

New Arctic Project Under ESSAS

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The international RACArctic (Resilience and Adaptive Capacity of ARCTIC marine systems under a changing climate) Project developed by the Ecosystem Studies of Sub-Arctic Seas (ESSAS) regional programme of IMBER was recently rewarded funding for a synthesis activity under the Belmont Forum call on Arctic Observing and Research for Sustainability. The project, which is funded for 3 years and begins in July 2015, is a joint undertaking by Japan, the USA, and Norway to synthesize information from completed and ongoing regional studies on how climate variability and change in the Subarctic to Arctic transition zones may affect future marine ecosystems of the Pacific and Atlantic Arctic (see Fig. 1 for geographic areas of focus). In particular, it will examine how fish populations and their prey are able to adapt or respond to natural and anthropogenic changes in the Arctic and how these are expected to affect existing and future fisheries, subsistence harvests, and the socio-economic systems that depend upon them. The Project also will incorporate input from user groups who directly or indirectly depend on living marine resources and assess the strengths and weaknesses of current management institutions in Japan, the US and Norway in terms of their capacity to successfully meet the anticipated challenges associated with global warming and ocean acidification.



Figure 1: Physical geography of the Arctic highlighting the Subarctic-to-Arctic transition zones in the Pacific and Atlantic Arctic that are the principal areas of investigation within RACArctic. The red line denotes the location of the 10°C July isotherm for air temperatures.

The project is headed by the three co-chairs of ESSAS, with Dr. Sei-Ichi Saitoh from Hokkaido University at Hakodate in Japan the overall lead while Dr. Franz Mueter of the University of Alaska, Fairbanks leads the US team and Dr. Ken Drinkwater at the Institute of Marine Research in Bergen the Norwegian team. While in its first years, ESSAS focused almost exclusively on the subarctic regions, more recently it has extended its work into Arctic-Subarctic interactions, in particular the physical and biological consequences of exchanges between the Subarctic and Arctic. It thus was in a good position to put together a strong proposal in response to the Belmont Forum call. In selecting national team members for RACArctic, we strove to achieve a balance amongst natural scientists, economists, social scientists, and representatives of user groups, while drawing on past and current international collaborations among investigators, where possible.

Because direct experiments on large ecosystems are not practical, an alternative method to study ecosystems is through a comparative approach. Contrasting different systems can provide insights into what are fundamental ecosystem processes and what might be unique to a particular ecosystem (Murawski et al., 2010). Thus the emphasis in RACArctic is on a comparative synthesis, a research approach that ESSAS has been using since its inception in 2005 to highlight the importance of climate variability in driving tropho-dynamic interactions in these systems and to determine the dominant processes through which climate influences ecological communities (see e.g. Mueter et al., 2009; Link et al., 2012, Hunt et al., 2013). The RACArctic project will build upon and extend these ESSAS studies, as well as incorporate other recent studies.

Future reductions in sea ice under anthropogenic forcing and the associated changes in productivity are expected to affect marine fish, marine mammals and seabirds in the Subarctic and Arctic. Anticipated changes include fish movements from the Subarctic towards the Arctic with changes in local productivity and abundance. While the nature and magnitude of such effects will vary among different ecosystems, they are of interest because existing fisheries will be affected and potentially new fisheries will develop in areas where none presently exist. Also, fish are prey to marine mammals and seabirds that provide a livelihood for many Arctic inhabitants, especially indigenous peoples. Marine mammals such as walrus and some seals that use sea ice for hauling out or birthing will lose their habitat. Much of the variability in the Subarctic to Arctic transition zones is tied to advection of warmer waters into the Arctic. This transport is highly variable and its effect on the ecology is poorly understood. With warming, there is uncertainty about whether the primary productivity of the Arctic will increase or decrease. On the seasonally ice-covered Arctic shelves, primary production is expected to increase owing to a longer growing season but to what extent this added production becomes available to fish is not known. In addition to warming, ocean acidification is also particularly pronounced in high-latitude regions as the decline in sea-ice coverage allows more CO₂ to enter oceanic waters and cold water more readily absorbs CO₂. Continued sea-ice loss is likely to result in aragonite undersaturation that will directly impact calcifying organisms as waters become corrosive to their shells, several species of which are prey for commercial fish populations. These are just a few of the issues that RACArctic will attempt to address as part of their syntheses.

These syntheses will be achieved principally through a series of 3 workshops, one in each of the sponsoring nations, coupled with inter-session work. The first workshop will be held in Japan in the spring of 2016 at which each of the nations will provide a review of the main processes on how climate influences their particular ecosystems. A plan will be established at this meeting for the development of the comparative syntheses. The second meeting will be held in early 2017 in Alaska where the emphasis will be on user input. This will largely be from Alaskan indigenous peoples as well as local fishing companies, fishers and other fishing communities. Users from Japan and Norway will also be invited to

provide their perspectives. The final workshop will be held in late 2017 in Norway and will include investigators and other stakeholders from all three countries. It will complete the syntheses and lay out the plans for the writing of scientific papers and reports based on the results from the Project. These will include stakeholder summaries that will evaluate the potential sustainability of Arctic marine ecosystems under climate change and provide recommendations to both the fishing industry and northern communities to prepare for potential problems they might encounter. They will be written by a team consisting of both scientists and user groups. Recommendations on future internationally coordinated research and monitoring activities will also be made.



Fig. 2. With the reduction of sea-ice area in the Arctic and Subarctic, some marine mammals such as these walrus, will lose habitat for hauling out and resting.

To our knowledge, this is the first international project that draws on similar and complimentary research programs across the Pacific and Atlantic Arctic to assess the resilience and adaptive capacity of Arctic marine systems to climate variability and change, with an emphasis on fish and fisheries and including socio-economic subsystems. We in ESSAS look forward to this exciting challenge.