Understanding MPA Networks as Tools for Resilience in a Changing Arctic

Report from the Second Expert Workshop on Marine Protected Area networks in the Arctic

February 2017 - Copenhagen, Denmark

PAME
Protection of the Arctic Marine Environment

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Summaries and Key Discussion Points

Report from a workshop held under the auspices of the Protection of the Arctic Marine Environment (PAME) Working Group of the Arctic Council in 2016: "Area-based conservation measures and ecological connectivity in designing Arctic MPA Networks" (2016),

Editors: Stefan Norris with contributions from the PAME Working Group and invited speakers.

Acknowledgements

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Background

For a review of the five-year history of the PAME Marine Protected Areas projects, see https://pame.is/index.php/projects/marine-protected-areas

PAME's Framework for a Pan-Arctic marine Protected Areas Network document recognizes that individual Arctic countries pursue MPA development based on their own authorities and priorities, and that MPA networks can be comprised of "both MPAs and 'other' area-based measures that contribute to network objectives".

PAME's "toolbox" project aims to develop guidance to assist countries in advancing MPA networks in the Arctic. The project will produce this guidance in the form of a catalogue of examples of diverse existing area-based measures, including different types of marine protected areas and of "other area-based conservation measures" that contribute to the long-term conservation of important categories of Arctic marine biodiversity (e.g. important species and habitats). The toolbox is intended to be a living document that will be expanded and refined over time.

Over the course of the 2015-2017 work cycle, project leads hosted the following workshops on connectivity in the Arctic:

- 1st MPA Workshop: Science and Tools for Developing Arctic Marine Protected Area (MPA) Networks: Understanding Connectivity and Identifying Management Models (22-23 September 2016)
- 2nd MPA Workshop: Understanding MPA Networks as Tools for Resilience in a Changing Arctic (2-3 February 2017 - *this Report).*
- 3rd MPA Workshop: marine protected area (MPA) networks in a changing Arctic climate (21-22 September 2017)

Introduction to the report

This report presents the content and outcome of the 2nd MPA workshop: Understanding MPA Networks as Tools for Resilience in a Changing Arctic

The report can be used as a supplement to the information on the MPA workshop series provided on the PAME website[1]. The website includes a brief introduction to each workshop and provides links to downloadable versions of the slides / presentations given at these workshops.

This report provides additional information to what is presented on the PAME website, including:

- Summaries and key findings from the presentations.
- Key points from discussions following the presentations, and from facilitated discussions and exercises at the workshops.

[1] https://pame.is/index.php/projects/marine-protected-areas

- Key outcomes from the workshops pertaining specifically to the development of the PAME-led **Arctic MPA Toolbox project**, which explores new approaches to protecting marine ecosystems and their components in an arctic context.

Workshop Introduction and Setting the Stage

The purpose of the workshop was: *"To support a PAME project studying best practices for linking area-based conservation measures to categories of Arctic marine biodiversity in support of the long-term conservation of the Arctic marine environment and associated services and cultural values."*

The workshop objectives were:

1. Develop our understanding of ecological resilience, and of how MPA networks can help support such resilience.
2. Develop principles to guide management of MPAs and MPA networks to enhance ecological resilience in a changing environment.
3. Develop our understanding of key elements needed to design MPA networks that support ecological resilience in a changing environment.
4. Identify priorities for future scientific and/or other collaboration to apply knowledge and guidance to MPA network design.
5. Identify potential next steps to advance the understanding of how MPA network design and management can support ecological resilience to a changing environment.

In addition to presentations on a range of topics of relevance to the workshop objectives, and ensuing discussions and Q&A sessions, the workshop included:

i) a continuation of discussions from the first workshop (held in September 2016) on the role and function of particular species that highlight the importance of ecological connectivity in the Arctic marine environment,

ii) discussions on how ecological connectivity can vary and be affected by anticipated climate change,

iii) Discussions on how MPA networks can help build ecosystem resilience to climate change;

iv) presentations and discussions on the role and importance of various design elements when developing MPA networks in the Arctic under a changing climate; and

v) the development of additional guidance that will be used to expand and refine the "MPA Toolkit" which can be used my PAME members when planning or designing new protected areas in the Arctic.

Participants are listed in Annex I.

Workshop website and presentations

The presentations given at the 2nd workshop can be downloaded from the workshop website, which is hosted by PAME: here

Introduction

Facilitator: Elizabeth McLanahan, Director, Office of International Affairs, NOAA (USA)

- Welcome to the workshop, to Copenhagen, and to the venue
- Overview of workshop goals, context and review of the five-year history of the PAME Marine Protected Areas project here.
- Participant introductions.

Theme 1: Understanding the consequences of a changing environment for Arctic marine biodiversity and the importance of maintaining ecological resilience

Facilitator: Lauren Wenzel, Director, National Marine Protected Areas Center, NOAA (USA)

- Presentations and overviews of the scope and scale of environmental changes in Arctic waters.
- Discussion on ecological resilience (What it is, and value of maintaining it)
- A starting point? Holling's (1973) original definition of resilience: 'the magnitude of the disturbance that a system can absorb without fundamentally changing.'

1) Understanding the Concept of Resilience

- **Martin Sommerkorn,** WWF Global Arctic Program
- Download

Presentation summary, extract and key points:

The concept of resilience in an ecological or ecosystem context has developed over time. Resilience was earlier generally understood as a system's ability to not change, or to maintain in its present state. Now it is more understood as the ability of a system to maintain certain core or desirable structures and functions, despite being exposed to factors that change some elements of the system.

A definition of resilience that captures this thinking (Walker et al. 2006, incl. later modifications):

> *"The capacity of a system to experience shocks while responding or reorganizing in ways that maintain essentially the same function, structure, feedbacks, and therefore identity."*

Key to working with the concept of resilience is the ability to answer the questions: "Resilience OF what TO what?"

- Where the 'of what' can be for example individual species, communities or assemblages, whole ecosystems, or specific ecosystem functions.
- And the 'to what' can be various disturbances, pressures or shocks such as harvesting, climate change, pollution, etc.
- So, the organizational level of the system being studied or managed is key to understanding and communicating resilience issues.

So, for example, relevant structures and functions of a resilience focus at the ecosystem level could be biodiversity, ecosystem processes, functions, and services ("of what"), and disturbances ("to what") could be climate, fragmentation and air pollution. A resilience focus at the species level may focus on structures and functions such as populations, genetic diversity, and connectivity ("of what") and disturbances may be food availability, harvest, predation and disease ("to what").

With the evolving more "socio-ecological" approach to resilience, which focuses on maintaining certain values, such as ecosystem services and linked ecosystem structure and functions, the human and local community role in ensuring and strengthening the resilience of the ecosystem of which they are a key part becomes essential. With such a focus on ecosystem services, it can be useful to have a more social-ecological definition of resilience, for example (Adger et al. 2005):

> *"The capacity of social-ecological systems to absorb recurrent disturbances (...) so as to retain essential structures, processes and feedbacks."*

Taking a resilience view focuses on the capacity of the system i) to absorb disturbances, ii) for self-organization, and iii) for learning and adaptation.

If the goal is to preserve or secure such 'core' or 'desirable' ecosystem functions or services, in a rapidly and dramatically changing world, how do ecosystem managers approach and support resilience? Some answers:

- "It's not about managing the resource, it's about managing our interaction with the resource…"
- Plan for a world of change.
- Take a systems approach, realizing that the systems are complex, and that they have inherent adaptive capacity.
- Realize that change is the norm, and rather than setting a specific state as a goal, we must approach sustained development as the main goal.
- Focus on feedbacks, i.e. the consequences and effects of changes of certain elements on the remaining parts of the system.
- Focus on thresholds, 'tipping points' beyond which further change will have dramatic effects on the entire system, generally bringing it to a new and different state altogether.

As such, key ecosystem services, (such as fish resources, spawning grounds, tourist attractions, climate regulation), can become more resilient through active governance that targets specific properties and attributes of the social-ecological systems that generate such services.

2) *Overview of Impacts of a Changing Environment on Biodiversity, with emphasis on the Arctic Ocean*

- Paul Wassman, University of Tromsø, Norway

- Download

Presentation summary, extract and key points:

A condition for discussing 'ecosystem resilience' in terms of the Arctic Ocean is a clarification of the terminology to be used:

- Is resilience used in the context of physical, ecological or socio-economic relations?
- Do we know what the ecosystem component's buffer capacity is in terms of how and when it will respond to various forms of impact? If so, what are the upper and lower limits of the buffer? And how many and frequent perturbations will it take to breach the buffer?

Key characteristics of the Arctic Ocean related to climate change impacts, biodiversity, and ecosystem resilience:

- The Arctic Ocean is a young ocean. It has low biodiversity and few endemics. It is also, because of its geophysical characteristics and open access to adjacent oceans, prone to some of the most large-scale and frequent disturbances and greatest climatic and ecological variability (5 ice ages over a million years).
- It is difficult to define and determine how to use 'resilience' in such a variable system, especially as it is experiencing ever-accelerating change. For example, within what time frame does one determine resilience? Decades, centuries, millennia?
- The Arctic Ocean is relatively poorly studied. It is difficult to define and use 'resilience' when we know so little about its natural steady state or its natural variability. (Indigenous knowledge is thus highly relevant and useful).
- Due to the rate and scale of the changes coming, driven by global climate change, all ecological knowledge from the region (science-based and indigenous) will soon be outdated.
- The Arctic Ocean is haunted by four "apocalyptic riders": Warming, Sea Ice Change, changes in light penetration, water freshening (less salt).
    - Surface warming leads to sea-ice melting, which changes light penetration to productive phytoplankton and algae. This will likely result in more low pressure weather patterns, more stratification of sea-water, and less biological productivity.
- We know that the "riders" will fundamentally change the function, ecology and dynamics of the seasonal ice zone, but we have no idea how.
- Warming of the ocean will primarily be seen in the surface layer (down to 200 m depth), and have impacts along the ocean shelves and shelf breaks, particular in productive regions.
- The deeper Central Arctic Ocean will not be as significantly affected.

- The warming will mainly be seen in autumn
- There are good chances for many lower trophic organisms to find niches and to survive in the new temperature regimes
- Biological productivity is linked to the seasonal ice zone, and to the Arctic Ocean rim. Along the rim, climate change modeling and projections show major differences in productivity changes in different geographic areas:
    - Some areas will become 'hot', and could see a doubling to tripling of present day production.
    - Some areas will become warmer, and could see a doubling of current production.
    - Some areas will get cooler, in which case productivity will stay low or decrease.
- Global warming will thus lead to increased productivity in some places in the Arctic Ocean, and decreases in other places.
- Arctic-wide, the warming is not expected to substantially boost or sustain new fisheries industries.
- Protected areas with permanent, 'fixed' boundaries will "host" very different communities in the future.
- Deep-water formation, which presently takes place in the Greenland Sea, and which is a key driver of the so-called 'great conveyor belt' ocean current that distributes energy and nutrients globally, will likely shift east to the Nansen Basin. This will have huge global biodiversity, geochemical and energy implications, though the exact outcomes are unknown.

Some core Arctic ecosystem features are under pressure from climate change that is pushing their resilience towards tipping points, beyond which we have no idea what will happen to the features, nor how the changes will impact other bio-geochemical processes, biodiversity, productivity, or human communities. These Arctic "tipping elements" or features include:

1) Summer sea ice on the Arctic ocean;
2) The Greenland ice sheet;
3) Boreal forest;
4) Siberian permafrost

For 1) we are already locked into a development that will take it beyond a tipping point, regardless of short-term emission reductions. For the others we are rapidly moving towards critical tipping points.

Key Points from Q & A and discussion

From Martin's presentation:

- Workshop participants accepted the proposed definitions of resilience in the context of the workshop objectives.
- A need for clean graphics to explain resilience to broader audiences
- Resilience is scalable – doesn't have to be for entire ecosystem

- Ecosystems need some disturbance to remain resilient but there are tipping points.
- Spatial connectivity can enhance resilience of populations & ecosystems

General discussion:

- MPA networks are an important concept, but given the rate and scale of changes Arctic marine ecosystems are expected to be going through, how significant are the terms ‘resilience’, ‘stability’ and ‘indigenous knowledge’ for their establishment?
- The functional biodiversity of an ecosystem currently undergoes significant change on a decadal scale. It is thus a major challenge to know where to place MPAs to protect specific biodiversity elements.
- Our current knowledge of ecosystems reflects the time interval and the ecosystem state from which the knowledge is derived. How useful is thus our current knowledge when trying to address management responses to the projected ecosystem changes, given their scales, rapidity and uncertain outcome?
- How relevant is this knowledge after a tipping point is passed and a new and unknown phase of ecosystem function is in place?
- Dedicated, coordinated and system-ecological investigations of all sectors throughout the seasonal ice zone are mandatory to comprehend and manage the Arctic Ocean.

Theme 2: MPAs, MPA networks, and marine ecosystem resilience

Facilitator: Lauren Wenzel (USA).

- Participants explored how area-based conservation measures (MPAs and other measures that contribute to MPA networks) and MPA networks can enhance the resilience of Arctic marine ecosystems.

1) MPAs and MPA Networks as Tools for Resilience

- Dan Laffoley, IUCN Senior Advisor, Marine Science & Conservation, Global Marine and Polar Programme at IUCN and Vice Chair, Marine for IUCN’s World Commission on Protected Areas

- Download

Presentation summary, extract and key points:

The conceptual thinking around developing MPAs as tools for strengthening ecosystem resilience has been evolving for decades. Much of this knowledge is captured in scientific literature and government reports. These can and should be used in refining the thinking around developing MPAs for resilience in the Arctic context.

The science and policies linked to MPA networks is driven by a growing interest in ecosystem services, connectivity, the rate and scale of change of overriding drivers, and an emerging understanding of the levels of required ambition to address these drivers.

> “Protecting biodiversity and the essential ecosystem services it supports has become a priority for the scientific community, resource managers, and national and international policy agreements...” (Selig et al, 2014)

The benefits of well-functioning MPAs include:

- Greater biomass…
- Greater density of living organisms…
- Larger sizes of individual plants and animals…
- Higher biodiversity…

  … on average, than in nearby non-protected areas.

However, functioning ecosystems with representative biodiversity cannot be secured by a single MPA or efforts of an individual country. Conservation at larger scale is required in the face of multiple stressors on the ocean, e.g. climate change (including ocean warming, ocean acidification and ocean deoxygenation) on top of 'traditional' stressors such as over-fishing and chemical and plastic pollution.

The benefits of effective MPA networks include:

- Greater efficiency and effectiveness of reducing risk and in enhancing ecosystem resilience.
- Less duplication of efforts and resources compared with establishing individual, isolated MPAs.
- Ensuring protection of ecosystems or species that cannot otherwise be adequately protected, such as migratory species.
    - Thinking on more of a life cycle scale
- Sharing effective conservation approaches across similar sites in different regions.
- Developing transboundary MPAs and collaboration between countries to address common challenges and issues.

"Climate trajectories" must be taken into account when designing MPA networks. However, this is very complex, since:

- About 93% of global warming heat since 1970 has been absorbed by the oceans, so the warming effect is inherent and long-term.
- One can expect sudden onsets of major regional or global impacts due to the heat already captured in the oceans, yet a very long time before the impacts of any mitigation efforts or other solutions are noticed (=slow cure).

2) Ecological Connectivity and Resilience; Implications for Marine Protected Areas

- Mark H. Carr, Professor

Dept. of Ecology and Evolutionary Biology, University of California, Santa Cruz, USA

- Download

Presentation summary, extract and key points:

Ecological spatial connectivity: Processes by which genes, organisms, populations, species, nutrients and/or energy move among spatially distinct habitats, populations, communities or ecosystems.

There are four important forms of connectivity for marine ecosystems:

1) *Population (demographic)*

- The movement of individuals between populations.

2) *Genetic*
    - The movement of genes among populations.
3) *Community*
    - The movement of multiple species between communities.
4) *Ecosystem*
    - The movement of nutrients, materials and organisms between ecosystems.

Connected MPAs (networks) support population and ecosystem resilience, through:

1) *Population buffers*
    - MPAs usually have larger and more productive individuals, and are more resilient.
2) *Trophic interactions*
    - E.g. Predators controlling prey outbreaks, or predators controlling community composition.
3) *Maintaining biodiversity*
    - Higher ecosystem diversity generally enhances for example fisheries production.
4) *Ecosystem subsidies*
    - The movement of nutrients, materials and organisms between ecosystems

Consequences of the above for MPA planning:

- The size and spacing of MPAs influences the diversity of species. MPAs should thus be sized to be **self-replenishing,** and to replenish populations outside the MPA.
- Protecting "keystone" predators should be encouraged as this generally enhances resilience, for example of kelp forest communities.
- Multiple smaller MPAs contribute to greater area or replenishment of keystone species with longer larval dispersal.
- Multiple ecosystems components should be encompassed within larger individual MPAs.

<u>Conclusion:</u>

- MPAs and networks of MPAs designed to protect and facilitate spatial ecological connectivity can enhance the resilience of populations and ecosystems.

3) Resilience through an MPA Network: Hawaii Case Study

- Todd Stevenson, Circumpolar Conservation Union, USA
- Download

Presentation summary, extract and key points:

Herbivore fish populations and corals were declining because of over-harvesting by scuba-fishers for the international (home / hobby) aquarium market. Algae that kill corals increase when not grazed by fish. Conflict between fishers and recreational scuba divers emerged when reef fish began declining from overharvest.

This conflict led to Act 306: 'West Hawai'i Regional Fisheries Management Area', which has three important features:

1) > 30% of coast was designated as a MPA (Fish Replenishment Areas- FRA).
2) Local communities and Fisheries Councils were actively involved.
3) The effectiveness of the protection was thoroughly evaluated.

The BACI (Before After Controlled Impact) methodology was used for MPA monitoring. The focus was on the fish Yellow Tang (herbivore = 90 % of aquarium fish take). Multiple, long-term studies were done on recruitment, larval dispersion, self-replenishment vs long-range spread – and effect of the FRA network.

Conclusions:

- MPA networks are effective, and significantly increased herbivorous fish abundance, production & density, which improved coral reef ecosystem health and resilience.
- In terms of ecosystem resilience and health, the whole network is (quite likely) greater than the sum of its parts.
- It is important to have detailed, documented life history information on the target species of your monitoring studies. (Don't assume!)
- A robust monitoring framework and long-term monitoring is vital for adaptive management.

4) The PAME MPA Network Toolbox Project through a Resilience lens

- Martin Sommerkorn, WWF Arctic Program
- Download

Presentation summary, extract and key points:

The "PAME Framework for a Pan-Arctic Network of MPAs", has as a goal to develop:

> *"An ecologically connected, representative and effectively-managed network of protected and specially managed areas that protects and promotes the resilience of the biological diversity, ecological processes and cultural heritage of the Arctic marine environment, and the social and economic benefits they provide to present and future generations."*

The MPA network goal is basically conceived through a lens of social-ecological resilience; aspects such as the insurance value of natural capital, nature for and with people, and a systematic approach at biome scale allow understanding social-ecological resilience as objective, and the MPA network as a tool for its implementation. Interpreted in this way, PAME's MPA toolbox project can be understood as a project to support social-ecological resilience. Providing knowledge, theory and tools and fostering collaboration and participation are toolbox elements in support of such an agenda.

Relevant to resilience, the measures presented in the Toolbox are designed to support or sustain critical system components:

- key ecological *structures or features* (e.g. species, habitats, ecologically and biologically significant areas, geophysical features, landscapes),
- ecological *processes and services*
- cultural values
- Places where important *interactions* take place, protecting system *feedbacks*

By protecting the spaces where critical interactions take place through networked MPAs, conservation objectives linked to important components of Arctic biodiversity and linked ecosystem services and cultural values can be pursued.

With respect to supporting the capacity of Arctic marine ecosystems to adapt to changes, protective measures should focus on providing space to function and adapt, while reducing other pressures. Ecosystem properties such as modularity (the network organization of species interactions), functional redundancy (where different species contribute in equivalent ways to an ecosystem function), and response diversity (where species contributing to the same ecosystem function can respond to environmental change in diverse ways) are candidates for protection through networked MPAs, in support of providing space for species, habitats and ecosystems to function and adapt, while reducing other pressures.

While MPAs form the backbone of MPA networks, thoughtful inclusion of "other measures" can help strengthen ecosystem resilience in several ways

- Dynamic protection measures (not tied to a permanently fixed geographic space) as ecological features become more dynamic (e.g .the sea ice marginal zone), species move, geographic ranges change, where different locations may shift in importance or condition through time.
- Banning or limiting specific threats or pressures during a critical period of time for biodiversity (e.g. in a species' life cycle, for a particular habitat, for an emerging or seasonal pressure, or to protect critical ecological linkages, such as for migratory species, or mobile life-stages that provide conditions for foodwebs and processes).
- Safeguarding biodiversity, places, or ecosystem services in a precautionary approach, such as providing for range shifts or safeguarding "new" habitat from additional pressures, to bolster adaptive capacity
    - Where conservation is an outcome rather than the primary objective of management efforts
    - Linked to livelihood and culture maintenance, strengthening ecosystem functions & valued services, food security and/or cultural and spiritual aspects

This category also considers measures where conservation is an outcome, rather than the primary objective of management efforts, e.g. indigenous and local community efforts to support services essential to sustainable livelihoods, food security, human wellbeing, and/or other cultural and spiritual aspects.

Key Points from Q & A and discussion

- Q: How should one design an MPA to achieve ones goals?
- A: Many shapes, sizes, and approaches depending on what you want to achieve. (Laffoley)
- Q: Do we want to become ecosystem engineers, as we acknowledge that we can't stop the major changes, but can tweak certain elements? Are we capable? (Sweden)
- A1: We need to reset our acceptance levels for what we want and are striving to achieve. We must reconsider what constitutes success. (Laffoley).
- A2: We need to also develop MPAs to save the current biodiversity as found there today, not only plan for future impacts from climate change or habitat destruction. Everything is not fine today, so there is plenty to do also in terms of short-term, urgent conservation. (Irina Onufrenya, Russia)

Other discussion points

- MPAs can be an insurance policy. (Laffoley)
- Considerations to keep in mind when planning to integrate climate change and strengthening of resilience in MPA network design:
    - Size – the bigger the better.
    - Shape – keep it simple.
    - Protection – higher levels deliver greater resilience.
    - Spread the risk – representation, replication, spread.
    - Protect critical areas – not just biologically or ecologically important, but climate-resilient locations.
    - Ensure connectivity – mutual replenishment, whole ecological units, systems, 'future space'.
    - Secure ecosystem functions – functional groups, ecosystem services.
    - Integration – embed in broader management, land/sea interactions, and utilize local knowledge and sustainable use practices.
- Considerations to keep in mind when planning to secure connectivity in MPA network design:
    - Identify connections for species with planktonic life history phases, ensuring protected areas are spaced taking into account biological and oceanographic characteristics of larval dispersal (fish, invertebrates).

- Identify Connections for Active Swimmers and Flyers, e.g. through a combination of direct observations of migration and genetic information on population structure.

- The PAME MPA Network Toolbox should incorporate measures that use MPAs not only for conservation, but also to enhance fisheries production. Many productive fish populations and nursery habitats need protection and/or improved management. (Mark Carr)
- We need simple ways to illustrate and explain resilience to broader audience, for example cartoons.
- Alternative methods and approaches to monitoring MPA efficiency need to be urgently developed and used in the Arctic. Due to the rate and scale of changes and impacts, we don't have time to wait for securing full funding, development and implementation of large, long-term research programs to monitor Arctic MPAs. (Sweden)
- The toolbox should include a larger scope for more inclusivity of other options beyond MPAs to build resilience in the Arctic, capturing the diversity of the current knowledge base, to ensure sound monitoring and management. (ICC)
- Not all monitoring and management of MPAs / marine ecosystems in the Arctic can or should incorporate indigenous knowledge and involvement, since large parts of the Arctic don't have indigenous marine peoples resident who can do that work. (P Wassman)

Theme 3: Managing MPAs and MPA networks to support marine ecosystem resilience

Facilitator: Lisa Speer (NRDC)

- Discussion how MPAs and MPA networks can be managed to support the resilience of marine ecosystems.
- Examples from theory and practice (e.g. participant contributions from different Arctic States) formed the basis of a facilitated discussion of what managing for resilience may mean for managing MPAs and MPA networks in the Arctic.
- The aim was to begin to formulate principles to inform management of MPA and MPA networks in the Arctic in support of ecological resilience to a changing environment.

1) Valuable and Vulnerable Areas: The Case of the Barents Sea

- Cecilie von Quillfeldt, Norwegian Polar Institute, Norway

- Download

Presented the management plan for the Barents Sea – Lofoten area

- Background, approach and use of management plans in Norwegian spatial planning and management of marine resources
- Consequences for human activities in the area (petroleum, fisheries, transportation)
- The Barents Sea ocean environment

- Valuable and vulnerable areas - The identification process, and selected examples.
- Distinguishing between different types of threats and pressures, and how an area's vulnerability can change throughout the course of the year
- Challenges; Current and projected impacts.

The purpose of the Integrated Management Plans is to provide a framework for the sustainable use of natural resources and goods derived from an area and at the same time maintain the structure, functioning and productivity of the ecosystems of the area.

Management plans are dynamic and adaptive: New information and impacts emerging, and are integrated.

Also presented information on 'traditional' MPAs and OSPAR sites in Norwegian waters.

Theme 4: Working Towards Resilient Marine Protected Area Networks in the Arctic (Case studies)

1. Case studies from the U.S. Arctic

- Lauren Wenzel, National Marine Protected Areas Center, NOAA (USA)

- Download

Managing existing US Arctic MPAs for resilience and connectivity

- "Working towards" resilience is correct term, and important: not there yet.
- Also in progress with regards to networks securing functional connectivity: work in progress.

Designating "other measures", which include:

- US Arctic Fishery Management Plan (Addresses commercial, not subsistence fisheries)
- Oil and Gas Exclusion Areas (Most US Arctic waters as of Dec 2016).
- Northern Bering Sea Climate Resilience Area, (withdrawn from oil & gas leasing and bottom trawling; includes federal task force and tribal council)

Identifying important blue carbon habitats

- Salt marshes
- Sea grasses

Beginning the dialogue on resilience

- MPA Federal Advisory Committee (Inclusive process) (http://marineprotectedareas.noaa.gov/fac/products/)
- Coastal Resilience Workshops (Focused on community resilience and links to ecological resilience)

2. Case study from the Canadian Arctic

- Nadine Templeman, Canada

- Download

Anguniaqvia Niqiqyuam as an example of establishing Building Blocks for MPA Network Design at the Bioregional Scale

- Resiliency in Canada's MPA Networks
- New MPA establishment (Canadian Arctic)
- Canada's Marine Conservation Targets

The National Framework for Canada's Network of MPAs (2011) mentions resilience in its vision, but does not provide guidance or address how resilience should be dealt with.

The Framework bases its MPA development on these design properties:

- EBSAs
- Representativeness
- Connectivity
- Replication
- Adequacy / Viability

The Anguniaqvia niqiqyuam (2,361 km2; November 2016) is Canada's second Arctic MPA designated under the *Oceans Act*. It is the first Oceans Act MPA to have a conservation objective based solely on Indigenous traditional and local knowledge. The size and function of the A.N. MPA secures a degree of resilience, e.g. by protecting 28% of the world's belugas.

> Regulations for the area: prohibits "any activity that disturbs, damages, destroys in the ANMPA or removes from the ANMPA any living organism or any part of its habitat"

Canada's Marine Conservation Targets (from 2015 Minister's Mandate Letter) :

- Strive to increase the proportion of Canada's marine and coastal areas that are protected to 5% percent by 2017 and to 10% by 2020.
- Work with the provinces, territories, Indigenous Peoples, and other stakeholders to better co-manage our three oceans.
- Use scientific evidence and the precautionary principle, and take into account climate change, when making decisions affecting fish stocks and ecosystem management.

Even with the newly created Anguniaqvia niqiqyuam MPA only about 1% of Canadian waters have been protected to date. However, plans are in place to reach the 5% target. Includes more MPAs, NMCA (National Marine Conservation Areas), and Other Effective Area-Based Conservation Measures (OEABCMS).

1) *Designing a Network of MPAs in the Russian Arctic to Support Marine Ecosystem Resilience*

- Irina Onufrenya, WWF-Russia
- Download

Russia has implemented an ambitious program to map priority marine conservation areas, including in the Arctic, and prepare and implement plans for protecting the key, representative features.

Creating a viable network of MPAs now is important, and a government priority. Pressures are urgent. First priority is urgently reducing biodiversity loss.

MPA design in Russia is based on representation, connectivity, sufficiency – not only individual area management.

After the MPA network process is well under way, then Russia will focus on and incorporate issues such as resilience, management regimes, monitoring, and improvement for adaptation to climate change.

When incorporating resilience in MPA planning one must first clarify "resilience of what to what?". I.e. identify priorities. Then management solutions can be developed

Resilient MPAs should be developed taking into consideration nature use (local people), and known larger human impacts: oil & gas, shipping, fisheries; tourism; military… Need also to incorporate resilience to changes in governance / government policies: conservation feature should be protected in more than one way and area.

2) Resilience and Connectivity Values of MPAs: Planning for Top Trophic Marine Animal Conservation in the Barents Region and Beyond

- Kit Kovacs. Norwegian Polar Institute, Norway

- Download

- Presented the key biological and geophysical features found in the Barents Sea, mainly in terms of marine mammals.
- Presented unique features of Barents Sea marine mammals, such as different behaviors than in other arctic areas, which must be taken into consideration when planning MPAs or other management strategies.
- Barents Sea and Svalbard are under more pressure from climate change, as well as other impacts (oil & gas; fishing; shipping; tourism) than most other arctic seas.
- This must also be take into consideration when planning MPAs for resilience and connectivity.

Key Points from Q & A and discussion

- Q: How are conflicts of interest managed in the Norwegian Marine Area Management Plans? A: Cross-sectoral working groups try to resolve issues based on science & available knowledge, avoiding politics. Provide recommendations. If not resolved, must be clear on why, and what is needed to resolve. (C. von Quillfeldt)
- Q: Does the A.N. MPA in Arctic Canada protect beluga habitat for belugas, or for beluga hunters? (Mark)
- A: Its protected as a (sustainable) hunting area, as defined by the local Indigenous People. (Jimmy).
- Q: So is it then an MPA – if hunting is OK? What then about fisheries management areas – also MPAs? (Mark)

- A: When answering what is being achieved in terms of an MPA plan or strategy, it is important to "know your AICHI targets": 11 = biodiversity. 6 = fishery measures. (Laffoley)

Theme 5: Designing MPA Networks in a Changing Arctic

Facilitator: Lauren Wenzel (USA)

- Discussion on key design elements of MPA networks that support ecological resilience of marine ecosystems in a changing environment.

- Participants also took stock of and discussed gaps in available data, measures, and tools to integrate these elements in MPA network design.

1) Building Resilient MPA Networks – Summary of work carried out by the Commission for Environmental Cooperation

- Ellen Kenchington, Department of Fisheries and Oceans, Canada

- Download

The North American Marine Protected Areas Network (NAMPAN) is a tri-national, multi-sectoral initiative to establish a system of North American MPA networks that enhances and strengthens the protection of marine biodiversity.

Under this there is a ICES-NAMPAN Study Group on Designing Marine Protected Area Networks in a Changing Climate. SGMPAN has produced several reports with guidance (2011,2012).

Excerpt from guidelines for designing resilient MPA networks in a changing climate:

1) Protect species and habitats with crucial ecosystem roles, or those of special conservation (and/or cultural) concern.
2) Protect potential carbon sinks
3) Protect ecological linkages and connectivity pathways for a wider range of species.
4) Protect the full range of biodiversity present in the target biogeographic area.

CEC have assessed:

- what properties of populations, habitats and ecosystems increase the resilience of marine systems to impacts of climate change in the region of the NW-Atlantic to the Caribbean.
- characteristics and management challenges linked to biological connectivity (both horizontal and vertical in the water column) in Arctic marine environments in a changing climate.
- phenological characteristics, phylogenetic diversity, migratory species, and other characteristics that are important to keep in mind when planning MPAs for climate change.

This information is used in providing guidance on creating MPA networks, and on assessing the effects of resilience in MPAs.

2) Ecosystem Resilience – What is it – and how can we measure it?

- Benjamin Planque, Norwegian Institute of Marine Research, Norway (on skype)

- Download

Resilience: the ability of a system to absorb disturbance and maintain structure and function

Resilience: resistance, flexibility, reorganization.

To understand and manage resilience it is essential to assess:

- resilience of what to what?

Resilience at ecosystem level does not result from or entail resilience at individual, species or community levels.

Presented detailed studies on measuring Barents Sea ecosystem resilience in practice, including both structural and time-series analyses. The Barents Sea is one of the best studied seas, with plenty of data over many years. Still there is insufficient data to assess climate change impacts and to incorporate these into resilience-strengthening models.

Summary and conclusions:

- Resilience: resistance, flexibility, reorganisation
- Ecosystem resilience is not the sum of the resilience of its parts
- It is possible to measure some key aspects of resilience at the ecosystem level
- Structural aspects of resilience are easier to address than temporal ones
- There is a need for 'reference' of ecosystem states and dynamics to be able to assess change.

3) Modeling Tools for Designing for Resilience – Connectivity Under Changed Conditions.

- Pat Halpin, Marine Geospatial Ecology Lab, Duke University, USA

- Download

The Arctic Context

We tend to view Arctic marine ecosystems in terms of vertical connections across seasonal ice conditions, but there is significant horizontal connectivity in the Arctic that controls the distribution of species, habitats and exchanges of resources.

Movement and connectivity in the Arctic is highly dynamic at multiple spatial and temporal scales.

All of the physical factors effecting marine connectivity are changing:

- Ocean currents (surface & sub-surface)
- Water mass properties (temperature, salinity, freshwater circulation...)
- Surface wind
- Sea ice
- Seasonality / phenology

Presentation of the Connectivity Modeling Framework used in their analyses

Many spatially referenced connectivity scenarios modeled in the Arctic Ocean for a range of ecosystem components (e.g. fish spawning, surface currents, ice thickness, foraging areas, feeding grounds) and human impacts / management (oil & gas development, fishing, governance, EPSAs)

Conclusions:

- Patterns of physical connectivity in the Arctic are not uniform and are rapidly changing;
- Assessments of connectivity need to be tied to specific cases (species, processes or functions);
- Connectivity needs to be assessed in space and time across multiple scales;
- Connectivity cannot be assessed in isolation from human uses in space and time.

Key Points from Q & A and discussion

- Q: Do you have enough data from the Barents Sea for the Norwegian Institute of Marine Research to run temporal models? (Mark Carr)
- A: No, not really – even in the Barents Sea, with such a vast amount of data collected. (Planque)
- Q: How do you incorporate life history data into your functional diversity models. (Kit Kovacs)
- A: We interpret all data we have and come up with an index as input into the model (Planque)
- Q: Are the dots you are connecting in the Duke University models correlated with suitable habitats for actual recolonization / recruitment i.e. actual connectivity, and is such data available? (Mark Carr)
- A: Important to do. Models are still in early stages, and intentionally "naïve". Data is course. More detailed and thus useful data not available. We incorporate more detailed / suitable data as it becomes available. (Halpin)
- Q: Do any countries have such detailed / suitable data available now? (M Sommerkorn)
- Pat Halpin disussed a "sacrificial map" – throwing out a "bad" (incomplete) map to get people to comment "I've got better data" and add to it. Don't wait until you have all the perfect data as you'll be waiting forever
- A: Russia has some, from their detailed mapping of valuable and vulnerable areas (Irina)
- A: Indigenous groups have data, but there are obviously sensitivities in accessing it. Must ask in right way, with respect, and shared understanding of intentions of use. (Jimmie)

- Q: Can coastline data be used as a proxy for near shore topography?

- A: Russians extrapolate shoreline data. Could possibly be used wider. (M Sommerkorn)

- The Arctic ocean is dynamic and changing. Much map data is thus outdated. Beware of using old maps / data in models or management plans. (C von Quillfeldt)
- Note: Map data doesn't always have to be so detailed, specific or complex for it to provide useful ecological information. E.g. larval drift for 2 months covers many relevant species that are relevant in mapping vulnerable / important connectivity nodes. (Mark Carr)
- Less than 1% of EPSAs are protected. Let's not make this too complex or take too much time. WWF is willing to continue supporting this modeling work. (M Sommerkorn).

Theme 6: Developing Principles to guide management of MPAs and MPA networks to enhance ecological resilience in a changing environment.

Facilitator: Lisa Speer, NRDC, USA

- Presented proposed guidelines for Designing MPA Networks to Promote Resilience of Arctic Marine Ecosystems in a Changing Climate, based on the Canadian CEC guidelines (see Presentation 12: Kenshington)
- One additional final guideline added: "*Incorporate MPA networks into integrated ecosystem-based management approach in the target region*".

Key Points from Q & A and discussion

- Q: How do make such guidelines useful in a PAME MPA Network Toolbox context?

- Q: Should we be designing MPAs only to address future impacts of climate change? Or should the first priority be on protecting current biodiversity now? Would that be meaningful given current change scenarios? (Elisabeth McLanahan)

- A: Let's protect diversity hotspots. That will preserve connectivity and distribution. (M Sommerkorn)

- Start out with different steps:

    - For the areas that we know with high biodiversity, we look to protect them
    - Then as we think about climate change, we can apply some of these lenses to help design how you want to move forward for designing future MPAs
- Use of diversity proxies can be of value: Protect habitats that support broad diversity. (Mark Carr)

- Take a twin approach: Protect what you <u>know</u> now. Protect what you <u>need</u> as you proceed. I.e. Protect first, then develop guidelines.) (D Laffoley)

    - Once it's already endangered, it become an uphill battle – genetic variability is lost and there is a difficulty in trying to regenerate (Liz McLanahan)

- Yes, protect what we can now, despite knowing too little to make perfect MPAs. Then use what we know to develop new knowledge, e g in modeling and guidelines. (E. Kenchington, L. Speer)

- Locations of settlements / local communities can be indicative of where biodiversity hotspots can be found. The interactions of the communities with the hotspots are part of the ecosystem and should be incorporated into future protection or management models. (ICC / Carine)

- In addition to protecting what we know now, and what we need as we proceed, we also need to include how one manages MPA networks for the future into contemporary thinking and plans. (M. Sommerkorn)

- Both the US and Norway already incorporate this in their MPA approach to vulnerability assessments and management plans. (Lauren and Cecilie v Quillfeldt)

- Norway practices an alternative mechanism for identifying hotspots: If trawlers identify corals in trawls, then location is GPS identified and subsequently assessed and mapped for no-trawling. Good example of "other measures" for protecting valuable / vulnerable habitats (S. Norris)

- Countries are responsible for protection and management of many, but not all species or elements, eg large whales. PAME (or other international body) should to pick up this responsibility. (Irina)

- Important to remember to link PAME's MPA work to other Arctic Council working groups dealing with related issues. (C. von Quillfeldt)

- Q: How can PAME incorporate ocean acidification into the Arctic MPA network planning & design process? (S. Norris)

- Green List from IUCN – not just about the standards for "Green Listing" an area, but also about the journey to get there in terms of delivering effective management

- A: Sweden will be hosting workshop after PAME meeting in September 2017.

- Further resources that also address management development needs during MPA design and development can be found on IUCN's "Green List" website[2]

Theme 7: Opportunities for future collaboration, priorities, and next steps

Facilitator: Lisa Speer (NRDC)

- Based on the discussion on developing principles, participants aimed to identify collaborations that are needed and priorities to be set for managing and designing

[2] https://www.iucn.org/theme/protected-areas/our-work/iucn-green-list

MPA networks that support resilience of Arctic marine ecosystems in a changing environment.

- Participants discussed key partners, efforts, knowledge, and tools that can help to better understanding of how to design and manage effective MPA networks, including other Arctic Council working groups.
- Participants identified priority actions that will support Arctic countries in developing MPA networks, including ecological, social, cultural, and economic resilience.

Key Points from Q & A and discussion

What to save, when, and why?

- It is important to use the term resilience right. Why save something that isn't threatened today? Why use "scatter gun" and protect large areas and everything within it, without identifying key threats and vulnerabilities and key features, and taking current sustainable use into account? Traditional protection, as discussed here, is only a small part of what is going on, what is needed, and what is important in these areas. Other aspects, such as income generation and livelihoods, (in areas with indigenous people and local communities), must also be considered and given value. (Jimmy/ICC).

- We are moving the emphasis in our conservation discussions from "vulnerability" to including and using "resilience" in analyses and plans. This involves and requires inclusion of the socio-cultural dimension (M Sommerkorn)

- In terms of the priority areas to protect from large-scale damage, the indigenous people know: most of the living resources come up the Bering Strait, then disperse and settle at known places. (Jimmy / ICC).

How? Tools and approaches to building resilience in arctic marine ecosystems:

- If we know what we are looking for, and can plan modeling and identify data gaps, then Pat Halpin / the Marine Geospatial Ecology Lab, Duke University, could likely do connectivity analyses for floaters, flyers, swimmers.

- Important to also link with other Arctic Council working groups. CAFF might for example already have ready info on flyers (migratory birds) and on marine mammals.

- MPAs are only one set of tools needed – among many.

- Important to shift focus from traditional MPAs towards ecosystem based management, reigning in specific negative impacts, not protecting everything. Subsistence hunting and fishing needs to continue and be legal, whether its an MPA or a 'managed' area.

- It is important that countries protecting arctic marine environments use all available data, including cultural, and take necessary considerations. Small-scale local utilization is not the threat, whether traditional or recreational. But if its, for example, large-scale, damaging trawling then its restrictions should be the same whether its indigenous or done by 'outside' interests. (Finland / Jan)

- "Sustainable utilization" can and should be included as part of MPA or 'other measure' conservation goals. (Kit Kovaks / Norway)

- Ecosystem-Based Management and Marine Spatial Planning concepts already include "sustainable use" (Cecilie + Lauren)

- Hotspots for primary productivity should be prioritized for resilient MPA designation. Must remember though that each hotspot (e.g. shelf breaks vs. marginal ice zone) can have a different 'stories' related to how it reacts to climate change. (Cecilie).

- Q: Do good indicators or data on socio-economic parameters exist? On ecosystem services? Indigenous knowledge?

- A: No. There are processes to compile these in PAME and CAFF but not quite there. (Jimmy, Cecilie, Lauren)

- Consensus: The compilation of such data needs to be strengthened and accelerated.

- Other data gaps and needs, (given that we've identified what we're trying to do…) also need to be identified and specified. (Pat)

- Trans-national and cross-boundary discussions on data sharing should be strengthened in the Arctic Council context.

- Q: Can resilience analyses and biodiversity mapping experiences be extended from the Barents Sea for specific elements (e.g. fish) to the larger Arctic? (Ellen)

- A: In theory yes, but since there is less baseline data other places, it might not be useful. Important: We need to know what we're looking for before requesting data to be input into specific analyses, for example on resilience. (Cecilie)

    - The Arctic Council / ICES Working group is compiling data for from the Central Arctic Ocean LME (and adjacent LMEs) as part of an ecosystem assessment. This process is one transnational approach. BBNJ could be a possible opportunity to develop MPAs in high seas, under the Law of the Seas. (Elizabeth).

    - It's important to consider organizational models and management / jurisdictional arrangements as part of planning MPAs. (Jimmy/ ICC)

    - Look to the Baltic Sea for a good multi-national MPA arrangement: Joint agenda – linked to network, but each country has and manages its own MPAs . Includes CBD-AICHI 11 issues. Also addresses need also to protect and manage areas around MPAs. (Jan / Finland)

The way forward and proposed follow-up

- There is a need for data on Arctic MPA networks and stressors / drivers for September 2017 PAME workshop (and Helcom process?).
- Good slides for communication and recommendations should be prepared by this

PAME forum: The World Commission on Protected Areas and IUCN can then use and incorporate / discuss these as new global approaches are discussed. Arctic is ahead of the game! (Dan Laffoley)

- There is a need for good maps: Exisiting MPAs / EEZs / national boundaries. (Martin S informed that ArkGIS has these datasets / maps, and that WWF can share and offer services based on that data.
    - Important to take the data layers that look at attributes from resiliences and review them to make sure to extend coverage, so that the latest & best information is codified and available
- Good indicators and datasets on socio-economic parameters, ecosystem services, and indigenous knowledge are also needed (realizing that there are natural indigenous sensitivities around releasing such data for conservation / MPA purposes.
- Martin: Food diversity and security issues are mapped and studied in Alaska North Slope. Important info. Conservation needs and food security are closely linked (= the same, re Karoline). Jimmy: Not only “security” – it’s the true “soul food”.
- Countries should consider using the Canadian CEC guidance on mapping resilience?

Summary follow up (Lauren Wenzel, USA):

1) Put presentations on PAME website
2) Lisa’s slides finalized and distributed for comment and reference.
3) Workshop report (1 +2) - longer term
4) Updated toolbox report – longer term.

Thanks and Adjourn (Elizabeth McLanahan, USA)

Annex 1: Workshop Participants

Last Name	First Name	Affiliation
Bjarnadottir	Sesselja	Ministry for the Environment and Natural Resources (Iceland)
Boertmann	David	Danish Centre for Environment and Energy, Aarhus University
Carr	Mark	University of California Santa Cruz
Eberhard Trykker	Signe	Government of Greenland, Ministry of Independence, Nature, Environment and Agriculture
Ekebom	Jan	Metsahallitus Parks & Wildlife (Finland)
Halpin	Pat	Duke University
Í Dali	Birita	Government of Greenland, Mineral License and Safety Authority
Isokallio	Kristiina	Ministry of the Environment (Finland)
Kanayurak	Nicole	Inuit Circumpolar Council
Kankaanpää	Paula	Marine Research Centre of Finnish Environment Institute
Kenchington	Ellen	Department of Fisheries and Oceans (Canada)
Klinggaard	Thomas	National Institute of Aquatic Resources (Denmark)
Kovacs	Kit	Norwegian Polar Institute
Laffoley	Dan	International Union for the Conservation of Nature
McGivern	Alexis	Gallifrey Foundation
McLanahan	Elizabeth	U.S. National Oceanic and Atmospheric Administration
Mundy	Phil	U.S. National Oceanic and Atmospheric Administration

Nilsson	Jessica	Swedish Agency for Marine and Water Management
Nilsson	Per	University of Gothenburg
Norris	Stefan	
Onufrenya	Irina	Russia
Sommerkorn	Martin	World Wildlife Fund
Speer	Lisa	Natural Resources Defense Council
Stevenson	Todd	Circumpolar Conservation Union
Stotts	Jimmy	Inuit Circumpolar Council
Strickler	Laura	U.S. National Oceanic and Atmospheric Administration
Templeman	Nadine	Department of Fisheries and Oceans (Canada)
von Quillfeldt	Cecile	Norwegian Polar Institute
Wassman	Paul	University of Tromso
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