promoting development and use of the EA by a major federal agency in the USA. She provided examples of the work in the California Current system and in Alaskan waters. Mandy Karnauskas presented a case from the Gulf of Mexico in the US which involved collaboration with local fishermen to provide information for management of fish resources in the area.

Boris Solovyev described (in three presentations) work in the Russian Arctic seas to identify Priority Conservation Areas (PCAs) through a systematic conservation planning process (see previous section on Networks of priority conservation areas and MPAs). This work has informed establishment of MPAs and contributed to an overall picture of conservation needs and priorities. Large areas of the Russian Arctic have been leased for oil and gas development, and one important aspect of management in the Russian marine Arctic is to balance the development of the petroleum industry with the required conservation as part of the EA for the Russian Arctic LMEs.

While there are encouraging developments at the national level in the Arctic countries, the progress toward EA implementation in the full meaning of the definition ('comprehensive integrated management of human activities') appears slow. An inquiry to get a clearer picture of progress at national and international levels (e.g. management cooperation for LMEs) could be a next step in the Arctic EA work.

The Central Arctic Ocean is undergoing dramatic change

The Central Arctic Ocean (CAO) is undergoing dramatic change associated with the extensive loss of sea ice in the last few decades (about 50 % by area and 75 % by volume) in what had been termed the Great Melt.

In session 5, Alf Håkon Hoel (presented by Hein Rune Skjoldal) described the legal framework (UNCLOS) and some of the regional agreements and organizations involved in marine scientific research in the Arctic. This included the International Arctic Science Committee (IASC), the International Council for the Exploration of the Sea (ICES), scientific activities under the Arctic Council, Arctic Science Ministerial Meetings in 2016, 2018, and 2020, and the Agreement on Preventing Unregulated Fishing in the High Seas Portion of the Central Arctic Ocean (signed in 2018) with its provision for a Joint Program of Scientific Research and Monitoring. Hein Rune Skjoldal described the work of the joint ICES/PICES/PAME Working Group on Integrated Ecosystem Assessment for the Central Arctic Ocean (WGICA). This group is now completing a first version IEA report from three years of work (2016-2018): Integrated ecosystem assessment of the Central Arctic Ocean: ecosystem description and vulnerability characterization.

Vassily Spiridonov described work to identify and characterize vulnerable benthic biotopes in the Arctic Ocean, notably the deep Gakkel Ridge (which is a continuation of the Mid-Atlantic Ridge) that separates the Nansen and Amundsen Basins in the Eurasian Basin. Øyvind Paasche presented the plans for the Synoptic Arctic Survey (SAS), which is a major scientific international program involving ice-going research vessels from many countries to be carried out over the next two years (2020-2021).

Annex 1: Program for the 2nd Arctic EA conference

Second International Science and Policy Conference on
Implementation of the Ecosystem Approach to Management in the Arctic:

Integrating information at different scales in the framework of EA implementation

25-27 JUNE 2019 - BERGEN - NORWAY

CONFERENCE PROGRAM

TUESDAY 25 JUNE

OPENING AND KEYNOTE PRESENTATIONS

CHAIR: ELISABETH LOGERWELL (USA, NOAA)

09:00 - 10:30

Geir Huse (Norway, Scientific Director, Institute of Marine Research)
Conference Opening and Welcome

Anne-Christine Brusendorff (Denmark, ICES)
"Science for sustainable development in Areas Beyond National Jurisdiction – how can ICES support evidence needs in the Central Arctic Ocean?"

Mayor Harry K. Brower, Jr. (USA, Utqiagvik)
"Implementation as a Part of the Ecosystem and Through Sustaining an Inuit Way of Life"

Hein Rune Skjoldal (Norway, Institute of Marine Research)
"Scale Integration and EA Implementation: Goals of the 2nd EA Conference"

10:30 - 10:55: Coffee

SESSION 1. INTEGRATED ECOSYSTEM ASSESSMENT

CHAIR: LIS L. JØRGENSEN (NORWAY, INSTITUTE OF MARINE RESEARCH)

11.00 - 12.30

Elena Eriksen (Norway, Institute of Marine Research)
"IEA in practice – Experiences from the Working Group on the Integrated Assessments of the Barents Sea (WGIBAR)"

Per Arneberg (Norway, Institute of Marine Research)
"IEA in practice – Experiences from the Working Group on the Integrated Assessments of the Norwegian Sea (WGINOR)"

Andrea Niemi (Canada, Fisheries and Oceans)
"Off-Shore Integrated Ecosystem Assessments in the Canadian Sector of the Beaufort Sea LME"

Tom Christensen (Denmark, Aarhus University)
"The Circumpolar Biodiversity Monitoring Program – Monitoring and reporting changes in Arctic Biodiversity and ecosystems. Status and next steps"

Discussion (15 min)

12:30 - 13:30: Lunch

SESSION 1. CONTINUED: INTEGRATED ECOSYSTEM ASSESSMENT
13.30 - 15.00

Sue Moore (USA, NOAA, retired; University of Washington)
"Including underwater sound in Arctic and Subarctic IEAs: an ecosystem component to link ecological, social, and economic factors in support of holistic decision-making"

Judith Rosellon-Druker (USA, University of Alaska Fairbanks)
"Development of socio-ecological conceptual models as the basis for an IEA framework in Southeast Alaska"

Fern Wickson (Norway, North Atlantic Marine Mammal Commission)
"Integrating the Scales of Interest in Different Knowledge Systems for Ecosystem Management: An opportunity to share experiences and collectively build best practices"

Per Arneberg (Norway, Institute of Marine Research)
"A system for assessing the state of ecosystems based on some principles from IPCC"

Lisa Eisner (USA, NOAA Fisheries)
"Arctic Integrated Ecosystem Research in the Chukchi and North Bering Seas"

Discussion (15 min)

15.00 - 15.30: Coffee

SESSION 1. CONTINUED: INTEGRATED ECOSYSTEM ASSESSMENT
15.30 - 17.00

Bérengère Husson (Norway, Institute of Marine Research)
"What scale(s) to study an ecosystem? A case study in the Barents Sea"

Sue Moore (USA, NOAA, retired; University of Washington)
"The Distributed Biological Observatory: A Change Detection Array in the Pacific Arctic"

Hein Rune Skjoldal (Norway, Institute of Marine Research)
"Description of Arctic species and Arctic LMEs – integrating information on species and habitats"

Phillip Wallhead (Norway, Norwegian Institute for Water Research) - *Presented by Wenting Chen.*
"Urchin harvesting and culling in northern Norway under ocean acidification and warming"

Discussion (30 minutes)

18:00 – 21:00 Reception (at IMR Pynten by the waterfront in Bergen)

WEDNESDAY 26 JUNE

SESSION 2. MPAs AND OTHER SPECIAL AREAS

CHAIR: TOM CHRISTENSEN (DENMARK, AARHUS UNIVERSITY)

09.00 - 10.30

Lauren Wenzel (USA, NOAA Fisheries)
"Marine Protected Areas and Networks as a Component of Ecosystem-Based Management"

Boris Solovyev (Russia, Russian Academy of Sciences)
"From principles to practice: systematic conservation planning approach in the Arctic"

Martine Giangioppi (Canada, World Wildlife Fund)
"Marine Ecological Conservation in the Canadian Eastern Arctic (MECCEA): A project to identify Priority Areas for Conservation (PACs)."

Martin Sommerkorn (Norway, World Wildlife Fund)
"The Pan-Arctic Marine Protected Area Network initiative and its contribution to implementing the Ecosystem Approach to Management in the Arctic"

Boris Solovyev (Russia, Russian Academy of Sciences)
"Systematic conservation planning for ecosystem based approach to management: case study from Pechora Sea"

Elizabeth Logerwell (USA, NOAA Fisheries)
"Long-Term Benthos Monitoring network for identifying vulnerable areas in Arctic benthic ecosystems"

10:30 - 11:00: Coffee

SESSION 2. MPAs AND OTHER SPECIAL AREAS

11.00 - 12.30

Ole Anders Turi (Norway, Sámediggi/Sámi Parliament)
"What challenges could Ecosystem Approach solve at Saami resource use level"

Lis L. Jørgensen (Norway, Institute of Marine Research)
"Vulnerable areas and Ecosystem-based fishery management in the Barents Sea"

Wenting Chen (Norway, Norwegian Institute for Water Research)
"Marine ecosystem accounting to support coastal and marine governance"

Gerold Janssen (Germany, Leibniz Institute of Ecological Urban and Regional Development)
"Implementing an Ecosystem-based approach in MSP"

Discussion (15 minutes)

12:30 - 13:30: Lunch

SESSION 3. VOICES FROM THE NORTH – A CONVERSATION ABOUT PEOPLE, NATURE, AND SUSTAINABILITY

CHAIR: GUNN-BRITT RETTER (NORWAY, SÁMI COUNCIL)

13.30 - 17.00

Fred Phillips and Mellisa Heflin (USA, Bering Sea Elders Group)
"The ocean is our garden"

Nicole Kanayurak (USA, Utqiagvik, North Slope Borough Department of Wildlife Management)
"Inuit have an 'Ecological Clock'"

Gerry Inglangasuk (Canada, Inuvialuit Member, Fisheries Joint Management Committee) and
Alan Kennedy (Canada, Chairman, Fisheries Joint Management Committee)
"Co-management as a Framework for Ecosystem Management of Arctic Resources: Experience from the Inuvialuit Region of Canada"

Andrea Niemi and Elizabeth Hiltz (Canada, Fisheries and Oceans)
"An Inclusive Approach to Public Outreach: A Case Study from Canada's Arctic" with video "Guardians of Tariug"

14:30-16:00
Breakout groups will meet to discuss the Ecosystem Approach from both science and Local Traditional and Indigenous Knowledge perspectives. We envision that during these informal gatherings we will discuss ideas and challenges; share experiences; talk about goals and values; and discuss topics that arise during the Conference.

Coffee break: 15.00 - 15.15

16:00 - 17:00
Reports from the breakout groups

19:30: Conference dinner (at venue)

THURSDAY 27 JUNE

SESSION 4. NATIONAL EA IMPLEMENTATION

CHAIR: MARTIN SOMMERKORN (NORWAY, WWF ARCTIC PROGRAMME)

09.00 - 10.30

Cecilie von Quillfeldt (Norway, Norwegian Polar Institute)
"Integrated Management Plans for Norwegian Sea Areas"

Daniel Van Vliet (Crown Indigenous Relations and Northern Affairs Canada)
"Strategic Environmental Assessment Processes in Canada's Arctic"

Elizabeth Logerwell (USA, NOAA Fisheries)
"NOAA's Integrated Ecosystem Assessment (IEA) Program"

Boris Solovyev (Russia, WWF Russia/Russian Academy of Sciences)
"EA Implementation in Russian Arctic"

Anders Mosbech (Denmark, Aarhus University)
"On the road to EA in Greenland: The use of spatial biodiversity data to identify important areas"

Discussion (15 minutes)

10:30 - 11:00: Coffee

SESSION 4. CONTINUED: NATIONAL EA IMPLEMENTATION

11.00 - 12.30

Bjarne Lyberth (Greenland, The Association of Fishers & Hunters in Greenland)
"International and national wildlife management from a local perspective (fishers and hunters in Greenland)"

Mandy Karnauskas (USA, NOAA Fisheries)
"Identifying relevant spatial scales and priorities for ecosystem-based management of the Gulf of Mexico snapper-grouper fishery complex"

Daniel Taukie (Canada, Nunavut Tunngavik Inc.)
"Inuit-led Marine Monitoring in Nunavut, Canada"

Gunn-Britt Retter (Norway, Saami Council)
"The Arctic Environmental Impact Assessment – a Model for Meaningful Engagement of Indigenous Peoples"

Discussion (30 minutes)

12:30 - 13:30: Lunch

SESSION 5. CENTRAL ARCTIC OCEAN

CHAIR: LIANNE POSTMA (CANADA, FISHERIES AND OCEANS) TBC

13.30 - 15.00

Alf Håkon Hoel (Norway, University of Tromsø; presented by Hein Rune Skjoldal)
"Organizing science for the central Arctic Ocean"

Hein Rune Skjoldal (Norway, Institute of Marine Research)
"WGICA Integrated Ecosystem Assessment report for the CAO"

Vasily Spiridonov (Russia, Russian Academy of Sciences)
"Indicators of vulnerable benthic biotopes in the Arctic Ocean"

Are Olsen (Bjerknes Centre for Climate Research/Geophysical Institute, University of Bergen)
Presented by Øyvind Paasche.
"An Outline of the Synoptic Arctic Survey"

15:00 - 15:30: Coffee

CONFERENCE CONCLUSION

15.30 - 17.00

Conference Summary and Conclusion (Hein Rune Skjoldal, Libby Logerwell and Lis L. Jørgensen)

Annex 2. List of participants at the 2nd EA conference, Bergen, 25-27 June 2019

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Annex 3. Summaries of discussions in each of the sessions 1-5.

Below are summaries from the discussions in the various sessions of the EA conference. The summaries of sessions 1, 2, 4, and 5 are in the form of minutes, and they are lightly edited versions of notes prepared by appointed rapporteurs. Session 3 had three parallel breakout groups, and the report is a compiled and edited version of the reports from these groups.

The reports are annexed here to be used as reference material in the further work by the EA-EG.

Session 1 – Integrated Ecosystem Assessment

Is IEA working? Whatever it is working or not we absolutely need it. IEA is the way to approach current and future problems in ecosystem management. We can't answer that initial question because this is a long-term research process. Everything is connected in the ecosystem so we need to understand different aspects of the "ecosystem puzzle" to be able to understand what is currently happening and what the future trends might be.

Monitoring human activities should be part of this ecosystem approach. We need to put more focus on subsistence fisheries/activities rather than give all the research weight to commercial fisheries/activities. Not everything has a dollar value. We need to focus in research that tries to understand how detrimental effects on subsistence resources will affect communities that completely depend on them.

LK and TK need to be integrated in the IEA process. Indigenous participation is absolutely needed to have better management.

Ship noise – There is some research on reactions of animals to noise, but how much does it take to drive a whale (e.g. beluga or narwhal) out of their habitat?

- Most of the information is observations related to seismic activities and ice breakers
- Some limited studies suggest response within a 10-15 km range. At 50 km away, whales get quieter, then they are harder to track.
- Most noise impact studies on whales have been done on bowheads (through oil and gas development funding)

Noise – What are the effects of windmills?

- These produce low frequency sound in the water
- They have not been around long enough for a full assessment of impacts, and there is recognition that there are cumulative effects with ship noise, so that raise the sound levels
- There are no final results as of yet

Integrated Ecosystem Research

It has been proposed that climate change hypotheses indicate that there will be less production at the bottom of the food web that will lead to ecosystem changes. What kind of differences might be seen between the Chukchi and the North Bering Sea? Response – Need more data.

Different knowledge systems

An example was given from 2008-2011 where there was an issue with the bottom trawl group. Indigenous community wanted a boundary in place. They wanted interviews with the Elders and the younger hunters to create a report using local knowledge to solve this issue. This was a very successful process and the approach is starting to be accepted in the fisheries world.

There is a desire to have integrated knowledge and good will. We need good examples of what works in order to learn about how we can continue and how to do better.

It was noted that there was a lack of cases that address subsistence needs in these ecosystem assessments. We are expecting all kinds of changes in the ecosystems and the focus is on the impacts to commercial fisheries. What resources are available to address assessments of subsistence fisheries and the regulatory processes around these? We recognize that only so much can be done, but subsistence is a way of life and it has seasonal windows. We need to build the nuances of subsistence harvest practices into the model – for example, the need to travel further distance to harvest due to changing climate, and the availability of resources for subsistence harvest.

This is a science and policy conference and the economic issues are therefore the focus. However, there are different vulnerabilities and these need to be overtly recognized.

This session covered several themes and it is a big topic with several scales. Other topics and comments that need to be raised:

1. The potential to integrate IEA with subsistence harvesting – should definitely look at an IEA linked with subsistence economy. One could look at economics study practices, for example, household studies. However, there is a six-element framework for IEAs and socio-economic is one of those. Subsistence could be also considered here. But to be clear, many of the concepts and steps in the EA process have been impacts driven (to sustain yield of use). The approach itself, though, is not only applicable to just that. So the IEA could be made more appealing for other elements, but the meaningfulness needs to be explicitly stated. An impacts driven objective could be shifted to focus on subsistence and therefore be driven by more human development.

2. What happens in the development of IEA when there may be competing objectives, for example, oil and gas development where there are large economic implications versus subsistence harvesting where it is the only source of food for the community. In these cases, indicators need to be very carefully selected. Also, the time scales need to be considered – maybe don't look as pressure situations in the present moment only but also look at what could be the needs in ten years.

3. An intrinsic focus of the IEA and EBM seems to be the economic drivers for sustainable fisheries – where is the objective of protecting nature for nature's sake? There are many ways of doing

things that may sound good, but how will it be accomplished? As humans, we are dependent on a healthy ecosystem and it is in our own self-interest to maintaining ecosystem health. This should be a selling point for EA/EBM. The idea of goods and services for future generations is rooted in conservation. Conservation targets may be a good place to start, but then it is necessary to move into assessment and management. Also, the idea of valuation is difficult to compare, i.e. the value is seen as high for commercial fisheries (serves more people) and low for subsistence (serves fewer people).

4. There is a need for IEA driven by both subsistence and economic interests. Both will be affected by climate change. One approach could be to look at areas with neither economic nor subsistence activities and monitor the downstream effects. We have also not talked about non-use values of ecosystems and resources. In some places there would be a desire to pay to keep ecosystems untouched.

5. It would be good to have further discussion on ecological objectives, and perhaps in the future focus on more holistic definitions. There may be some good examples to learn from, such as an EU Report (not specifically named), or from more developed examples like the Barents Sea assessment.

Session 2 – MPAs and other special areas

Q: Learning from the Canadian and German examples, what are the requirements in terms of resources, monitoring and human? In a resource-limited scenario, how do we get there?

A: WWF is there to help, they can raise money for capacity-building, however, they need commitment from the start that outlines the common interest.

Q: How is the dialogue with the government on these processes?

A: WWF engaged all of the indigenous communities and the government from the beginning, and they were engaged throughout. Now exchanging data and results, helping local communities.

Q: MSP (Marine Spatial Planning) implies competing user objectives - has there been thought to evaluating the effectiveness of these projects to support its ongoing existence?

A: For Canada, this was one of the reasons MARXAN was chosen. It allows for transparent dialogue and tradeoffs.

A: As scientists we can invent models, but do they work? Why put all the energy to developing these things? So, need to take a step back and figure out where we are going and how we will get there, what does management need.

A: The world has learned that if you don't protect some sites, nature will deteriorate and provide fewer services. Few examples of putting the pressures on the map as in the Germany example, but this is important to do.

Q: Bringing back discussion of scale, thinking about static policy under a changing environment. What is the time scale for these policy recommendations given the changes taking place.

A: Understand that conclusions are fluid, recommendations are subject to change. Need dynamic tools to support dynamic management.

A: Also talked about tradeoffs, but have not discussed how to solve user conflicts. Maybe a future step would be how to develop complementary policies to facilitate MSP implementation.

Comment: We have struggled for many years to have indigenous cultural values and ethics included, and change has occurred last 5-10 years. Advancements in understanding as subsistence hunters.

Comment: We don't know what will happen for any network (of MPAs) we propose, but we have found that most changes are driven by oceanographic factors; once we understand these it will be easier to predict what will occur.

Comment: Social scientists may view ecosystem services as assets, but they are viewed as way of life by indigenous groups.

Comment: Notion of change in a ministry is different, communities have to be proactive because changes occur much more quickly than policy reaction.

Session 3 – 'Voices from the North – a Conversation about People, Nature, and Sustainability'

Themes, issues and ideas from Breakout Group discussions

Breakout groups were formed consisting of a balanced mix of indigenous and science knowledge holders. Groups were provided three broad questions to stimulate and structure their discussions:

1) How can Indigenous Knowledge and science knowledge come together to inform management?
2) How to manage in a holistic way?
3) How do we minimize the gap between science language and LTK language?

All three groups discussed question 1 in detail, whereas the other two questions got a bit less attention. Key themes, issues and ideas from the Breakout Group discussions are found below. Also included are verbatim quotes that expressed key points particularly well.

How can Indigenous Knowledge (IK) and science knowledge come together to inform management?

A paradigm shift is needed.

"There is no alternative to not working together."

"There are so many issues facing the Arctic, and every knowledge system is going to be needed to face the future."

“Both science and TK should have open mind.”

We need to build a bridge between quantitative and qualitative observations.

“You try to get the whole picture otherwise you will not know the change, and when things change you can make the decision.”

Some view science knowledge as reductionist and IK as more holistic. Some see that science can also take a holistic approach. We should not demonize science knowledge “because there are things that science can do”.

Do ecosystem models resemble nature?

Some local/community/indigenous concerns with changing climate are increased human population and noise; increased vessel traffic; threats to sustainability; and invasive species.

Listen to the people who are closest to the resource about the changes that they are observing.

Commonalities is a place we can start from.

Audience and context will require different approaches for meaningful involvement.

The time it takes is long and the timing is crucial.

The most effective communication will be in person, at local venues. It should also be at the beginning of a project or process (i.e., scoping) and continue throughout the duration (including reviewing results and making recommendations). This follow up is very important and ideally is consistent, with the same individuals meeting together repeatedly over time.

Listening is also required.

Oral communication to communities is more effective than written. Newspapers and radio are preferred over social media which can be biased.

Resource and capacity limitations challenge scientists’ and IK holders’ ability to communicate and follow up.

IK holders “don’t want to be fit into a model – but to help develop the model.”

Trust and respect are prerequisites for effective communication. Sitting down together can build trust and respect. Some IK holders find it difficult to trust science knowledge holders and managers. What rules of engagement could build trust?

Involve local people in the project. They can then become advocates for the project and can speak to the issues to their fellow community members.

Making discoveries together can be a bonding experience.

Interpreting science for IK holders is required. Are we using language to exclude or include others? Develop a mutual understanding to speak a language that resonates locally.

We need to accept that there are other ways of knowing and respect those ways.

IK holders are very good at observation.

"For some it is survival and for others it is research"

IK and science knowledge both have a spatial or geographic aspect, which can provide a basis for understanding.

Traditional knowledge involves working together at all levels, sharing and being inclusive. It focuses on common issues affecting people such as changes in food sources. Local knowledge holders (such as commercial fishers) also work together and may take advantage of management systems to sell bycatch and apply for different permits and licenses. Scientists also work together but may ignore traditional and local knowledge. Social scientists may study communities and the impacts of policy on them.

Management is often discussed at a large scale, but it implemented at a local scale. So local and regional management should be involved early in the process.

It can be challenging to scale local indigenous knowledge up the population scale or larger.

Ecosystems are dynamic and always changing, sometimes slowly and sometimes abruptly. How does this variability impact the effectiveness of the management processes in place now?

Scientists should show the communities the benefits of working together. Engagement received should be reflected in the work so communities can see the outcomes or products of this research. So they see meaningful results.

Involving locals in the research can be helpful. Self-empowerment goes a long way. Father-son duos are an example of knowledge transfer. It would also be helpful to incorporate training in their language as well.

Subsistence resources do not have traditional monetary value. We need a way to having an equity of value.

"On all these fronts we can focus on difficulties and challenges, but we should focus on the progress that has been made."

In the ISR [Inuvialuit Settlement Region] scientists worked with locals for 20-30 years on seals and beluga studies (such as tagging).

IK holders provide guidance about where to sample (e.g., for phytoplankton samples, tagging seals…). Scientists must not neglect to acknowledge their help in publications.

IK holders provide guidance about indicators (e.g., beluga fat).

There was a moratorium placed on bowhead whaling in the 1970s resulting from low counts of whales in the water. Locals told scientists there were more whales under the ice, which acoustic data eventually confirmed. This eventually resulted in a working relationship between scientists and locals. A paper has been published describing this as an example of successful sharing of understanding and coming together (Moore and Hauser, 2019 Marine mammal ecology and health: finding common ground between conventional science and indigenous knowledge to track arctic ecosystem variability. Env Research Letters 14 075001, https://doi.org/10.1088/1748-9326/ab20d8). However, it took time, a couple of decades.

How to manage in a holistic way?

“It always comes back to equity and capacity. “

Co-management takes a while to develop and requires mutual trust, mutual respect, and mutual objectives. Local residents need to be a part of the decision making and all parties must be willing to accept different views.

Indigenous knowledge and science knowledge should have equal weight.

One way forward would be to create more institutions with both knowledge systems and co-management systems. This would be a central place or institution to incorporate both ways of thinking.

There is a challenge regarding participation in decision-making. There is sometimes a reluctance to share power. It would be helpful to start at the local level and then go upward – not a downward approach.

How do we minimize the gap between science language and LTK language?

All parties involved should use plain language and speak to others as clearly as possible.

Note that there are differences in language, different dialects, and different interpretations.

Management is missing from the table. All the value systems have to participate, or it won’t come together appropriately.

Session 4 - National EA implementation

Comment - Positive picture of Russian arctic – good science, successful way for implementation. Good things happening in Russian arctic area.

Q - Russia side: how are indigenous peoples included/represented? Land claims/collaboration?

A - Most of Indigenous population not related to sea, just in one East area – at that area they are involved in design of Bering park. Participate in management program. Report whale encounters etc. Rest of Russian arctic not much interest in marine – more terrestrial.

Q - In Greenland, what did you gain from community inputs?

A - Collaborative projects to identify areas important to the people. Also data collection, validation of data and areas. Documentation of their activities. Locals prepare own data to contribute to management plan.

Q - Strategic environment assessment. What is difference between normal and strategic assessment?

A - In Canada they are inter-changeable. One could be project specific. More general/regional = strategic, pre-planning tool rather than project tool.

A - Greenland – pre-planning tool. Regional, not for a single license area.

Q - Legal perspective: national and international law. Do we need better laws? Is it enough what we have? Do you have legal basis for Norway plan?

A - Different opinions. Legally planning for management plans (some want it). Includes international conventions in management plans. Some would like to see stronger.

A - Canada did change impact assessment law and did mention regional studies – need to see what that means. Many layers to consider. Harder to have one law to strengthen it because so many regulatory layers involved.

There is a fragmentation issue due to scale. Spatial and time scales increase fragmentation and have impact on laws – need for institutional renewal.

Comments regarding Greenland:

Not more laws, more governance (Greenland)

Representatives from Ministries needed

Greenland – is it working (areas). Not a high priority, ministries don't understand the concept yet. Not known how to do it. Silo thinking. Ministries don't know how to cooperate.

Management plan (Greenland) – limited

Q - Norway management plans. What's the difference between update versus revise?

A – - update: specific issues

-revision: go through everything in detail. Very time consuming. Difficult to do.

Q - Alaska: desire to better understand research and EA approach. Subsistence seen, want to understand the supporting ecosystem. Need uncomplicated flow of information regarding shipping etc – streamline of communication needed. Appreciation for all the information presented. Continue to build partnership – share Inuit knowledge of science.

Q - provide training to scientist to how to effectively engage. Does anyone have those training programs in place?

Norway – no program.

Nunavut – safety training. Language to consider – training requires translators.

Greenland: No. Municipal employee coordinates monitoring. Will include training for other municipal officers to engage in local monitoring of resources.

Canada: training cultural awareness, land claim understanding. Learn community to community. There likely isn't a single course, an adaptive process. Structures applied in different communities that work - ask for it.

Arctic council: adaptation exchange portal. Exchange information on climate change. Portal could be useful for best practices for engagement.

PAME: meaningful engagement program. Look into joint guideline/best practice to serve as inspiration at local levels. Could apply across working groups of the Arctic Council.

Q - Impact assessment versus Integrated ecosystem assessment. What is new or different?

IEA is informing an EIA, and vice versa.

Environmental IA – project, Strategic EA - larger context, Integrated EA - need to keep layers and meanings clear.

Integrated EA – to follow the development of an ecosystem. Why? What to do about issues.

-Stories outside the arctic can be a learning tool. But remember humans in Arctic are part of the ecosystem. Different than fisheries activities. International regulations are not going to change, when is ecosystem approach going to be included. There will be a cost. Still need to learn an approach to considered. Need to understand that fisheries and subsistence is very different – cost, values are very different. Not a cash value. Communication not always as clear as it needs to be.

Different levels of human values. Coming from inside and above ecosystems.

Greenland – blurred line of what is subsistence and what is commercial. Bowhead whales: tourism and hunting interest. Economic and cultural values.

-Norway: 3 management plans – first looked to Canada and was able to move forward more quickly because simpler system. Common things to learn from each other.

Session 5 – Central Arctic Ocean

- We do know a lot about the CAO already.
- Communication with research – management is important, suggest this in research in CAO.

- What is bottom-up? Questions cannot be answered unless you use a research vessel – this we consider bottom-up.
- What is the motivation of Asian countries in this research?
- What if there were high productivity area, would the moratorium decision be different? Still likely no fishable fisheries in the CAO.
- Information to wisdom?
- What does the data management plan look like? Beyond the scope, but portals.

Annex 4. Summaries of presentations given at the 2nd Arctic EA conference, Bergen, 25-27 June 2019.

The summaries are presented in the order they were given in the program of the conference (see Annex 1).

Opening session

Geir Huse (Norway, Scientific Director, Institute of Marine Research)
Conference Opening and Welcome

Talk: Conference Opening and Welcome

Anne-Christine Brusendorff (Denmark, ICES)
"Science for sustainable development in Areas Beyond National Jurisdiction – how can ICES support evidence needs in the Central Arctic Ocean?"

Talk: "Science for sustainable development in Areas Beyond National Jurisdiction – how can ICES support evidence needs in the Central Arctic Ocean?"

Mayor Harry K. Brower, Jr. (USA, Utqiagvik)
"Implementation as a Part of the Ecosystem and Through Sustaining an Inuit Way of Life"

Pictures: "Implementation as a Part of the Ecosystem and Through Sustaining an Inuit Way of Life"

Hein Rune Skjoldal (Norway, Institute of Marine Research)
"Scale Integration and EA Implementation: Goals of the 2nd EA Conference"

Summary: Bergen is an old city with the oldest building (the Maria Church) dating back to the 12th century. The New Church (Nykirken) is much younger, being completed in 1761. Twenty years earlier, in 1741, commander Vitus Bering sailed out from Petropavlovsk on Kamchatka to find the Great Land (Bolshaya Zemlya) which is now known as Alaska. Returning west in late autumn, Bering's ship 'St. Peter' wrecked at Bering Island (one of the two Komandorski Islands) where Bering found his grave. With Bering on this expedition was Georg Wilhelm Steller, a naturalist, botanist, and physician. Steller survived the stay on Bering Island where he described Steller's sea cow (and also Steller sea lion, northern fur seal, and sea otter) in the publication 'De Bestiis Marinis' (the Beasts of the Sea) published in St. Petersburg in 1751, some years after his death in Siberia (in 1746). Steller also discovered several birds which carry his name (Steller's jay, Steller's eider, and Steller's sea eagle). Members of the Bering expedition brought with them pelts of sea otters and other species, and this brought on a rush of people who went to the Aleutians and mainland Alaska. In about 20 years' time, or around when the New Church in Bergen was completed, the last Steller's sea cow was killed, and the species went extinct. Sea otters were strongly depleted, and a large fraction of the Aleut human population was killed in conflicts with hunters and soldiers. This is a sad example of exploitation that was a far cry from being sustainable.

Loss of biodiversity is probably the greatest environmental threat to life on our planet, even greater than the climate crisis although the two are clearly connected. Biodiversity is all the living things, the species of life forms, along with their living spaces, the habitats. In short, it is another name for Nature. We are losing biodiversity in a piece-meal manner, trading nature for money. Scaled-up, this is a global biodiversity crisis where we are losing habitats and species on a persistent path of non-sustainability. We are lacking the mechanism of a balance check where new development projects are evaluated in the context of the overall situation in the affected ecosystem and where previous loss in biodiversity is counted in when considering the 'health' and integrity of the ecosystem.

The Ecosystem Approach to management (EA) is this mechanism that can deliver sustainability for the ecosystems, where we as present generations meet our needs without compromising the ability of future generations to meet theirs. Work under the Arctic Council (AC) has resulted in a definition of EA, a set of principles, a framework, and guidelines for implementation of EA for Arctic marine ecosystems, all agreed by AC ministers. The purpose of this 2nd Arctic EA conference is to review progress on implementation of the EA to marine ecosystems. The focus is on the theme of scale, which is pervasive and important in all aspects of the EA. The scale issue has two aspects: the first is a clearer recognition of how scale comes into play both ecologically and management-wise, and the second is how we deal with it through scale integration. At this conference, we seek to illuminate the scale issue in five sessions that include Integrated Ecosystem Assessment (IEA) and Marine Protected Areas (MPAs) and other special areas (such as Ecologically and Biologically Significant Areas, EBSAs). The goals are to increase awareness about the scale issue and to provide suggestions for further work to promote EA implementation in the Arctic.

Talk: "Scale Integration and EA Implementation: Goals of the 2nd EA Conference"

SESSION 1. INTEGRATED ECOSYSTEM ASSESSMENT

Elena Eriksen (Norway, Institute of Marine Research)

"IEA in practice – Experiences from the Working Group on the Integrated Assessments of the Barents Sea (WGIBAR)"

Talk: "IEA in practice – Experiences from the Working Group on the Integrated Assessments of the Barents Sea (WGIBAR)"

Per Arneberg (Norway, Institute of Marine Research)

"IEA in practice – Experiences from the Working Group on the Integrated Assessments of the Norwegian Sea (WGINOR)"

Abstract: The ICES group WGINOR was established in 2013 to perform integrated ecosystem assessments (IEA) for the Norwegian Sea. During the first years, relevant time series of data on physical and biological components of the ecosystem were assembled and used to describe key aspects of the state and development of the system. Principal Component Analysis was initially used to perform integrated trend analyses (ITA). This approach was later shown to generate artefactual results for the time series collected by the group and was subsequently abandoned. Other analytical methods are now tried out for ITA, such the hypothesis-based method Structural Equation Modelling. In addition, in the coming years the group aims at developing new operational products that can be relevant for management. This includes a model-based food web assessment, a forecast product for the physical environment and routine assessments of signals of risk that are relevant for management. The group also aims at performing repeated scoping among managers and stakeholders to better serve the needs of these groups.

Talk: IEA in practice – Experiences from the Working Group on the Integrated Assessments of the Norwegian Sea (WGINOR)"

Andrea Niemi and Andy Majewski, Jim Reist, Rob Young (Fisheries and Oceans Canada, Winnipeg MB, Canada).

"Off-Shore Integrated Ecosystem Assessments in the Canadian Sector of the Beaufort Sea LME"

Summary: The Canadian Beaufort Sea Marine Ecosystem Assessment (CBS-MEA) is an off-shore, ship-based research program. Fisheries and Oceans Canada developed the program, in consultation with co-management partners in the Inuvialuit Settlement Region (ISR), to provide integrated ecosystem-based information in support of climate change science and co-management priorities including subsistence resource security. Integration of information across ecosystem components, including marine fishes, provides needed baseline information

for species and processes, measures of inter-annual variability and assessments of ecosystem connectivity at different scales. The CBS-MEA is integrated with other programs, including community-based beluga programs in the ISR, in order to provide a more holistic understanding of the Beaufort Sea ecosystem. Andrea.Niemi@dfo-mpo.gc.ca

Talk: "Off-Shore Integrated Ecosystem Assessments in the Canadian Sector of the Beaufort Sea LME"

Tom Christensen (Denmark, Aarhus University) Tom Barry, Kari Fannar Lárusson.

"The Circumpolar Biodiversity Monitoring Program – Monitoring and reporting changes in Arctic Biodiversity and ecosystems. Status and next steps"

Abstract: Arctic marine biodiversity faces increasing threats from a variety of anthropogenic stressors including, chemical pollutants, climate change, and ocean acidification. The primary objective of CAFF´s Circumpolar Biodiversity Monitoring Programme, CBMP, is to provide early detection of changes in biodiversity and ecosystems and to coordinate ongoing monitoring and measure trends that can be used to inform the development of international policies to mitigate further degradation of Arctic biodiversity. CBMP, is an adaptive and question driven ecosystembased monitoring programme. This ecosystem-based approach integrates information across ecosystems, species, and their interactions, and lends itself to monitoring central biotic aspects of Arctic ecosystems called Focal Ecosystem Components (FECs). Changes in FECs status likely indicate changes in the overall marine and Coastal environment and which therefore CBMP monitors and tracks. The release of the State of Arctic Biodiversity reports as first outcomes from implementation of the CBMP ecosystem monitoring plans demonstrates how cooperative efforts to monitor and report on biodiversity can both help identify status and trends, as well as identify vital gaps in monitoring.

The State of the Arctic Marine Biodiversity Report (SAMBR) in 2017 is a synthesis of the state of knowledge about biodiversity in Arctic marine ecosystems, detectable changes, and important gaps in the ability to assess status and trends of biodiversity across six focal ecosystem components (FECs): marine mammals, seabirds, fishes, benthos, plankton, and sea ice biota. The *State of the Arctic Freshwater Biodiversity Report* (SAFBR) scheduled for release in May 2019 *State of the Arctic Terrestrial Biodiversity Report (START)* is under development and scheduled for release in 2020. The final CBMP ecosystem monitoring plan: the CBMP Coastal plan scheduled for release in May 2019 presents for the first time a platform to support co-production of knowledge and as such is an important step in ensuring a more comprehensive understanding of what is happing in Arctic ecosystems using different knowledge sources. The CBMP Marine group is currently undertaking a scoping process were national implementation of the recommendations presented in the SAMBR is being explored and next steps within the group being prioritized and would welcome input from meeting participants on how the CBMP could further contribute the IEA process.

The State of The Arctic Biodiversity Reports and also the newly published CBMP Coastal Plan and the CBMP strategic plan, each contain several activities related to increased cooperation between CBMP and other Arctic Council Working Groups. This talk will present latest developments in of the Circumpolar Biodiversity Monitoring Program's (CBMP) progress and next steps.

Talk: "The Circumpolar Biodiversity Monitoring Program – Monitoring and reporting changes in Arctic Biodiversity and ecosystems. Status and next steps"

Sue Moore[1], Rebecca Shuford1, Jason Gedamke1 and Leila Hatch2
"Including underwater sound in Arctic and Subarctic IEAs: an ecosystem component to link ecological, social, and economic factors in support of holistic decision-making"
1 NOAA Fisheries, Office of Science and Technology, Silver Spring, MD 20910
2 NOAA National Ocean Service, Stellwagen Bank National Marine Sanctuary, Scituate, MA 02066

Abstract: Sound is a primary sensory modality for many aquatic organisms because it travels readily through water. With the dramatic reduction in sea ice and warming of Arctic and Subarctic seas, concern is growing regarding the impact of sound from anthropogenic activities on wildlife. This concern is especially focused on marine mammals, which are protected by US and international laws. Furthermore, Native communities rely upon marine mammals for subsistence and cultural wellbeing; a point recognized in the 2009 Arctic Marine Shipping Assessment. Although a key element of the marine environment, sound is not routinely included as a component in ecosystem assessments, due primarily to a lack of standardization in sampling protocols and soundscape metrics. However, increasing use of autonomous recorders has provided rich datasets on seasonal variability of sounds from natural (e.g. wind, sea ice, marine mammal calls) and anthropogenic (e.g. ships, sonars, seismic surveys) sources within high-latitude LMEs offshore the USA-Alaska, Canada, Greenland and Norway-Svalbard. In 2014, a passive acoustic data archive was initiated at NOAA's National Centers for Environmental Information and, in 2016, sound was included as a core variable for the US Integrated Ocean Observing System. Concurrently, NOAA developed an Ocean Noise Strategy that recommended including acoustics as a fundamental habitat quality, part of a coherent approach to reducing the impacts of anthropogenic sounds on marine life. Integrated Ecosystem Assessments (IEA) provide a framework for an ecosystem-based approach to management of marine ecosystems. Including underwater sound in Arctic and Subarctic IEAs would provide a component to link ecological (ambient sound, marine mammal detection), social (connection to local communities, subsistence food security) and economic (shipping, resource extraction, tourism) factors. The science of underwater sound is now mature enough to warrant inclusion in ecosystem assessments, to underscore its role in marine ecosystems and support holistic decision-making.

Talk: “Including underwater sound in Arctic and Subarctic IEAs: an ecosystem component to link ecological, social, and economic factors in support of holistic decision-making”

Rosellon-Druker, Judith and Marysia Szymkowiak, Curry J. Cunningham, Stephen Kasperski, Gordon H. Kruse, Jamal H. Moss, and Ellen M. Yasumiishi (NOAA and University of Alaska Fairbanks, USA)

Development of socio-ecological conceptual models as the basis for an IEA framework in Southeast Alaska

Summary: Introduction: Integrated Ecosystem Assessment (IEA) is a framework that organizes science to aid in the transition from a traditional single species management towards a holistic management approach known as Ecosystem Based Management (EBM). An essential step of the IEA framework is the development of conceptual models. These models allow the integration of intrinsically linked social, environmental and biological components of marine ecosystems which is pivotal to address unsolved questions in fisheries management.

The U.S NOAA Integrated Ecosystem Assessment (IEA) Program currently has five active regional programs:

- California Current
- Pacific Islands
- Alaska Complex
- Northeast Shelf
- Gulf of Mexico

Within the Gulf of Alaska LME place-based IEA efforts have started. Sitka is a relatively small fishing community located in Southeast Alaska. Commercial, subsistence and recreational fisheries are the most important economic, social and cultural activities in this coastal community.

Methods: We constructed socio-ecological conceptual models of relevant commercial and subsistence focal fisheries for Sitka by collecting and synthesizing available scientific information and local ecological knowledge (LEK). We operationalized these models by using a modeling approach called Qualitative Network Models (QNMs). QNMs are mathematical representation of a conceptual model in where perturbations can be assessed for their qualitative impact on the system of interest.

Results: The resulting models co-produced by scientists and Sitka stakeholders, illustrate the main biological and environmental factors driving the abundance of Pacific halibut (*Hippoglossus stenolepis*), Pacific herring (*Clupea pallasii*), Chinook salmon (*Oncorhynchus tshawytscha*), and sablefish (*Anoplopoma fimbria*) fisheries in Southeast Alaska. These co-produced models also elucidate how the interaction between Sitka residents and these fisheries affect community well-being. Operationalizing these models via QNMs allowed to highlight pivotal current research questions about these stocks. For example, in the case of sablefish, abundant smaller size classes that are favored by certain environmental conditions

and are unwanted by fishermen may result in avoidance behaviors. These avoidance behaviors may have an effect on different components of the system and on the well-being that is being derived from this fishery.

Conclusions

- Conceptual models serve as the basis to assess EBM objectives for Sitka as part of an IEA place-based framework
- Sitka is a unique fishing community in terms of its people and in terms of the relationship that people have with their local fisheries.
- Sitka stakeholders have a deep understanding of their local ecosystem
- Conceptual models are a pivotal exercise to capture and integrate LEK into science and to highlight important knowledge gaps in the ecosystem structure.
- Incorporation of LEK into science is needed to achieve sustainable, effective, and equitable management of fisheries
- Stakeholder participation in the scientific process leads to a more informed and empowered community in relation to their local ecosystem and resources
- IEA inherently leads to a more holistic view of fisheries management
- Operationalizing conceptual models allow an understanding of how different components of the model respond to a particular perturbation

Talk: "Development of socio-ecological conceptual models as the basis for an IEA framework in Southeast Alaska"

Fern Wickson, Genevieve Desportes, (Norway, North Atlantic Marine Mammal Commission)
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"Integrating the Scales of Interest in Different Knowledge Systems for Ecosystem Management: An opportunity to share experiences and collectively build best practices"

Summary: NAMMCO (The North Atlantic Marine Mammal Commission) is a regional inter-governmental organization providing advice from both scientific and local communities for policy on the management of marine mammals. The organization considers impacts on marine mammal species from a wide range of sources (e.g. hunting, fishing, pollution, climate change) and is committed to implementing an ecosystem approach to management (EA). In trying to implement EA in practice, NAMMCO regularly deals with the difficulties of achieving effective integration of diverse knowledge systems and diverging interests from scientists, local communities, and policy-makers. Not only do these different stakeholders have varying worldviews, terminologies, and cultures, their knowledge systems can also operate at different scales of interest. This can be the case for biophysical, geographical, temporal and jurisdictional scales. Knowledge systems are often characterized into two broad categories. One is compartmentalized, quantitative, based on abstraction and generalisation, striving for a value free ideal and relying on written documentation. The contrasting approach is then characterized as holistic, qualitative, based on experiential knowledge, integrated with morals

and beliefs, and relying on oral documentation. Typically, the first knowledge system is seen as embodied by western science, while the latter more representative of local, traditional or indigenous knowledge systems. Although this is not a strict or complete match – because there is variance across different disciplines of science and local and indigenous cultures - the distinction between two general types of knowledge systems is widely recognised.

In a body of academic work on ´politics of scale´, emphasis has been placed on the way choices regarding scale are not neutral and favour some actors and knowledges while disadvantaging others (Swyngedouw 2000). This is because the different actors and knowledge systems often have preferences for operating at certain biophysical, geographical, temporal and jurisdictional scales. For example, hunting communities are typically specifically interested in local environments, long multi-generational timeframes and community based approaches to management; policy makers typically operate on short timeframes connected to political cycles and are particularly occupied with national level interests; while scientists may have regional or global interests and work across timeframes spanning several decades. Making choices on "meaningful scales" for EA therefore presents not only scientific challenges, but also difficulties for integrating different knowledge systems.

Given that human communities and activities cannot be separated from natural systems, robust environmental policy requires combining the best available science with local and traditional knowledge. Reflecting on the politics of scale is important for our ability to integrate these knowledge systems. In this presentation, I highlight how some of NAMMCO's foundational choices regarding scale (i.e. the choice of a regional geographic scale, an inter-governmental jurisdictional scale and short temporal scales for policy advice) tend to favour scientific knowledge. Recognising NAMMCO´s ongoing commitment to integrate science and user knowledge in management advice, I emphasise the importance of reflecting on the politics of scale in our future work and present an upcoming working group on narwhal in east Greenland as an illustrative opportunity. I briefly explore different models available to NAMMCO for responding to such cross-scale challenges, including institutional interplay, co-management and boundary/bridging organizations (Cash et al. 2006). In closing I invite conference participants to share their experiences and best practices for integrating diverse scales of interest across different knowledge systems to help advance our collective learning and ability to adapt in future work.

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Talk: "Integrating the Scales of Interest in Different Knowledge Systems for Ecosystem Management: An opportunity to share experiences and collectively build best practices"

Per Arneberg and Anna Siwertsson (Norway, Institute of Marine Research)
"A system for assessing the state of ecosystems based on some principles from IPCC"

Abstract: To follow up a governmental white paper on protection of biodiversity, a system for assessing the state of ecosystems is currently being developed in Norway. This is based on assessing ecological state for the seven following ecosystem traits: (1) primary productivity (2) distribution of biomass among trophic levels (3) diversity of functional groups (4) abundance of species that are central to the dynamics of the system (5) area of habitats (6) changes in species and genetic composition and (7) abiotic conditions. For each of these ecosystem traits, indicators are used to assess whether the trait is affected by anthropogenic activities. This is done through the following steps: (1) describe how we expect each indicator to change with the anthropogenic drivers present (2) perform analyses of time series to assess whether such change has occurred and estimate its magnitude, and (3) assess the overall evidence of human impact on a trait based on all its associated indicators. In this process, information on data quality is considered together with estimates of uncertainty in conclusions from the time series analyses as well as uncertainty in attribution (i.e. how sure we are about the links between drivers and indicators). Together, this produces an assessment framework with many similarities to key assessment processes in IPCC. The system is currently being tried out for the Arctic part of the Barents Sea and results will be presented from this.

Talk: "A system for assessing the state of ecosystems based on some principles from IPCC"

Eisner, Lisa[1] and Seth Danielson[2], Ed Farley[1], Carol Ladd[3]
[1]Alaska Fisheries Science Center, NOAA, [2]University of Alaska, [3]Pacific Marine Environmental Lab, NOAA
"Arctic Integrated Ecosystem Research in the Chukchi and North Bering Seas"

Summary: Recent ecosystem level projects in the north Bering and Chukchi seas include Arctic Integrated Ecosystem Studies (IES) phase1 (2012 and 2013) and 2 (2017, 2019), and Arctic Shelf Growth Advection Respiration and Deposition (ASGARD, 2017 and 2018). This is a joint effort among US government and academic scientists to understand the relationships among physics, lower and upper trophic levels, including humans, in the context of ongoing climate change. Arctic IES 1 and 2 were late summer (August-September) surveys. Data include profiles of temperature, salinity, chlorophyll, light, oxygen, and nutrients, zooplankton and ichthyoplankton abundance from Bongo nets, pelagic fish from surface and midwater trawls and acoustics, and counts of seabirds and marine mammals. Arctic IES2, also includes primary production experiments, microzooplankton and phytoplankton community analysis, lipid and fatty acid analyses of plankton and fish, and beam trawls to quantify fish and epibenthic community abundances. ASGARD spring (June) surveys collected similar data, along with onboard rate measurements (e.g., zooplankton egg production, benthic respiration), and

multicore deployments to examine macro and meiofauna, organic matter deposition, environmental DNA and sediment. Hydrographic, marine mammal and acoustic moorings deployed over the study area provide information on daily, seasonal and interannual variations in physics and biology. Our data, along with other sampling programs (e.g., DBO), can aid ecosystem assessments of the western Arctic.

Goals: Three questions addressed are: How will reductions in sea ice and associated environmental changes influence the flow of energy through the northern Bering & Chukchi sea ecosystems? How will warming likely affect abundance of fishes and invertebrates? How is food security influenced by environmental vs. socio-economic factors? We show examples of year-round, seasonal, interannual and spatial comparisons that begin to address these questions.

Results: Preliminary findings indicate that over recent years near-bottom temperatures over the NE Chukchi shelf have increased in magnitude and duration, with almost no time with temperatures above 0 °C in fall 2014 (mean T of -1 °C) up to 4 months in fall 2017 (T up to 3°C). The melt period in spring and freeze-up period in fall has decreased by 30 and 40 days since 1979, so there is less time for ice edge processes to manifest. Seasonal comparisons indicate there is higher primary production in spring than summer and production scales with carbon biomass. Pelagic export appears to be highly efficient, even in a warm year, with ~ 50% of primary production exported to benthos. There were large interannual differences in spring zooplankton communities with much higher abundances in 2017 than 2018 of *Neocalanus* spp., an important lipid-rich copepod prey for fish, seabirds and marine mammals. Acoustic backscatter transect data indicate that age-0 Arctic cod had much higher abundances in 2017 than in 2012, 2013 and 2018. Acoustic mooring data indicate that Arctic cod disappear in mid-winter and return in spring after ice breakup. Consequences for humans include altered seasonality for subsistence hunting, altered access to winter hunting grounds, new subsistence food sources, new management decisions for commercial fishery oversight, increased vessel traffic in ice-free waters, earlier open water, and changes in timing of arrival of toxin-producing phytoplankton.

Discussion: Our research is still in the collection and analysis phase. However, potential applications of the data to IEA include filling gaps at under-sampled times of year, providing abundance, biomass and rate measurements for lower and higher trophic levels to understand carbon turnover and partitioning within the ecosystem. This will improve our ability to model the ecosystem and to evaluate mechanisms to better understand and predict effects of climate change as baselines shift.

Talk: “Arctic Integrated Ecosystem Research in the Chukchi and North Bering Seas”

Bérengère Husson, Maria Fossheim, Mette Mauritzen (Norway, Institute of Marine Research)

“**What scale(s) to study an ecosystem? A case study in the Barents Sea**”

Summary: The Arctic is experiencing the strongest warming on earth. The Barents Sea is under the conjugated influence of the Atlantic and the Arctic and is also strongly affected by the climate. Recent studies have shown that the increasing warming trend in temperatures is occurring at the same time as a northward shift of fish communities in the whole Barents Sea. BSECO project aims at understanding how those changes impact the functioning and the vulnerability of the ecosystem. As for all ecosystem studies, finding suitable spatial, temporal and taxonomic study scales are a challenge. Spatial scales influence the type of question you can answer (e.g. Chapin et al., 2011). Temporal scales are traditionally studied on the long term, but recent research focusing on extreme events linked to climate change draw the attention on short temporal scales (e.g. Ummenhofer and Meehl 2017; Jentsch et al., 2007; Harris et al., 2018; Bailey and Pol 2016). Thirdly and finally, changing taxonomic scales greatly affects the observed patterns (e.g. Smith et al. 2019; Queenborough et al., 2009; Sale and Guy, 1992). Our work uses data collected during fourteen years of autumn ecosystem survey (2004-2017) and assesses changes occurring through all functional groups of the ecosystem. Those data are analyzed through the lens of different temporal (trend and extreme years), spatial (over the whole Barents Sea and per subregion) and taxonomic (functional groups and individual species) scales. Simple standardized time series of each species are hard to analyze. However, when pooling all the species together, we can see that the whole demersal community is pulsing in 2006, 2012, 2016. Those pulses occur on years with low sea ice import and high heat content in the water (Lind et al., 2018). Through cross correlation analysis, we found which species are causing those pulses. They are several small demersal fish from the arctic area. Our hypothesis is that we observe larger abundances because their habitat is shrinking, and they regroup. The response was different according to the spatial scale at which the temporal trends were studied. Community level analyses reveal large scale response patterns to climate that cannot be detected at species level. Results will later be combined with traits, food web analyses and end-to-end models to assess changes occurring in the state of the ecosystem.

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Talk: “What scale(s) to study an ecosystem? A case study in the Barents Sea”

Jacqueline M Grebmeier[1]*, **Sue E Moore[2],** Lee W Cooper[1], Karen E Frey[3]

The Distributed Biological Observatory: A Change Detection Array in the Pacific Arctic

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Abstract: The Pacific Arctic region is experiencing major reductions in seasonal sea ice and increases in sea surface temperatures. A key uncertainty is how the marine ecosystem will respond to these shifts in the timing of spring sea ice retreat and/or delays in fall sea ice formation. Variations in upper-ocean water hydrography, stratification, light penetration, planktonic production, pelagic-benthic coupling and sediment carbon cycling are all influenced by sea ice and temperature changes. In order to evaluate these responses, the Distributed Biological Observatory (DBO) was initiated in 2010 as a change detection array for the identification and consistent monitoring of biophysical responses to environmental change in the Arctic. The DBO sampling approach to determine the status and developing trends for the ecosystem is facilitated by repeated sampling each year through multiple international occupations of agreed-to transect lines. Continuous data collections obtained through mooring and satellite observations, with an accompanying data sharing policy, help to integrate between shipboard sampling efforts. The Pacific DBO activities are focused on five regional biological transects (designated DBO1, 2, 3, 4, 5), which are located at biological hotspots along a latitudinal gradient in the Bering and Chukchi seas. Three additional locations have also been designated in the Beaufort Sea; expansion plans include development of DBO

sites in the Baffin Bay/Davis Strait region, the Atlantic sector of the northern Barents Sea, and possibly into the Russian Arctic. Seasonal sampling along the five core DBO transects indicates freshening and warming as Pacific seawater transits northward during the open water season. Ongoing observations of reduced sea ice extent and duration, and seawater warming are being linked to shifts in species composition and abundance, and northward range expansions in higher trophic predators (e.g. gray and humpback whales, and commercially harvested fish). Spatial changes in carbon production and export to the sediments, shifts in macrofaunal community composition and biomass, changing sediment grain size, and range extensions for some benthic species are additional observations that have grown out of DBO sampling efforts. There is also direct evidence of negative impacts on ice dependent species, such as walruses. Notably in 2018, limited production of sea ice in the northern Bering Sea area south of St. Lawrence Island (DBO1), removed thermal barriers and allowed commercial fish species to travel north as far as Bering Strait. Both the changing seasonality of spring sea ice retreat and associated ice edge production have a dramatic potential to impact pelagic-benthic coupling processes that can have major impacts on the ecosystem structure in the Pacific Arctic region. The continued development of the DBO is proving to be a significant resource for the identification and consistent monitoring of biophysical responses in the changing Arctic.

Talk: “The Distributed Biological Observatory: A Change Detection Array in the Pacific Arctic”

Hein Rune Skjoldal (Norway, Institute of Marine Research)

“Description of Arctic species and Arctic LMEs – integrating information on species and habitats”

Summary: The Arctic marine area (as used for the work of the Arctic Council) extends south into boreal and permanently ice-free areas, including the Aleutian Islands in the Pacific and the waters around Iceland and the Faroe Isles in the Atlantic. This area has been subdivided into 18 Large Marine Ecosystems (LMEs) based on four ecological criteria: bathymetry, hydrography, productivity, and trophic linkages. The bathymetry, or the underwater landscape, sets the stage for the hydrographic and oceanographic regimes, which in turn determine or influence the productivity and ecology of an area. The species of animals and plants, which form the living part of the ecosystem, are connected into trophic food webs, and they are also connected to places through habitat associations. In the wider Arctic area, there are a total of about 35 marine mammal species (seals, whales, polar bear), 200 bird species (seabirds, waterfowl, shorebirds), around 750 species of fish, and several thousand species of plankton and benthos.

The Arctic marine ecosystems are characterized by large seasonal changes in light and productivity between winter and summer, and mammals, birds, and many species of fish have adapted to these changes by performing extensive migrations between high Arctic and sub-Arctic areas for some species (e.g. ice-associated), while leaving the Arctic to overwinter in warmer climate further south for many others (e.g. shorebird species). The extensive

migrations by birds and mammals, with fidelity to routes and places (e.g. stop-overs and staging areas for birds) based on learning from generation to generation, have resulted in geographical patterns in population and taxonomic structure within species. Many species have wide circum-Arctic distributions with several subspecies recognized (e.g. common eider with six species, and brent goose with three or four subspecies). Another example is polar bear which is not separated with subspecies but occurs with 19 recognized subpopulations, which are reproductively isolated population units.
The Arctic species are described with information provided on subspecies and populations where they exist and are known. The descriptions are in two parts: a general part where ecological process and species are described with a pan-Arctic perspective, and a specific part where the species and ecology are described for each of the Arctic LMEs. The descriptions emphasize spatial and geographical patterns in distributions and seasonal migrations of species. The material was initially prepared for the AMAP assessment in 2007-2010: 'Oil and Gas Activities in the Arctic – Effects and Potential Effects'. The draft descriptions were also used as a basis for the 'Arctic Marine Shipping Assessment 2009 Report' by PAME, and for the follow-on report 'Identification of Arctic marine areas of heightened ecological and cultural significance: Arctic Marine Shipping Assessment (AMSA IIC)' by AMAP, CAFF, and SDWG. The extensive descriptions of Arctic species and LMEs (with some updates since 2010) are now in a stage of final editing (by Janet Pawlak and Carolyn Symon) for publication, intended to be used as baseline information for assessments of impacts of climate change and human activities.

Talk: "Description of Arctic species and Arctic LMEs – integrating information on species and habitats"

Phillip Wallhead, Phil Wallhead[1], **Wenting Chen[2]**, Laura Falkenberg[2], Magnus Norling[1], Richard Bellerby[2,3], Sam Dupont[4], Camilla with Fagerli[1], Trine Dale[2], Kasper Hancke[1], Hartvig Christie[1]

"Urchin harvesting and culling in northern Norway under ocean acidification and warming"

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Abstract: The harvesting of green sea urchins in northern Norway is a potentially important fishery for the region because of the high value of urchin gonads on the global market. We developed a computer model (integrated ecosystem assessment type of model) of urchin and

kelp populations growing in a typical fjord in northern Norway and used it to simulate the impacts of different harvesting/culling strategies. We did this both for present-day conditions and for a future scenario based on projected ocean acidification and warming for the next 30 years under a business-as-usual scenario (0.8°C warming, 100 micro atm pCO2 increase or ~0.1 pH unit decrease). Our simulations suggested that a minimum harvested urchin diameter of around 5 cm would give the highest sustainable harvest yield (in terms of gonad biomass) and that this optimal restriction would be little affected by climatic change. However, the potential harvest yield was very strongly reduced (roughly sevenfold) in the future scenario. This was partly due to acidification, but mainly due to warming. To provoke a regime shift from an urchin barren to a kelp forest state with high probability, simulations suggested that an annual cull of all urchins larger than 10 mm would be needed, and this requirement was also little affected by climatic change. This study highlights the pressing need for investigations of organismal sensitivities at moderate levels of warming and acidification, and of other ecological effects including disease and higher predation. The model is potentially a useful tool for ecosystem management and harvest optimization in the context of ocean acidification and warming. These results should however be treated with caution because they depend on urchin life stage sensitivities that are currently not well constrained by experimental data. More experiments are needed at the required moderate levels of acidification and warming, and more field investigations are needed to understand the north-to-south variability in urchin abundance along the Norwegian coast.

Talk: “Urchin harvesting and culling in northern Norway under ocean acidification and warming”

SESSION 2. MPAS AND OTHER SPECIAL AREAS

Lauren Wenzel (USA, NOAA Fisheries)
"Marine Protected Areas and Networks as a Component of Ecosystem-Based Management"

Talk: "Marine Protected Areas and Networks as a Component of Ecosystem-Based Management"

Boris Solovyev (Russia, Russian Academy of Sciences)
"From principles to practice: systematic conservation planning approach in the Arctic"

Abstract: Systematic conservation planning, SCP (Margules & Pressey, 2000) is widely considered the most effective and most used approach for designing protected areas and other ecological networks (Smith et al., 2006). The approach was developed and applied mostly in the tropical or sub-tropical regions and before 2015 there were no attempts to apply the approach in the Arctic marine ecosystems. In most cases SCP was applied to the coastal regions and in the relatively small, regional scale.
The Arctic marine ecosystems are quite different as they are: 1) of a larger scale, 2) less diverse, 3) highly dynamic seasonally as well as interannualy.
As a group of experts under WWF Russia and Russian Academy of Sciences guidance started a study on identification of a network of conservation priority areas in the Russian Arctic Seas, these issues were encountered, and an interpretation of SCP approach led to the development of the practical solutions. This case study encompasses also other issues crucial for conservation planning such as lack of data, conservation feature selection criteria, target setting approach and post-analysis.
This set of practical solutions is now used for the expansion of the conservation priority area networks identification at the global (the Arctic Ocean) and regional (the Pechora Sea) scales contributing to the ecosystem approach to management in the Arctic.

Talk: "From principles to practice: systematic conservation planning approach in the Arctic"

Martine Giangioppi (Canada, World Wildlife Fund)
"Marine Ecological Conservation in the Canadian Eastern Arctic (MECCEA): A project to identify Priority Areas for Conservation (PACs)."

Abstract: WWF- Canada initiated a project intended to inform the development by the Government of Canada of a network of Marine Protected Areas (MPAs); specifically, to address a current gap in MPA Network planning in the eastern Arctic. Priority Conservations Areas (PACs), based on ecological principals that rely on both scientific and indigenous knowledge, have been identified. The PACs are integrated into the wider landscape and

seascape by patterns of connectivity, thus permitting the establishment of a true Network of arctic marine protected areas. The scope of the project includes the Arctic Basin, Arctic Archipelago, Eastern Arctic and Hudson Bay Complex marine bioregions. The outcomes of MECCEA can be used to inform future MPA Network planning in the Arctic, the establishment of individual marine conservation areas, and planning and management decisions outside of MPAs, including Ecosystem-Based Management, Marine Spatial Planning, Strategic Environmental Assessments, etc. This work will also contribute towards international efforts to support the development of a Pan Arctic Marine Protected Areas Network (PAMPAN).

Talk: “Marine Ecological Conservation in the Canadian Eastern Arctic (MECCEA): A project to identify Priority Areas for Conservation (PACs).”

Martin Sommerkorn (Norway, World Wildlife Fund)
“The Pan-Arctic Marine Protected Area Network initiative and its contribution to implementing the Ecosystem Approach to Management in the Arctic”

Abstract: The Protection of the Arctic Marine Environment Working Group (PAME)-produced *Framework for a Pan-Arctic Network of Marine Protected Areas* (MPAs) approved by the Arctic Council sets forth an ambitious blueprint for area-based protection that is embedded in, and contributes to, the ecosystem approach to management. There is urgency to establish this network given increasing human pressures, industrial activities, climate change, and very few existing MPAs. There are also opportunities in that there can still be a pre-cautionary approach to designing and implementing protection measures given the relatively little human industrial impact in the Arctic to date. Having in mind the challenge to apply the Arctic Council’s vision in a systematic, transparent and participatory way that contributes to the ecosystem approach, WWF is carrying out the Pan-Arctic Marine Protected Area Network (PAMPAN) initiative. The goal of this WWF initiative are twofold. The first goal is to apply a systematic conservation approach to identify candidate sites for marine protection of biodiversity, ecological processes, and associated ecosystem services and cultural values in a representative, adequate and efficient way. The focus of the PAMPAN analysis is on conservation features that are representative or distinctive at the pan-Arctic scale and deserve a dedicated analysis – this may be a different set than e.g. national scale sets. The Pan-Arctic analysis is neither the same as the sum of lower scale analyses, nor does it not replace them. Secondly, PAMPAN initiates and engages a community of practice in an open and inclusive process that showcases and applies a transparent analysis to produce maps of candidate sites for marine protection as concrete proposals for planning and implementation processes. Post analyses will include oceanographic connectivity analysis, assessment of the identified network candidate sites against existing area-based conservation measures (gap analysis), and analysis of the persistence of candidate sites in a climate-changed Arctic Ocean. With this presentation, the authors seek to initiate discussions exploring the contribution of MPA networks to the ecosystem approach in the marine Arctic and potential implication for the design and implementation of area-based protection measures.

Talk: "The Pan-Arctic Marine Protected Area Network initiative and its contribution to implementing the Ecosystem Approach to Management in the Arctic"

Boris Solovyev (Russia, Russian Academy of Sciences)

"Systematic conservation planning for ecosystem based approach to management: case study from Pechora Sea"

Abstract: Pechora Sea is the southeastern part of the Barents Sea, known for (still) an extensive and long-lasting sea ice cover, and a specific oceanographical regime. It was recognized as an Ecologically and Biologically Significant Area, according to the criteria adopted by the Convention on Biodiversity. On the other hand, this is the first region in the Eurasian Arctic where offshore oil production has recently been started (Prirazlomnaya field), and where a number of new areas have been leased for hydrocarbon exploration. It is characterized by intensive ship traffic. Although this sea now supports only limited coastal fishery, it may face an alien snow crab fishery in the future. We have used MARXAN as a decision support tool for conservation planning to develop a coherent network of conservation priority areas which can be further used for marine spatial planning in the region and as a model for other regions. 70 conservation features were considered, grouped into several categories: plankton and productivity, benthic communities, fishes, sea birds and marine mammals. Several MARXAN experiments and consultations with an expert community resulted in a rather conservative network of 13 areas, well representing the main subregions based on oceanography, and providing geographic and food web connectivity. A new methodology of threat and vulnerability assessment has been applied that made it possible to formulate ecosystem based recommendations for spatial management of the current and potential economic activities and monitoring of their impact in the Pechora Sea. The study was supported by WWF.

Talk: "Systematic conservation planning for ecosystem based approach to management: case study from Pechora Sea"

Elizabeth Logerwell (USA, NOAA Fisheries), Jørgensen LL (Norway), Blicher M & Hammeken N (Greenland), Roy V (Canada), Ólafsdóttir SH (Iceland), Strelkova N (Russia), Sørensen J (Faroe Island), Christiansen JS, Bodil Bluhm and Fredriksen R (Norway)

"Long-Term Benthos Monitoring network for identifying vulnerable areas in Arctic benthic ecosystems"

Abstract: Arctic benthic ecosystems are vulnerable to climate change and human activities such as bottom trawling. One challenge to identifying vulnerable areas that could be candidates for spatial management is the lack of consistency and methodological standardization among monitoring efforts. One potential solution is to develop a time- and cost-effective, long-term and standardized monitoring of megabenthic communities in all Arctic regions that conduct regular groundfish assessment surveys. To investigate the viability

of this approach, the "Long-Term Benthos Monitoring network" project was funded by the Nordic Council for 2017-2020. The goal of this project is to explore how national groundfish surveys including megabenthos bycatch can provide relevant data for evaluating the state of benthic communities. Two workshops have been held, in 2017 and 2018, involving representative from national groundfish monitoring programs from Russia, Norway, Greenland, Iceland, Faroe Islands, Canada and the USA. The 2017 workshop resulted in Pan-Arctic maps of survey effort; bottom depth, temperature and salinity; and megabenthos species richness and biomass. The 2018 workshop resulted in methods to use species traits analysis to identify vulnerable areas, which will be implemented in future workshops. Jorgensen et al (during this Conference) provide a detailed example of using this method to identify vulnerable areas in the Barents Sea and to communicate recommendations at the governmental level.

Talk: "Long-Term Benthos Monitoring network for identifying vulnerable areas in Arctic benthic ecosystems"

Ole Anders Turi (Norway, Sámediggi/Sámi Parliament)
"What challenges could Ecosystem Approach solve at Saami resource use level"

Talk: "What challenges could Ecosystem Approach solve at Saami resource use level"

Lis L. Jørgensen (Norway, Institute of Marine Research), Gunnstein Bakke (Directorate of Fishery), Alf Håkon Hoel (UiT)
"Vulnerable areas and Ecosystem-based fishery management in the Barents Sea"

Abstract: The Arctic Barents Sea is experiencing a record temperature increase and a poleward shift in the distributions of commercial fish stocks. An increase in Boreal species are observed, together with a reduced importance of Arctic species. Commercial fish stocks expand into the north western part of the Barents Sea which will increase exposure of large immobile species to trawling (Jørgensen et al 2019). How can these results be used in Ecosystem based Fishery management? We demonstrate the interaction between the scientist and the management, from the raw-data to the integrated maps and the final product presented to the governmental level. We also show how the Vessel-Monitoring-System (VMS) point out "good" fishing-grounds based on local knowledge. This can be used to direct an international fleet to areas where the fish catch, and hence the seabed, are not damaged doe to large aggregation of benthic fauna (complex habitats).

Talk: "Vulnerable areas and Ecosystem-based fishery management in the Barents Sea"

Wenting Chen[1], David Barton[3,] Kristof Van Assche[2], Stephen Hynes[4], Trine Bekkeby[1], Hartvig Christie[1], Hege Gundersen[1]

"Marine ecosystem accounting to support coastal and marine governance"

[1]Norwegian Institute for Water Research(NIVA), [2] University of Alberta, [3] Norwegian Institute for Nature Research (NINA), [4] National University of Ireland

Summary: Marine ecosystems cover large parts of the Arctic. The 18 large marine ecosystems of the Arctic Ocean cover 10 million km^2. The arctic ecosystems provide various ecosystem services to human society (CAFF 2015). The Arctic marine areas provide many important biochemical and medicinal resources and raw materials (provisioning services). The arctic marine and coastal ecosystems also allow for carbon storage and sequestration (regulating services), and provide habitats that are important for food web maintenance (supporting services). The coastal areas of the Arctic provide aesthetic views and recreation for both the locals and the tourists from other regions (cultural services). Much of the cultural identity and sense of place are closely connected to the marine ecosystems and the coastal areas (CAFF 2015).

The arctic has faced a series of challenges in recent decades. Increases in ocean economic activity such as new oil and gas fields, potential new shipping routes and increasing tourism brought both economic growth and at the same time increasing threats to the local environment and ecosystems as well as conflicts among various resource users. Other factors such as climate change, persistent organic pollutants and radiative waste pose additional challenge to the arctic environment (PRETEAR, 2010).

Natural capital accounting view nature and ecosystems as assets which provide a stream of ecosystem service benefits to society. Ecosystem accounting aims to identify periodic change in ecosystems' contribution to the economy. It is a holistic approach for measuring ecosystem, ecosystem services and their benefits to economic and human activities spatially and over time. Ecosystem accounting represents a fundamental methodological development in making national accounts sensitive to spatial variation in ecosystem services flows and their value as assets. The ability to identify change in the economic value of ecosystems is potentially important in evaluating aggregate effects of combinations of policy within an accounting area. Ecosystem accounts are potentially one of several tools in governance towards sustainable social-ecological systems. For example, ecosystem accounting will provide information on the quantity and location of the supply of a wide range of ecosystem services. It is vital for monitoring and achieving sustainable use of ecosystem assets and preventing further loss of biodiversity. Ecosystem accounting provides a tool to monitor status of ecosystem assets not only about physical indicators but also about ecosystem assets values. Via ecosystem accounting, we can easily identify the ecosystem assets and ecosystem types and services that are changing most significantly and hence help to determine the priorities for policy interventions. By addressing causes of change or degradation, relevant measures can be identified for effective policy responses (UN 2017).

Ecosystem accounting is still in experimental stages. Natural capital accounting has been applied mainly to terrestrial environments. Marine and coastal ecosystem accounting remains sparse. We carried out an experiment ecosystem accounting for Norwegian kelp forest along

the whole Norwegian coast. Our study shows that Barents Sea should be the prioritized area for kelp recovery (Saccharina Latissma) if we only consider the extent of kelp forest. Measures aiming to reduce sea urchin predation should be adopted. When we consider the change in extent of kelp coverage or change in values of ecosystem services provided by kelp forest such as change in the social cost of carbon, change in the value of supporting services and provisioning services, the Norwegian Sea would be prioritized.

Ecosystem accounting will be a useful tool to study both ecological impacts and social impacts of ecosystem change over time and space in the Arctic area. It can assist in the choosing of management hotspots and in facilitating the policy responses by identifying potential management measures. Beside the kelp recovery, ecosystem accounting can be applied in the Arctic area to study for example the effectiveness of marine protected areas (MPAs) and to support integrated coastal zone planning (ICZP) and marine spatial planning (MSP). It is important to make use of existing monitoring and socio-economic data from coastal communities in the coastal areas of the Arctic when carrying out accounting while it is also important to establish new data collection systems for ecosystem assets, ecosystem services and their change where there is no or limited data. We also need to be aware that there are various groups of indigenous people living along the Arctic coast. Most of them still live in a subsistence economy or a hybrid subsistence and market economy. Applications of ecosystem accounting need to be adjusted to fit the subsistence economy where food for example are produced and consumed within the family or the community. This means a family production model and relevant data should be applied to evaluate the value of ecosystem service change provided by ecosystem assets rather than the evaluation methods mentioned in the UN SEEA EEA Technical Recommendation (2017).

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UN, 2017. SEEA Experiment Ecosystems Accounting: Technical Recommendations

Talk: “Marine ecosystem accounting to support coastal and marine governance”

Gerold Janssen and Marius Werner (Germany, Leibniz Institute of Ecological Urban and Regional Development)

“Implementing an Ecosystem-based approach in MSP”

Abstract: Research findings have shown that MSP can be an effective instrument for preserving marine environments and present a way to translate the ecological requirements of an EBA into concrete marine spatial planning measures. In recent years the importance of

considering marine environment in spatial planning has strongly increased by introducing an **ecosystem-based approach (EBA)** to MSP through different regulations and guidance documents. Research findings of two research and development projects carried out by Leibniz Institute of Ecological Urban and Regional Development and Leibniz Institute of Baltic Sea Research Warnemuende together with various research partners and supported by the Federal Agency for Nature ConservationThe mentioned projects have shown that the implementation of requirements of the EBA sets new challenges for competent authorities and stakeholders. Against this background it is important to make clear, **that an implementation of an EBA can effect two aspects of planning: the planning process itself and the content of plan.** Therefore an implementation of an EBA should result in changes of both of these aspects. Still concrete implementation concepts remain vague. As a contribution to a further development of the implementation of an EBA in MSP both research projects aimed at presenting a proposal on how planners and stakeholders can handle new requirements for an ecosystem-based spatial planning. Therefore it has to be ensured that during the planning process the carrying capacity of ecosystems is considered and good environmental status according to the MSFD can be reached. Research findings have shown that MSP can be an effective instrument for preserving marine environments and **present a way to translate the ecological requirements of an EBA into concrete marine spatial planning measures.**

Talk: “Implementing an Ecosystem-based approach in MSP”

SESSION 3. VOICES FROM THE NORTH – A CONVERSATION ABOUT PEOPLE, NATURE, AND SUSTAINABILITY

Fred Phillips and Mellisa Heflin (USA, Bering Sea Elders Group)
"The ocean is our garden"

Talk: "The ocean is our garden"

Nicole Kanayurak (USA, Utqiagvik, North Slope Borough Department of Wildlife Management)
"Inuit have an 'Ecological Clock'"

Talk: "Inuit have an 'Ecological Clock'

Gerry Inglangasuk (Canada, Inuvialuit Member, Fisheries Joint Management Committee) and **Alan Kennedy** (Canada, Chairman, Fisheries Joint Management Committee)
"Co-management as a Framework for Ecosystem Management of Arctic Resources: Experience from the Inuvialuit Region of Canada"

Talk: "Co-management as a Framework for Ecosystem Management of Arctic Resources: Experience from the Inuvialuit Region of Canada"

Introduction by: **Andrea Niemi** and Elizabeth Hiltz (Canada, Fisheries and Oceans)
"An Inclusive Approach to Public Outreach: A Case Study from Canada's Arctic" with video "Guardians of Tariug":

Hiltz, Elizabeth[1] and B. Burke[2], S.D. Fuller[3], A. O'Rielly[4], T. Taylor[5], J. Qaumariaq[6], V. Karetak[7] and Z. Martin[8]
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Guardians of Tariuq" a music video celebrating Canada's eastern arctic marine conservation areas starring school children (Introduced by Andrea Niemi[1])

Summary: In 2017, Fisheries and Oceans Canada, in collaboration with stakeholders, established three conservation areas in Canada's Eastern Arctic to protect vulnerable species of corals and sponges. Inhabitants of Baffin Island, Nunavut are generally unaware that corals and sponges exist in the waters off their coast. To improve awareness of the Arctic marine ecosystem and protection efforts, a music video was created which involved youth and performance artists from Iqaluit, Nunavut. The music video incorporated two culturally important mediums - conversation and storytelling. The video demonstrates a special collaboration between government, industry, environmental, and community organizations

to promote conservation initiatives.

Talk/video: “An Inclusive Approach to Public Outreach: A Case Study from Canada’s Arctic” with video “Guardians of Tariug”

SESSION 4. NATIONAL EA IMPLEMENTATION

Cecilie von Quillfeldt (Norway, Norwegian Polar Institute)
"Integrated Management Plans for Norwegian Sea Areas"

Abstract: The Johannesburg declaration of 2002 calls for Ecosystem Approach (EA) to management of all marine ecosystems by 2010. As a result, the management plan for the Barents Sea-Lofoten area was first announced in the white paper Protecting the Riches of the Sea (St.meld. nr. 12 (2001-2002)). The white paper states that an ecosystem approach to management of marine sea areas should provide a framework for sustainable use of natural resources and goods derived from the area that at the same time maintain the structure, functioning and productivity of the ecosystems of the area. Since then, Norway has established management plans as the basis for integrated ecosystem approach to management of all Norwegian Sea areas (Barents Sea 2006, Norwegian Sea 2009, North Sea/Skagerrak 2013). Furthermore, Norway has signed several international conventions and agreements and participates in international processes that also provide guidance on the design of the Norwegian marine management plans. These plans represent a strictly knowledge-based management regime. Knowledge about ecosystem functions and about the extent of human activities and influences is critical to good management, and scientific data about changes in the different components of the ecosystem is essential for any functional management of an area. The management plans have contributed to a shift of Norwegian management, now taking into account individual species to ecosystems (e.g. Barents Sea as an ecosystem), dealing with short time frame to longer time frame (e.g. future scenarios), sector management to integrated management (e.g. combined assessment of impact of oil and gas activities, shipping and fisheries) and better cooperation between management and research (e.g. research and monitoring priorities set based on management needs).

Talk: "Integrated Management Plans for Norwegian Sea Areas"

Daniel Van Vliet (Crown Indigenous Relations and Northern Affairs Canada)
"Strategic Environmental Assessment Processes in Canada's Arctic"

Abstract: Crown Indigenous Relations and Northern Affairs Canada is undertaking 2 Strategic Environmental Assessment Processes in Canada's Arctic. These processes were developed in order to inform decision making around Offshore Oil and Gas activities in Canada's Arctic waters. These strategic environmental assessment processes were co-developed with Land Claim organizations in Nunavut and Northwest Territories. Daniel will be presenting on the co-management approach to this work and the practice of inclusion of both science and indigenous traditional knowledge to inform decision makers. He will also discuss the approaches to local indigenous community engagement used throughout this work.

Talk: [“Strategic Environmental Assessment Processes in Canada’s Arctic”]

Elizabeth Logerwell (USA, NOAA Fisheries)
“NOAA’s Integrated Ecosystem Assessment (IEA) Program”

Talk: [“NOAA’s Integrated Ecosystem Assessment (IEA) Program”]

Boris Solovyev (Russia, WWF Russia/Russian Academy of Sciences)
“EA Implementation in Russian Arctic”

Abstract: In 2016 WWF and Russian experts developed a new methodology for the identification of networks of marine areas based on an ecosystem approach. During the last 3 years this methodology was applied in the Russian Arctic at both the national and regional scales.

At the national level, an analysis was carried out for the entire marine area of the Russian Arctic. As a result, 47 marine areas which require the application of environmental measures at the Russian federal level were identified. Six of these areas have been included in the Russian federal plans for new MPAs and should be formally gazetted by 2023. To date one of the six areas “New Siberian Islands” has been established as a new MPA covering an area of more than 6 million ha. The remaining five areas in the plan cover more than 10 million ha. Additionally, some from these 47 areas will have conservation regime as buffer zones of the federal PAs and zones of marine mammal conservation. At the regional level, an analysis of the Pechora Sea (part of the Barents Sea) has been completed. While the Pechora Sea has been recognized as an Ecologically and Biologically Significant Area, it is also one of the most intensive areas in the Russian Arctic for hydrocarbon exploration and shipping.

The purpose of the analysis was not only to identify a system of important marine areas, but also to prepare recommendations for developing economic activity across the entire sea.

The analysis assessed the environmental value and vulnerability for each part of the sea. A network of important marine areas were identified and for each of these a set of management recommendations were developed covering the intensity of use of different zones, seasonal restrictions, and conservation areas etc.. . Now the results of this work we use as a basis for the Integrated Sea Use Management (ISUM) of the Pechora Sea and for communication with different nature use companies including oil& gas.

Talk: [“EA Implementation in Russian Arctic”]

Anders Mosbech (Denmark, Aarhus University), Tom Christensen, Kasper Lambert Johansen, David Boertmann, Daniel Spelling Clausen.
“On the road to EA in Greenland: The use of spatial biodiversity data to identify important areas”

Summary: In recent years a number of studies have provided an overview of important areas for ecosystems and species in Greenland (e.g. Boertmann and Mosbech 2017). Abundance, occurrence, migration routes etc. for more than 100 species or ecosystem components has been mapped focusing on the spatial distribution of important biological areas. The maps have further been combined to identify the most biologically important areas according to a set of criteria informed by national priorities and international processes such as the Convention on Biological Diversity to identify Ecologically and Biological Sensitive Areas (EBSAs) and the International Maritime Organization (IMO) to identify Particular Sensitive Sea Areas (PSSA) (Christensen et al. 2016). In relation to mineral exploitation in Greenland, a number of areas has been identified as sensitive (Important areas for wildlife, Mosbech et al. 2019), and the spatial analysis has further been used to identify biologically important areas in finer scales in the North Water polynya and Disko Bay and Store Hellefiskebanke areas. In relation to Disko Bay an Store Hellefiskebanke, each of the biological layers where further assessed and ranked according to their specific sensitivity to potential environmental effects caused by shipping, to identify where there may be a need for heightened awareness in relation to impacts from the shipping sector. Local knowledge has also been used in the process of gathering spatial information, mainly through interviews, but recently also in collaborative studies where hunters have used GPS devices to map their activities (Flora et al. 2018).

In relation to the Arctic Council initiative about Adaptation Actions to a Changing Arctic (AACA) (Mosbech et al. 2018), the use of spatial data was discussed in Greenland at a workshop in May 2019 with the purpose to explore the possibilities for a more ecosystem based approach to manage spatial planning in Greenland. Different departments from the administration, and representatives from industry as well as from representatives form subsistence hunting and fishing and NGOs took part in the workshop. Across all contributions there was a positive view on the EA approach, among other things underlining the advantages in relation to eco certification of fisheries (MSC) and hunting (CITES NDF), and the potential for a common ground in mediation of potential conflicting interests in area usage. Some EA work in relation to the North Water Polynya has been initiated by the administration.

However, it was evident at the workshop that lack of administrative resources to work across administrative sectors was a bottle-necks for the development of the EA approach. Greenland has a small population (approx. 56.000) and it was discussed how a resource efficient greenlandic ”model” for EA can be developed. As part of the way forward it was discussed to plan a case study to eplore new ways of cooperation. The need for strong local involvement and outreach was underlined, as well as monitoring of important animal populations to secure sustainable use.

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Talk: “On the road to EA in Greenland: The use of spatial biodiversity data to identify important areas”

Bjarne Lyberth (Greenland, The Association of Fishers & Hunters in Greenland)
“International and national wildlife management from a local perspective (fishers and hunters in Greenland)”

Summary: The presentation consisted of three topics. Facts about the Association of Fishers and Hunters in Greenland, work of the Pikialasorsuaq (North Water Polynya) Commission and a local monitoring program in Greenland, due to a failure in time management the last topic was not in the presentation but is included in the summary.
Following some previous discussions about ecosystem services and value systems, some facts about KNAPK and the Greenland legislation were presented, intended as an addition to the discussion. KNAPK is an umbrella organization of about 70+ local fishers and hunters organizations consisting of about 2000 individual members who live professionally of fishing and hunting. To be a licensed fisher and hunter, a minimum of 50% of your taxable income must come from fishing, hunting or relatable activities. About 90% of Greenland’s export values are from seafood products.
Second topic was the work of the Pikialasorsuaq Commission, Pikialasorsuaq is the Inuit name of the North Water Polynya, which lies between Greenland and Nunavut from about 75 to 79 degreees north. The approach of the Commission has been to develop policies based on consultations of communities adjacent to Pikialasorsuaq, consultations were carried out in 2016 on both sides of Pikialasorsuaq, following that a report was published in 2017 with recommendations on an Inuit led management and monitoring of the area, the implementation of these recommendations are the responsibility of both states and self governments.
In 2010 a local monitoring program was established in ten settlements at western Greenland, Local Resource Councils (PISUNA) consisting of hunter fishers and other record daily observations when out in the environment, no particular parameter is required, mostly

observations on living resources are recorded but also ice conditions and other observations are recorded. Each three months Local Resource Councils meet and evaluate their observations compile them and give management advices. Presently only three settlements have PISUNA, but an information tour is planned to other settlement to establish or re-establish PISUNA in more settlements.

Talk: “International and national wildlife management from a local perspective (fishers and hunters in Greenland)”

Karnauskas, Mandy and Matt McPherson, Adyan Rios, Skyler Sagarese, John Walter, Daniel Goethel, Suzana Blake, Amanda Stoltz[1], Chris Kelble[2], Michael Jepson[3], Casey Streeter[4]
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Identifying relevant spatial scales and priorities for ecosystem-based management in the Gulf of Mexico

Summary: *Background:* In 2016, NOAA Fisheries released its National Ecosystem-Based Fishery Management (EBFM) Policy, affirming a commitment to support an ecosystem approach to management applied at regional scales. The Gulf of Mexico Fisheries Management Council is the primary governing body for federal fisheries of the U.S. Gulf of Mexico. Although the Gulf Council has existing Fishery Management Plans containing many elements of EBFM, it has yet to adopt a Fishery Ecosystem Plan or other policy statement outlining priorities or objectives for the region. To engage stakeholders in planning for the region and development of a Fishery Ecosystem Plan, and to determine the appropriate scale and scope of EBFM in the region, the NOAA Fisheries Southeast Fisheries Science Center initiated a participatory fisheries system modeling approach.
Goals: The goal of this effort was to increase information flow between scientists, managers, and stakeholders, in support of improved stock assessment and ecosystem assessment in the Gulf of Mexico. A series of workshops were held in 2018 with both fishing communities and groups of fishery scientists and managers, with an initial focus on snapper-grouper fisheries of the West Florida Shelf. Fishery system conceptual models resulting from each workshop were then merged into a single network model, after first standardizing like terms used across workshops and then simplifying by grouping similar concepts into umbrella terms.
Results: Network analysis showed that the most influential nodes in the system were fishing pressure, followed by water quality – which was dominated by factors related to the harmful algal blooms known as “red tides.” The impacts of red tides had already been incorporated in the stock assessment process, whereby red-tide induced fish mortality is estimated and advice

can be given on the appropriate and sustainable levels of fishing mortality in light of these events. However the participatory workshops brought to light a number of additional concerns beyond the immediate impacts of red tide on fish mortality; red tide events are also observed to affect habitat condition, commercial and for-hire fishing businesses, aquaculture, tourism, protected species, and human health. These additive or potentially synergistic red tide impacts have further implications for the stock assessment, the ecosystem, and fishing communities as a whole. By leveraging resources and collaborating with state, federal, academic and private agencies, a red tide response plan was developed to better understand the severe red tide events and its impacts on the biological and human communities of the West Florida Shelf.

Discussion: The participatory modeling approach was useful for defining discrete priority EBFM issues, with specific scales, knowledge gaps and linkages to management. At the same time, it is an effective method for engaging both researchers and stakeholders, and building synergies and partnerships to work toward common objectives. Future work will focus on continuing collaborative work to improve our understanding of harmful algal blooms in the region, with the goal of ultimately mitigating blooms where possible and providing advice to managers on how they can improve the resiliency of coastal communities in light of events that are increasing in severity and frequency. The main challenge is to maintain a long-term, coordinated response, in the face of varying resource levels for budgets and staff time. Also, during this process it is essential to not only report back results to coastal community members regularly, but also to meaningfully engage stakeholders in the scientific process and find ways to transfer insights and capacity back to the communities.

Talk: “Identifying relevant spatial scales and priorities for ecosystem-based management of the Gulf of Mexico snapper-grouper fishery complex”

Daniel Taukie (Canada, Nunavut Tunngavik Inc.)
“Inuit-led Marine Monitoring in Nunavut, Canada”

Talk: “Inuit-led Marine Monitoring in Nunavut, Canada”

Retter, Gunn-Britt (Saami Council)
“The Arctic Environmental Impact Assessment – a model for Meaningful Engagement of indigneous Peoples”

Summary: Background: Finland lead the project “Good Practices for Environmental impact Assessment and Meaningful Engagement in the Arctic – including Good Practice Recommendations” under the auspices of the Sustainable Development Working groups during the Finnish chairmanship of the Arctic Council 2017-2019. More on the project: https://www.sdwg.org/activities/sdwg-projects-2017-2019/arctic-eia/ The first attempt to do so was the Arctic EIA Guideline from 1997. Each Arctic State already have national legislation on EIA

Goals: The aim of the project was to improve the application of EIA in the Arctic region and identify a common framework across the Arctic. The project focused on issues that were found to be Arctic specific, or what deserved additional emphasis compared to the earlier guidelines and in the general EIA framework in the states. They are gathered in the report for wider application.

Results

The project developed five recommendations for good practice:

1. Seek true dialogue to meaningfully engage
2. Utilize Indigenous knowledge and local knowledge
3. Build internal capacity and provide resources to meaningfully engage in EIA
4. Allow EIA to influence project design and decision-making process
5. Strengthen circumpolar cooperation on transboundary EIA

My emphasis was on models of meaningful engagement, as that is important for the Saami Council and an issue that was also stressed by the indigenous peoples during the EA discussions. Early engagement in the various processes is essential. The Arctic EIA project identifies several models of meaningful engagement of indigenous Peoples: Indigenous-led Impact Assessment, Indigenous Knowledge-based Impact Assessment, Specific Impact Assessments (Health-, Ethnological- and Cumulative Impact Assessment) and Collaborative Mitigation. The PAME project Meaningful Engagement of Indigenous Peoples and local communities in Marine Activities (MEMA) also underscores the similar points on what make engagement meaningful.

Discussion including "what is the main challenge" and "recommendation for further work"

The EIA and ecosystem approach to management serve different purposes, but when it comes to meaningful engagement with Indigenous Peoples, the recommendations and challenges are similar. A common Arctic Council guidebook for engagement with indigenous peoples could be useful to set a standard and state some principles. But most importantly is how indigenous peoples as a rightholders are involved in the ecosystem management regimes and how indigenous knowledge is recognized and valued as part of the knowledge foundation for decision-making as well as ecosystem approach systems. Capacity building is important to facilitate indigenous contribution and meaningful engagement. The involved communities need capacity building and resources to engage and authorities and proponents (Related to EIA) should receive training to work with Arctic communities.

Talk: "The Arctic Environmental Impact Assessment – a Model for Meaningful Engagement of Indigenous Peoples"

SESSION 5. CENTRAL ARCTIC OCEAN

Hoel, Alf Håkon (University of Tromsø, Norway) and Skjoldal, Hein Rune (IMR, Norway)

Organizing science for the central Arctic Ocean

Summary - The United Nations Convention on the Law of the Sea (UNCLOS) is the 'constitution' of the oceans and provides the legal framework for all activities globally, including science. UNCLOS includes provisions for marine scientific research, both in areas within national jurisdiction (where research requires the consent of the coastal states within their EEZs), and in the High Seas beyond national jurisdiction where research is one of the freedoms. There are several regional organizations involved in Arctic marine research. The International Arctic Science Committee (IASC) was established in 1990 to encourage and facilitate cooperation in all aspects of Arctic research. IASC has currently 23 member nations and is technically an NGO. The International Council for the Exploration of the Sea (ICES) was established in 1902 and is an Inter-governmental Organization (IGO) with a convention in 1964. ICES' "goal is to advance and share scientific understanding of marine ecosystems and the services they provide and to use this knowledge to generate state-of-the-art advice for meeting conservation, management, and sustainability goals."

The Arctic Council was established in 1996 as a high-level intergovernmental forum to provide a means for promoting cooperation, coordination and interaction among the Arctic States. Its various working groups (e.g. AMAP, CAFF, PAME, and SDWG) are involved in scientific research, focusing on monitoring and assessments (e.g. Snow, Water, Ice and Permafrost in the Arctic (SWIPA) 2017 (AMAP), State of the Arctic Marine Biodiversity Report 2017 (CAFF), Arctic Marine Shipping Assessment 2009 Report (PAME), and Arctic Human Development Report 2 (2015) (SDWG). The Arctic Council negotiated an agreement on international scientific cooperation in the Arctic that entered into force in 2018. The purpose of this agreement is to enhance cooperation in scientific activities in order to improve the scientific knowledge about the Arctic, e.g. by providing access to areas, data, and infrastructure.

The 2018 Agreement on Preventing Unregulated Fishing in the High Seas Portion of the Central Arctic Ocean is the result of almost a decade of negotiations, first among the five coastal states, then including also potential distant water fishing nations (Japan, China, Republic of Korea, the EU and Iceland). The agreement was signed in 2018 and has not yet entered into force. Through the entire process of developing the agreement, the interactions between science and policy actors have been critically important. The agreement contains provisions for the establishment of a Joint Program of Scientific Research and Monitoring, and science is likely to be the main activity under the agreement for the foreseeable future.

Two Arctic Science Ministerial Meetings were held in 2016 and 2018, and a third is planned for 2020. The meeting in 2018 was attended by 26 countries with interests in Arctic research. The main goal of the ministerial meetings is to shape the course of future Arctic research. The outcomes are ministerial declarations, which set out priorities under three main themes: Observations and data, Regional and global dynamics, and Vulnerability and resilience.

In addition to such 'top-down' science cooperation, there are also several 'bottom-up' initiatives driven mainly by scientists. Examples of such programs include MOSAIC where the German RV 'Polarstern' will drift for one year with the ice in the CAO starting this summer, the Synoptic Arctic Survey (SAS) which is a multi-ship coordinated effort over the next two years, and the Nansen Legacy project.

Talk: "Organizing science for the central Arctic Ocean"

Hein Rune Skjoldal (Norway, Institute of Marine Research)

WGICA Integrated Ecosystem Assessment report for the CAO

Summary: The Working Group for Integrated Ecosystem Assessment of the Central Arctic Ocean (WGICA) is a joint group of ICES, PICES, and PAME. The group is led by three co-chairs: John Bengtson (NOAA, USA), Sei-Ichi Saitoh (University of Hokkaido, Japan), and Hein Rune Skjoldal (IMR, Norway). WGICA was established in autumn 2015 and has worked during a first 3-year period (2016-2018), with Terms of Reference renewed for another 3-year period (2019-2021). The main work in the first period has been to prepare a report: 'Integrated Ecosystem Assessment of the Central Arctic Ocean: Ecosystem Description and Vulnerability Characterization'. The ecosystem description puts emphasis on spatial aspects and trophic (food-web) connections, and provides accounts of the geophysical setting, main ecological features, and distribution of organisms. Available information on primary production by phytoplankton and ice algae is compiled and shows that the level of production is very low, around 10 g C m^{-2} $year^{-1}$, which is an order of magnitude lower than production in surrounding sub-Arctic seas (e.g. Barents and Bering seas). The fish chapter summarizes information on the number of species found, or likely to be found, in the CAO. For birds and mammals, all species that live or are recorded as seasonal visitors in the CAO are described with a circum-Arctic perspective, with information provided on subspecies and populations where such exist and are known. Attention is given to the two gateways (Atlantic and Pacific), which connect the CAO with the North Atlantic and North Pacific, respectively. The vulnerability part of the report provides an introduction and overview of the concept of vulnerability and how it relates to human activities in or around the CAO. The report is now being reviewed internally by WGICA, and the aim is to have it published in the ICES Cooperative Research Report series by the end of this year.

Talk: "WGICA Integrated Ecosystem Assessment report for the CAO"

Vasily Spiridonov[1], Boris Solovyev[2,3], Irina Onufrenya[3], William Meritt[4]

"Indicators of vulnerable benthic biotopes in the Arctic Ocean"

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Abstract: Vulnerable benthic biotopes are those that fit at least some criteria of vulnerable marine ecosystems as defined by FAO (2009). They mainly include bottom biotopes and communities forming by habitat-making organisms (aedificators), such as deep-water corals, sponges, mollusks and some other taxa building biogenic structures as well as biotopes built around underwater volcanism and hydrothermalism. Except of some boundary areas, i.e. the Barents, Norwegian, and the Bering Seas they have been never identified in the Arctic Ocean. Within a WWF project for marine systematic conservation planning (PAMPAN – Pan Arctic Marine Protected Areas Network) we attempted to include vulnerable marine biotopes as distinct conservation features in the process of constructing a network of conservation priority areas, using MARXAN as a decision support tool. Actual data on deep sea (cold-water) coral spots were obtained from the World Conservation Monitoring Center database. Cold seeps and mud volcanoes with a characteristic biota have been recently identified on the Arctic shelf, i.e. in the Laptev and Beaufort Seas. Other possible vulnerable biotopes can be inferred from indicative geological and geomorphological structures. In particular, hydrothermal phenomena have been documented for the slow-spreading Gakkel (Mid-Ocean) Ridge. Although no actual observations of biota in these spots are available. Gakkel Ridge is also known for a number of distinct seamounts, which may host communities that are not necessarily based on heosynthetic production but are nevertherless rich and diverse, with sponges as the main habitat forming organisms. The data gathered in PAMPAN, and the expected results of PAMPAN should contribute for planning further research in the CAOF area. Identification of VME should be considered within CAOF research plan.
The study was supported by the PAMPAN project by WWF and by the Russian Foundation for Basic Research project 18-05-70114.

Talk: “Indicators of vulnerable benthic biotopes in the Arctic Ocean”

Øyvind Paasche, Are Olsen, Leif Anderson, Jeremy Wilkinson, Jackie Grebmeier, Takashi Kikuchi, Sung-Ho Kang, Carin Ashjian and the SAS Community.
(Bjerknes Centre for Climate Research/Geophysical Institute, University of Bergen,)

“The Synoptic Arctic Survey (SAS) – towards 2020”

Talk: “An Outline of the Synoptic Arctic Survey”

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