

IMBeR REPORTING FORM

Please return completed form to john.claydon@hi.no by 15th May.

Please retain the formatting for headings - this will help to compile the reports together.

Thank you.

Past reports can be found at the following links:

[Reports submitted for Hobart SSC meeting 2018](#) (pdf)

[Reports submitted for Virtual SSC meeting 2018](#) (Google Drive folder)

Programme: Ecosystem Studies of the Subarctic and Arctic Seas (ESSAS)



Authors:

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1. Ongoing activities, in line with the IMBeR Grand and Innovation Challenges

1.a. Grand Challenge I. Understanding and quantifying the state and variability of marine ecosystems

Understanding variability in high-latitude marine ecosystems in response to climate variability and change is a central goal of ESSAS. A major initiative by ESSAS to further this goal was the Resilience and Adaptive Capacity of Arctic marine ecosystems (RACArctic) project, which was supported by the Belmont Forum. The project is nearing its end and a 3rd stakeholder meeting was held in Tromsø, Norway, 19 March 2019 (following two earlier stakeholder meetings in Hakodate, Japan, and Juneau, Alaska. Participants at this meeting included industry representatives and scientists from the Institute of Marine Research, the University of Tromsø, and others. This project aims to synthesize expected effects of climate change on high-latitude marine ecosystems, including their consequences for fisheries and fisheries management.

A number of national programs endorsed by ESSAS monitor marine ecosystems and conduct research in both the Pacific Arctic and Atlantic Arctic, in particular the northern Bering Sea / Chukchi Sea (Japan, USA, Korea), the Barents Sea / Fram Strait (Norway, Russia), the waters around Iceland, and the Northwest Atlantic (Canada, Greenland).

To foster a better understanding of high-latitude changes within the IMBER community, ESSAS is organizing a scientific session on *'Arctic marine ecosystems in a changing climate'* (28 oral presentations and 15 posters) at the IMBER OSC to better understand recent variability and changes in the Arctic. ESSAS is also organizing two workshops at the OSC that focus on variability in Arctic fish communities and impacts of climate change and ocean acidification: (1) The Bioenergetics WG is organizing a workshop on *'Bioenergetics and survival trajectories of Arctic fish in response to environmental stressors'*, and (2) the AnalogueART WG (Natural Analogues of an Arctic in Rapid Transition) is organizing a workshop on *'Using natural analogues to investigate the effects of climate change and ocean acidification on northern ecosystems'*.

1.b. Grand Challenge II. Improving scenarios, predictions and projections of future ocean-human systems at multiple scales

As part of the RACArctic project (see 1a), we have focused on developing plausible scenarios for anticipated changes in high-latitude marine ecosystems, and in particular its consequences for fish populations and fisheries, based on a review of available literature, including qualitative predictions and available projections. Three manuscripts are in preparation, as well as an informational sheet for stakeholders.

ESSAS focuses on comparative analyses among Arctic marine ecosystems and works to initiate and facilitate such comparisons by bringing together scientists from around the circumpolar North at workshops and scientific sessions such as at the IMBER OSC.

1.c. Grand Challenge III. Improving and achieving sustainable ocean governance

One of three RACArctic synthesis papers will assess the ability of current management structures in the Pacific and Atlantic Arctic to address challenges associated with the effects of climate change on marine systems.

1.d. Innovation Challenge 1. To enhance understanding of the role of metabolic diversity and evolution in marine biogeochemical cycling and ocean ecosystem processes

N/A

1.e. Innovation Challenge 2. To contribute to the development of a global ecosystem observational and modelling network that provides essential ocean variables (EOVs) and to improve marine data and information management

Many of the ESSAS-endorsed national projects provide observations of EOVs in high-latitude marine ecosystems. For example, the Arctic Marine Biological Observation Network (AMBON), an ESSAS endorsed project, is developing a long-term observing program in the Chukchi Sea to monitor EOVs and biodiversity at all trophic levels, from microbes to whales. Several Japanese programs routinely contribute to sampling standard transect lines in the northern Bering Sea and Chukchi Sea that together form the 'Distributed Biological Observatory'.

Former ESSAS co-chair and SSC member S.-I. Saitoh and current co-chair F. Mueter were involved in the development of an 'Integrated Ecosystem Assessments (IEA)' for the Central Arctic Ocean. F. Mueter is working with the PAME Ecosystem Approach to Management group to develop an IEA for the Chukchi Sea. Co-chair B. Planque is involved in IEAs for the Norwegian and Barents seas.

ESSAS organized a workshop in 2018 on Integrated Ecosystem Assessments for the Subarctic and Arctic that helped inform the development of plans for a new Chukchi Sea IEA.

1.f. Innovation Challenge 3. To advance understanding of ecological feedbacks in the Earth System

N/A

1.g. Innovation Challenge 4. To advance and improve the use of social science data for ocean management, decision making and policy development

Alan Haynie (NOAA, USA), chair of the working group on Human Dimensions, is active at the national and international levels to develop better approaches to using economic data for supporting decision making in fishery management.

2. Selected highlights

2.a. Selected scientific highlights last year (1-3)

One of the major scientific stories in marine systems of both the Pacific Arctic and the Atlantic Arctic has been the increasing ‘Borealization’ of the Arctic, as evident in the northward expansion of boreal species from zooplankton to fish and mammals. This has been well documented in the Barents Sea, and has more recently unfolded in the northern Bering Sea and Bering Strait region. An unexpected and, based on the historical record, unprecedented lack of sea ice in recent winters has, among other changes, led to the disappearance of the cold pool of water on the Bering Sea shelf, which typically formed during winter and remained on parts of the shelf throughout summer. The cold pool was completely absent in 2018, and this absence was associated with a northward shift in the distribution of some of the large commercially important stocks such as walleye pollock and Pacific cod. For example, over half of the biomass of Pacific cod occurred in the northern Bering Sea in the summer of 2018. These changes have had profound effects on local communities who rely on subsistence hunting and fishing and are struggling to adapt.

There has also been increased inflow through Bering Strait over time and the water flowing into the Chukchi Sea is becoming warmer. Hence the open-water season in the Chukchi Sea has become substantially longer and warmer Pacific waters have brought with them a number of more southern species. The fate of these “expatriates” in the Chukchi Sea is currently unknown.

2.b. Publications last year

(Partial list – to be updated)

Drinkwater, K., Mueter, F., Saitoh, S.-I. (2018) Shifting boundaries of water, ice, flora, fauna, people and institutions in the Arctic and Subarctic. *ICES Journal of Marine Science*. doi: 10.1093/icesjms/fsy179

Holsman, K., Ito, S.-I., Hollowed, A, Bograd, S., Hazen, E., King, J., Mueter, F., Perry, I. (2018). Chapter 6: The North Pacific & Pacific Arctic. *In: Barange, M., Bahri, T., Beveridge, M.C.M., Cochrane, K.L., Funge-Smith, S., and Poulain, F. (eds.) Impacts of climate change on fisheries and aquaculture: synthesis of current knowledge, adaptation and mitigation options. FAO Fisheries and Aquaculture Technical Paper No. 627, Rome.*

Iken, K., Mueter, F.J., Grebmeier, J.M., Cooper, L.W., Danielson, S, Bluhm, B. (In Press) Does one size fit all? Observational Design for Epibenthos and Fish Monitoring in the Chukchi Sea. *Deep-Sea Research II*. doi: [10.1016/j.dsr2.2018.11.005](https://doi.org/10.1016/j.dsr2.2018.11.005)

Mueter, F.J., Baker, M.R., Dressel, S.C., Hollowed, A.B. (Editors) (2018) Impacts of a Changing Environment on the Dynamics of High-latitude Fish and Fisheries. Alaska Sea Grant, University of Alaska Fairbanks. doi: 10.4027/icedhlf.2018.02

Planque, B., Mullon, C., Arneberg, P., Eide, A., Fromentin, J.-M., Heymans, J.J., Hoel, A.H., Niiranen, S., Ottersen, G., Sandø, A.B., Sommerkorn, M., Thébaud, O., Thorvik, T., 2019. A participatory scenario method to explore the future of marine social-ecological systems. Fish and Fisheries. doi: 10.1111/faf.12356

Vestfals, C.D., Mueter, F.J., Duffy-Anderson, J.T., Busby, M.S., De Robertis, A. (In Press). Distribution of early life stages of Arctic cod and saffron cod in the Pacific Arctic. Polar Biology.

2.c. Events, Meetings, and Workshops

RACArctic Stakeholder Workshop, 19 March, 2019., Tromsø, Norway. The focus of this workshop, organized by K. Drinkwater, was on existing and potential future fisheries in the Norwegian and Barents seas, as well as in the near Arctic and includes the general state of the ecosystems and how they might be affected by the changing climate. Four other science projects co-sponsored this workshop: ARCTic Marine Resources under Climate Change: Environmental, Socio-Economic Perspectives and Governance (ARC Change); Spatial shifts of marine stocks and the resilience of polar resource management (STOCKSHIFT), an investigation of future scenarios of ecosystem services in the Svalbard region; and Climate change and European Aquatic RESources (CERES) that is examining climate change influences on Europe's most important fish and shellfish resources. A total of 7 stakeholders representing different Norwegian fisheries agencies and organizations and 9 scientists from the different sponsors attended the workshop. The objectives were:

1. to identify to what extent managers have considered potentially disruptive changes due to climate change in their short- and long-term planning;
2. to identify possible threats and opportunities related to climate change and fishing;
3. to assess what the current management framework needs to do to better cope with these challenges and conflicts; and
4. to determine what information needed from scientists for stakeholders to better deal with climate change issues.

Belmont Forum 'Valorization' event. December 8-10, 2019. Washington, DC. ESSAS Co-chair Mueter participated in facilitated discussions and helped prepare text for a brochure during and following the event, which brought together representatives from three Belmont sponsored "Collaborative Research Actions (CRAs)" focusing on the Arctic, Mountain ecosystems, and Food Security, respectively.

IMBER Open Science Conference, June 15-21, Brest, France. ESSAS SSC and working group members organized and will be chairing a session and two workshops as described in (1a).

3. International collaboration and links

ESSAS members are based in countries around the circumpolar North and have established working relationships among agencies and institutions within and among these countries. ESSAS Annual Science Meetings, which are the primary means of information exchange and establishing

collaborations, are typically organized by one of the countries and institutions listed below, but may involve participants from many other organizations.

- Japan: Arctic Climate Centre, Hokkaido University, Sapporo, Dr. Sei-Ichi Saitoh, Dr. Irene Alabia; Graduate School of Fisheries Sciences at Hokkaido University in Hakodate, Dr. Toru Hirawake; Japan Agency for Marine-Earth Science and Technology (JAMSTEC), Yokosuka, Dr. Naomi Harada.
- Korea: Korea Polar Research Institute (KOPRI), Incheon, South Korea, Dr. Hyun-Cheol Kim.
- USA: University of Alaska, Fairbanks, Dr. Franz Mueter; University of Washington, Seattle, Washington, Dr. George Hunt and Dr. Ben Fitzhugh; NOAA, Dr. Alan Haynie, Dr. Benjamin Laurel.
- Canada: Bedford Institute of Oceanography, Dartmouth, Nova Scotia, Dr. Kumiko Azetsu-Scott.
- Greenland: Greenland Institute of Natural Resources (GNIR), Nuuk, Dr. Caroline Bouchard.
- Iceland: Marine Research Institute, Reykjavik, Dr. Olafur Astthorsson.
- Norway: Institute of Marine Research, Bergen, Dr. Ken Drinkwater; Institute of Marine Research, Tromsø, Dr. Benjamin Planque; Arctic University of Norway, Tromsø, Dr. Arne Eide; Norwegian Institute for Water Research (NIVA), Dr. Trond Kristiansen.

4. Input to management and policy

- ESSAS members Franz Mueter and George Hunt serve on the Scientific and Statistical Committee of the North Pacific Fishery Management Council, directly providing advice to fishery managers, including the setting of biological catch limits. The Council meets five times each year to review stock assessment, regulatory analyses, and other analyses in support of fishery management. Other SSC members provide advice to fishery managers in Japan (Sei-ichi Saitoh), Iceland (Olafur Astthorsson) or Norway (Benjamin Planque).
- The RACArctic project is currently preparing a synthesis manuscript on the preparedness and resilience of fishery management systems in Japan, Norway and the US.

5. Education and outreach

ESSAS did not engage in formal ESSAS-sponsored outreach activities since December 2018 except the RACArctic stakeholder meeting in Tromsø in March 2019.

6. Planned activities for next year

Specific plans for late 2019 and 2020 will be developed at the next ESSAS SSC meeting (held in conjunction with the IMBER OSC in Brest, June 15, 2019). The next Annual Science Meeting is planned for June 2020 in Sapporo, Japan.

6.a. Activities and how they link to the Challenges

A special issue on “Arctic Gadids in a Changing Climate” based on a session at the June 2018 ESSAS Annual Science Meeting in Fairbanks, Alaska, is in development with 10 papers submitted to date (deadline for submission is July 15, 2019). Papers in the Special Issue relate directly to Grand Challenge I, as they aim to understand variability in Arctic cod (*Boreogadus saida*), a key forage species in Arctic marine ecosystems and an indicator species for the position of the Arctic-Subarctic ecotone.

We will have representatives at the ICES Annual Science Conference and at the PICES Annual Science Meeting. At the PICES meeting, we will be participating in workshop to develop an Integrated Ecosystem Assessment for the Chukchi Sea, an activity that links directly to Grand Challenge III.

6.b. Outreach (Convening sessions, meetings, etc)

Plans for scientific sessions and for the Annual Science Meeting in Sapporo will be developed at the ESSAS SSC meeting in Brest on June 15, 2019.

6.c. Upcoming papers (Community-Position-Review-etc)

Results from RACArctic are being prepared for publication in a series of three articles focusing on (1) changes in the climate - Arctic Ocean system and in the biogeochemistry of high-latitude seas, (2) the responses of biological communities in Subarctic and Arctic marine ecosystems to these changes, and (3) the ability of fishery management systems to adapt to and prepare for these changes.

7. Funding

7.a. Funding from external sources

Support for the website is provided by the Hokkaido University Arctic Research Center. Funding for most SSC members and working group chairs to attend the ESSAS SSC meeting and IMBER OSC in Brest is provided by the member's home institutions or through various research grants.

7.b. Funding proposals in progress or planned

We are in discussions with the US National Science Foundation to develop a proposal for the support of a program office in Alaska. ESSAS members and partners are engaged in a 'bottom-up' effort to develop an international Synoptic Arctic Survey.

7.c. Funding requested from IMBeR for 2019-2020

The goals of ESSAS are primarily met through holding Annual Science Meetings that rotate among member countries and through participating in other regional and international meetings that include a component focusing on high-latitude research. While most participants are self-funded, several ESSAS SSC members have little or no support from their home institutions or research grants to attend these meeting. Our primary request is therefore for travel support to help these members attend the Annual Science Meeting.

Based on recent years, we anticipate the following needs in support of the 2020 Annual Science Meeting in Sapporo, Japan. We also request support for F. Mueter to attend the 2020 PICES meeting to maintain our relationship with PICES. ESSAS has been represented by Dr. Sei-Ichi Saitoh in recent years, but he recently retired as co-chair of ESSAS.

K. Azetsu-Scott, Canada (SSC)	US \$ 2,000
C. Bouchard, Greenland (SSC)	US \$ 3,000
O. Astthorson, Iceland (SSC)	US \$ 2,000
S. Rastrick, Norway (WG chair)	US \$ 3,000
B. Planque, Norway (SSC co-chair)	US \$ 1,500
G. Hunt, USA (SSC)	US \$ 2,500

Total requested	US \$ 14,000
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8. Changes to Organisational Structure (e.g. SSC) of RP / WG

None

9. Images / Figures

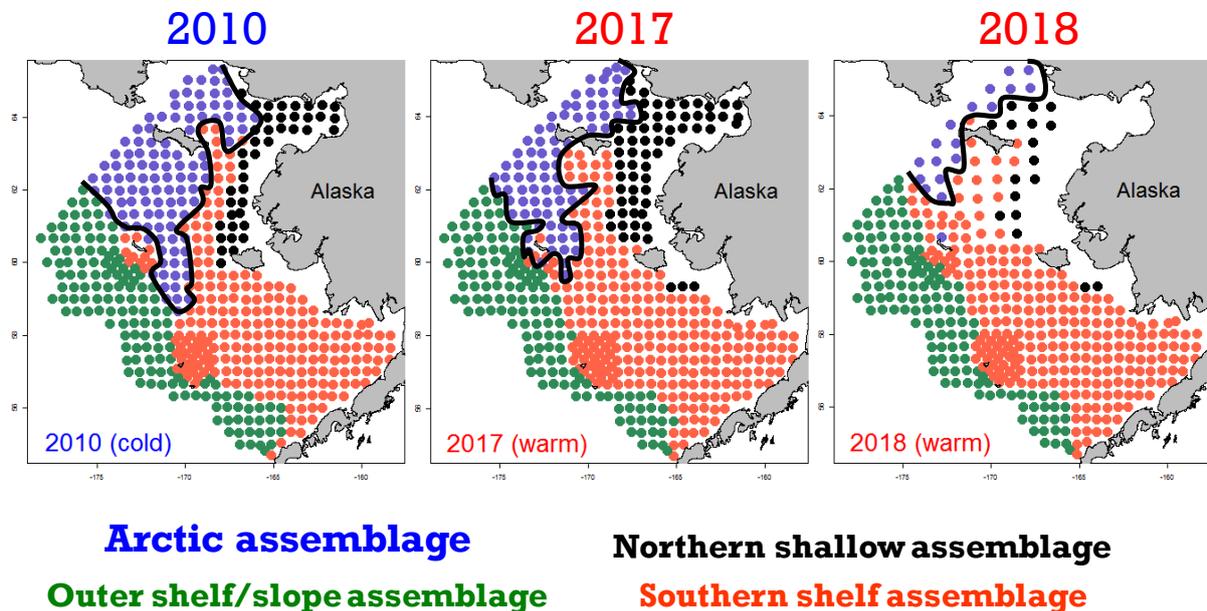


Figure 1: Borealization of the norther Bering Sea demersal community. Four major assemblages of demersal fish and large invertebrates can be identified on the Bering Sea shelf. The spatial extent of the Arctic assemblage, characterized by the presence of Arctic cod (*Boreogadus saida*), has greatly decreased, while a southern shelf assemblage has expanded northward.

10. Update on Action Items from Hobart SSC meeting

We updated the table of Action Items and followed up on each ESSAS item.

11. Anything not covered above

12. How to improve this form

I think the form is fine and easy to fill out. Updating publications is easy enough to do once a year after we compile relevant publications for our Annual Meeting, but seems cumbersome every 6 months as it requires querying all the ESSAS members twice a year. Moreover, we always struggle determining what makes a publication an ESSAS publication that can be “badged as IMBER”, as ESSAS does not directly support research, but facilitates collaborations and comparative studies. Perhaps some guidelines on what to report would be useful.

13. Appendices

None