Memorandum 2/11/2018

AS7: Arctic Ocean Acidification: Pan-Arctic Processes and Regional Ecosystem Impacts

This memo provides a summary of reports submitted on the session AS7 organized at the Arctic Biodiversity Session in Rovaniemi, Finland, October 9-12 organized by the NOAA, NIVA and the University of Alaska, Fairbanks.

Attendance: 40

Arctic Biodiversity Assessment recommendation themes most prominently addressed in the session:

- Climate change
- Addressing stressors
- Improving knowledge and public awareness
- Ecosystem Based Management

Key points raised in the session that were important to note:

- Ocean acidification (OA) is an important issue in the Arctic. This session launched a new AMAP report, highlighting some OA impacts.
- Arctic species, specialized to limit their energy requirements, have lower capacity to handle environmental stressors.
- Different biological responses in different species (copepods vs. cod vs. kelp/urchins). Need more data points to more fully understand
- Ocean acidification isn't happening on its own - it happens along with temperature change, for example. We need to better understand these "multi-stressor effects.
- It is important to consider multiple environmental stressors as well as the regional controls on pH when evaluating ocean acidification in the Arctic.
- While there is mixed biological responses several species such as copepods, Arctic cod, corals and phytoplankton show responses to OA and have the potential to drive food-chain wide impacts (both positive and negative).
- Model projections suggest that all Arctic regions will experience considerable declines in saturation over the century- particularly those that are associated with land-ocean interfaces- such as the Barents and Kara Seas near the Siberian shelf.
- There are differences in the level and in the changes in ocean acidification (OA) between Arctic sub-regions.
- OA is very likely to change the diversity and usability of different ecosystem services in the Arctic with socio-economic consequences but, it affects some species, processes and ecosystem components and ecosystem linkages a lot, while other species or processes are not necessarily affected at all, or only slightly (primary production, deep-sea cold-water coral Lophelia pertusa, some Copepods).
- Even a small impact can have consequences such as the increased brittleness of cold water corals
- Climate Change is the dominants factor and OA is likely to contribute to its effects

Recommendations/actions identified for how to deal with the issues raised in the session:

- The Arctic Ocean ecosystem is coming under pressure from multiple stressors and we must look at OA together with other stressors.
- All scientific results are not consistent (may even be contradictory) and in some cases the uncertainty of the impact of OA is high and, consequently, this is one reason to study the impact of Arctic OA further.
- Social and economic factors will have a large role in the outcomes of bio-physical changes and actions today can help prepare for what comes next.
- Additional monitoring programs should be established and should track environmental conditions with concomitant changes in food chain, which can be done by working with indigenous communities that can be equipped with tools and knowledge to work collaboratively
- Need studies on Arctic-specific species response to multi-stressors as well as the organism's capacity to adapt to environmental change.
- -Socioeconomic summary suggested that while effects may develop slowly actions now will allow for better positions in coming decades when effects are more pronounced. The most robust strategies are flexibility and adaptability—allowing for alternate options and diversification. The best management practices are those that manage the ecosystem rather than single-species.
- More research into multi-stressors effects (i.e. combination of acidification, with temperature, etc.)

Take home message from the session:

- OA is a big stress on Arctic marine environments, but it isn't the only stress. We need to know more about how OA combines with other stresses to understand their full effects.
- The OA in the Arctic is not an isolated problem, but it is a complex problem that impact on species and processes inconsistently (in a way that show differences between species, processes and regions), and it should be studied and mitigated along with other pressures that affects the Arctic biota and linked with other regions adjacent to the Arctic Ocean.
- Arctic Ocean pH continues to decline at a faster rate than most other regions of the world. Seasonal and regional drivers of ocean acidification result in considerable temporal and spatial variability in how acidification progresses. Biological responses are currently poorly understood with few Arctic-specific studies and a lack of knowledge regarding tipping points and adaptive capacity of organisms. This assessment highlights the need to understand the progression of OA and impacts to organisms, communities and economies through a multi-stressor prospective (e.g. acidification, warming, oxygenation, invasive species, noise, etc), as acidification stress is often secondary and compounding with ocean warming.