Recommendations from the first CoML Arctic Biodiversity workshop

The Artic Biodiversity workshop had two distinct programs. The first was to determine interest and need for a biodiversity study in the Arctic, while the second discussed the joining of the longitudinal and latitudinal NaGISA transects with a transect that would cross the North Pacific/Bering Sea at the Aleutian Islands.

Discussions during the Arctic biodiversity portion of the workshop identified what is known and what is unknown but knowable about diversity in the Arctic Ocean. An Arctic Biodiversity Transect was identified as being urgent since changes in environmental conditions have already happened, and Arctic biological communities are expected to have disproportionate responses to global climate change. The dependency of native peoples on the Arctic ecosystem for subsistence lifestyle adds social and cultural urgency.

How will the changes in the Arctic impact the biodiversity of sea ice communities on regional and temporal scales? For the sea ice system it was identified that delicate groups such as protozoan and metazoan meiofauna inhabiting the sea ice are among the least known groups. Little to no information is available on their species richness, distribution and abundance. The sea ice community is also subject to dramatic seasonal changes and information on these community structures in the winter compared to spring and fall is sorely needed. Also, most studies so far have focused on annual ice or fast ice while the significance of biological communities in multiyear ice - the majority of the sea ice present in the Arctic - is unknown. One way of combining multiyear ice studies with seasonal investigations is the establishment of permanent ice floe stations that can be revisited at intervals until 2010. It was proposed to establish ice stations in the Transpolar drift and in the Beaufort gyre.
Within the plankton, the major gaps in knowledge are delicate groups such as the gelatinous plankton, and nektonic groups such as cephalopods that are either destroyed or escape the traditional net sampling. Although copepods are reasonably well studied, knowledge on several small species is lacking for a comprehensive biodiversity understanding. Amongst the phytoplankton, morphological and physiological characteristics may vary within a species. A better understanding of species composition will improve our understanding of their ecology and physiology as well as interactions and processes in the ecosystem. A combination of microscope and molecular techniques were suggested to help eliminate ambiguities.

For benthic communities, patterns of floral and faunal biodiversity in the Arctic Ocean need to be related to hydrological processes and primary production to predict effects of climate change. Most efforts have traditionally been invested in shallow water benthic systems on the continental shelves. The Chukchi, Bering, Laptev and Kara shelf have been most studied, while the Eastern Siberian Shelf is still comparatively under-explored. The extent to which infauna and epibenthic megafauna have been studied so far varies among the different shelf regions, but common to all areas, meiofaunal communities including foraminifera are the most unknown. Also, among the coastal regions, the fjord systems of the Canadian Archipelago and of Greenland are among the least well known. The shelf breaks and the deep-sea basins of the Arctic Ocean are not well studied, with

the deep Canadian Basin being the least known of all. Since the Canadian Basin is a long-time separated system with little exchange to other deep-sea basins, this will be a particularly interesting area to study within an Arctic transect. Benthic, pelagic and sea ice systems are not isolated and the connectivity between these realms has to be the focus to understand biodiversity in the Arctic Ocean. Especially the ice-air and ice-water interfaces present unique but biologically unfamiliar habitats.

Agreement was reached that standardized sampling techniques would be necessary to ensure compatibility of data collected along a pan-arctic biodiversity transect. Image systems associated with ROVs or AUVs are appropriate for benthic megafauna and gelatinous plankton, while epibenthic sleds, grabs and cores are reliable quantitative tools for smaller and often infaunal macrofauna and meiofauna. Live microscopy in the field is the only tool to analyze and identify ice protozoa. Hard bottom coastal areas should be sampled using the already established standardized NaGISA protocols. Cooperation and coordination of sampling methods with those applied in other Census of Marine Life projects, such as MarEco, GoMe or CeDAMar is desirable. Several CoML projects have already expressed interest in an Arctic component, e.g. ChEss in the ultra-slow spreading Gakkel Ridge. Sampling metazoans from all Arctic Ocean realms for DNA barcoding, a newly evolving program within CoML, is highly recommended.

Conducting a biodiversity transect across the Arctic Ocean is only feasible as a multinational, multidisciplinary program. Next steps in initiating this program are advocating the Arctic Transect to a broader scope of scientists in follow-up workshops. Regional workshops in the U.S., in Russia and in Europe are the best way to reach and involve a broad range of scientists with Arctic interests. The idea of an Arctic Biodiversity Transect should also be presented at appropriate scientific conferences. Efforts are also being made to obtain funding for an Arctic OBIS node. There is a tremendous wealth of data and information from Russian investigations that is not accessible for the general scientific community. It will be a key issue to translate and organize these data to reveal a more complete picture of what is already known about marine life in the Russian Arctic. Also, old samples are available and could be re-analyzed on a more detailed taxonomic level. For this, and for the Arctic Biodiversity Transect work in general, the need for taxonomic expertise was expressed, as it is crucial to the success of describing life in the Arctic Ocean. The production of new and translation of existing keys should have high priority.

For the second program of the workshop, the extension of the NaGISA field project across the North Pacific/Bering Sea was discussed. Several biogeographic breaks are suggested along the Aleutian Chain, the Commander Islands and the Kamchatka Peninsula. A series of NaGISA transects was suggested to test the existence of a biogeographic break at Samalga Pass and between the Aleutians and the Commander Islands while at the same time linking the longitudinal and latitudinal NaGISA gradients. A major outcome of this cooperation is a joint proposal between the Far Eastern Branch of the Russian Academy of Science in Vladivostok, the Zoological Institute of the Russian Academy of Science (ZIN) in St. Petersburg and the University of Alaska Fairbanks, which was submitted to the National Science Foundation.