Final report: The Advancement of Knowledge in the Arctic Ocean and Bering Sea

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Within the endeavor of the Census of Marine Life, the abundance and diversity of marine life in the Arctic Ocean had not yet been considered. Although the Arctic Ocean, among the major oceans on Earth, is the smallest and at the same time the least accessible due to heavy sea ice for most of the year, its significance for our understanding of "the diversity, distribution and abundance of ocean life and to explain how it changes over time" (CoML mission statement) is tremendous. The Arctic Ocean also plays an important role in the Earth's climate with respect to heat exchange between the ocean and the atmosphere coupled with the permanent ice cover. The Alfred P. Sloan Foundation funded an international meeting to plan the advancement and to consider the limits of knowledge of Arctic marine life, where the known, the unknown and the unknowable of life in the Arctic Ocean were evaluated.

Background

At first glance the Arctic Ocean may seem to be a harsh and frigid environment uninviting for living organisms, but it is in fact a biologically active and productive region. For example, some of the largest marine mammals, such as gray whale and walrus, rely on Arctic benthic communities as their major feeding grounds. Polar organisms are often highly adapted to the physical and biological conditions such as cold temperatures and high seasonality in food supply. These high adaptations make them especially vulnerable to any changes in ocean dynamics caused by natural or humanly induced climate fluctuations. The effects of global climate change maybe more severe in the polar regions than in other parts of the world's ocean. It is essential to know what lives in the Arctic Ocean now to be able to monitor and evaluate shifts, and relate them to natural variability or large-scale changes. These evaluations are important for monitoring the ecological balance of the Arctic Ocean and the global climate, and also culturally since many native ethnic groups depend heavily with their subsistence lifestyle on traditional marine hunting grounds. Changes have already started to happen, such as a decrease and thinning of the sea ice cover and an increase of sea surface temperatures; baseline data of the Arctic Ocean native biodiversity are urgently necessary before the pristine status is lost.

The abrupt, extreme changes in light, temperature and other environmental variables not only pose challenges for the organisms living in the Arctic Ocean and affect biodiversity on a seasonal scale but they also pose fascinating, hard problems for scientists to census marine life, and more generally, set limits to the knowledge that can be gained of life in the Arctic Ocean. The mission of the Census of Marine Life to understand what lives in our oceans, what is known, what is unknown and what may be unknowable can only be addressed by a joint effort of scientists of many disciplines and countries.

A second program of this international workshop was to establish cooperation with Russian scientists within an expansion of the NaGISA field project across the Bering Sea. NaGISA is one of the initial field projects within the Census of Marine Life program focusing on biodiversity in large macrophyte communities in the intertidal and shallow subtidal down to a depth of max. 20 m. Currently, NaGISA field sampling is conducted in a number of countries in the Western Pacific to complete a longitudinal transect. Brenda Konar and Katrin Iken at the University of Alaska Fairbanks have started sampling along a latitudinal gradient along the Eastern Pacific, so that eventually global comparisons on ocean scale basis can be done. A NaGISA transect across the Bering Sea would be an important link between the two gradients, and it would test several important hypotheses of biogeographic breaks and species range extension.

The workshop

The international workshop was held in Fairbanks, Alaska, from 11-14 April 2003. Scientists from nine countries (Table 1) were invited to be representatives of their countries and share their knowledge on life in the Arctic Ocean and the adjacent Bering Sea.

Table 1: Participant list of the Arctic / Bering biodiversity workshop in Fairbanks, AK during 11-14 April, 2003.

COUNTRY	NAME and AFILIATION
Russia:	**Yuri Latypov** **ltpv@stl.ru** Russian Academy of Science (RAS), Vladivostok **Vladimir Kasyanov** **inmarbio@mail.primorye.ru** Russian Academy of Science (RAS), Vladivostok **Boris Sirenko** **marine@zin.ru** Zoological Institute of RAS (ZIN), St. Petersburg
England:	**Tammy Horton** **txh@soc.soton.ac.uk** Southampton Oceanography Center (SOC), Southampton
Scotland:	**Michael Burrows** **mtb@dml.ac.uk** SAMS, Dunstaffnage Marine Laboratory, Oban
Norway:	**Cecilie v. Quillfeldt** **cecilie@npolar.no** Norwegian Polar Institute, Tromsø
Germany:	**Karen v. Juterzenka** **kjuterzenka@awi-bremerhaven.de** Alfred Wegener Institute for Polar and Marine Research (AWI), Bremerhaven **Hendrik Deubel** **hdeubel@awi-bremerhaven.de** Alfred Wegener Institute for Polar and Marine Research (AWI), Bremerhaven
Denmark:	**Torkel Nielsen** **tgn@dmu.dk** National Environmental Research Institute (DMU), Roskilde

Canada: **Kathleen Conlan** kconlan@mus-nature.ca
Canadian Museum of Nature, Ontario

USA: **Ken Dunton** dunton@utmsi.utexas.edu
University of Texas at Austin (UTMSI), Port Aransas
William Ambrose wambrose@bates.edu
Bates College, Lewiston

CoML Participants

Ron O'Dor (CoML) rodor@COREocean.org
Census of Marine Life, Washington, USA
Eva Ramirez Llodra (ChEsS) ezr@soc.soton.ac.uk
Southampton Oceanography Center, Southampton, UK
Gerhard Pohle (OBIS) ARC@mar.dfo-mpo.gc.ca
Huntsman Marine Science Centre, St. Andrews, Canada
Robin Rigby (NaGISA outreach) r310x@hotmail.com
Hokkaido University, Japan

UAF Participants

Workshop initiators:

Katrin Iken (IMS) iken@ims.uaf.edu
Brenda Konar (GURU) bkonar@ims.uaf.edu

Others:

Vera Alexander (SFOS) vera@sfos.uaf.edu
Bodil Bluhm (IMS) bluhm@ims.uaf.edu
Russ Hopcroft (IMS) hopcroft@ims.uaf.edu
Rolf Gradinger (IMS) gradinger@ims.uaf.edu
Howard Feder (IMS) feder@ims.uaf.edu
Stephen Jewett (IMS) jewett@ims.uaf.edu
Arny Blanchard (IMS) blanchard@ims.uaf.edu
Gayle Neufeld (IMS) gneufeld@sfos.uaf.edu
Casey Debenham (IMS) ftcwd@uaf.edu

NGO Agency

Scott Stewart (ARCUS)

The organizers of the workshop, Katrin Iken and Brenda Konar, have provided a background paper introducing the idea of a census of marine life in the Arctic and adjacent Bering Sea. During the first day and a half of the workshop the participants gave presentations of their own and other Arctic marine research currently being conducted in their countries. Written summaries of the presentations and the background paper were handed to all participants in an information folder.

During the remaining days, participants gathered in smaller groups to discuss what is known, what is unknown and what may always be unknowable for different habitat types in the Arctic, e.g. sea ice, plankton, shallow water and deep-sea benthos, and to discuss the NaGISA Bering Sea transect (Table 2).

Table 2: Agenda of Arctic / Bering biodiversity workshop in Fairbanks, AK from 11-14 April, 2003.

Friday, April 11, 2003

900	Welcome and Introductions (Katrin Iken / Brenda Konar)
930	**CoML**: Ron O'Dor (Senior Scientist, Census of Marine Life)
1000	**OBIS**: Gerhard Pohle (Huntsman Marine Science Centre)
1030	break
1045	**NaGISA**: Brenda Konar / Katrin Iken (University of Alaska Fairbanks)
1115	**NaGISA outreach**: Robin Rigby (Hokkaido University)
1130	**ChEsS**: Eva Ramirez Llodra (Southampton Oceanography Center)
noon	lunch
1330	**Canada**: Kathy Conlan (Canadian Museum of Nature)
1350	**Denmark**: Torkel Nielsen (National Environmental Research Institute)
1410	**Norway**: Cecilie v. Quillfeldt (Norwegian Polar Institute)
1430	**Norway**: John Gray (University of Oslo, narrated ppt presentation)
1450	break
1530	**England**: Tammy Horton (Southampton Oceanography Center)
1550	**Scotland:** Michael Burrows (Dunstaffnage Marine Laboratory)
1610	**Russia:** Yuri Latypov (Russian Academy of Sciences)
1630	**Russia:** Boris Sirenko (Zoological Institute of RAS)
1650	**Germany:** Karen v. Juterzenka (Alfred Wegener Institute)
1710	**Germany:** Hendrik Deubel (Alfred Wegener Institute)
1730	concluding remarks
1800 -1900	icebreaker reception

Saturday, April 12

900	**US:** Ken Dunton (University of Texas at Austin)
920	**US:** William Ambrose (Bates College, Lewiston)
940	**US:** Russ Hopcroft / Rolf Gradinger / Bodil Bluhm / Katrin Iken (University of Alaska Fairbanks)
1000	break

Working Groups:

1015	introduction to working groups
1030	break-up into habitat working groups:

coastal/nearshore
continental shelf
deep sea

ice/pelagic

noon working lunch

Working Group Summary Presentations:
1400 coastal/nearshore
1430 continental shelf

1500 break

1530 deep sea
1600 ice/pelagic
1630 Elect Arctic Ocean Biodiversity Group lead person & general discussion

1700 leave for dinner at Pump House

Sunday, April 13
900 Welcome to UAF and SFOS by Vera Alexander (Dean of School of Fisheries and Ocean Sciences)
915 • Arctic Ocean Biodiversity Group meets to outline future plans
• Bering-NaGISA working group meets to outline proposal

noon working lunch

1300 Chena Hot Springs Trip
1800 Dinner at Chena Hot Springs Resort

Monday, April 14
900 Arctic Ocean Biodiversity Group continues
Bering-NaGISA working group continues

noon working lunch

1300 Present final outline and task assignments
1400 Concluding remarks
Meeting adjourns

Results

Arctic Transect

The following summarizes the major results of the working groups identifying what is known and what is unknown but knowable about diversity in the Arctic Ocean. For the sea ice and pelagic system it was identified that some major groups of zooplankton, such as copepods, are reasonably well studied. The importance of some smaller species, however, is likely being underestimated. For other more delicate groups, such as gelatinous plankton and protozoan and metazoan meiofauna inhabiting the sea ice very

limited information is available on species richness and distribution. The sea ice and planktonic communities are also subject to dramatic seasonal changes and information on these community structures in the winter is sorely needed. For benthic communities, most effort has traditionally been invested into the shallow water benthic systems of the continental shelves. The Chukchi, Bering, Laptev and Kara shelf have been most studied, while the Eastern Siberian Shelf is still comparatively under-explored. 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 very little 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 focused on to understand biodiversity in the Arctic Ocean.

Agreement was reached that standardized sampling techniques would be necessary to ensure compatibility of data. 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 macrofauna, meiofauna and infauna. Live microscopy in the field is the only way to analyze protozoa. Coastal areas should be sampled using the already established, standardized NaGISA protocols.

Conducting a biodiversity transect across the Arctic Ocean is only feasible as a multinational, multidisciplinary program. Next steps in initiating this program were identified as follow-up workshops and presentation of the idea during scientific meetings to advocate the Arctic Transect to a broader scope of scientists. The DIVA workshop in Germany (Tammy Horton and Karen von Juterzenka), the AAAS, SEARCH and Deep-Sea conferences in the US (Katrin Iken and Bodil Bluhm), and the CoML meeting in Moscow, Russia (Vladimir Kasyanov), presented excellent opportunities to introduce the Arctic Transect to a broad international audience. Efforts should also be 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 would 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.

NaGISA Bering Sea Transect

Researchers from the Far Eastern Branch of the Russian Academy of Science in Vladivostok (Yuri Latypov, Vladimir Kasyanov), the Zoological Institute of the Russian Academy of Science (ZIN) in St. Petersburg (Boris Sirenko) and the University of Alaska Fairbanks (Katrin Iken, Brenda Konar) met and discussed the feasibility and logistic details of a NaGISA Bering Sea transect. A proposal to the National Science Foundation Biodiversity Surveys and Inventories (BS&I) program was outlined to conduct a series of NaGISA transects along the Aleutians, the Commander Islands and Kamchatka Peninsula to link the longitudinal and latitudinal NaGISA gradients and to test the existence of a biogeographic break at Samalga Pass and between the Aleutians and the Commander Islands. This Bering transect was planned as two sampling cruises, one Aleutian section using US resources such as the UNOLS vessel Alpha Helix, and one Commander-Kamchatka section using Russian resources, such as the vessel “Professor Bogorov”. Scientists of both nationalities would participate in both sections for the most intense

cooperation. Russian taxonomists would be involved in the analysis of faunal samples, while a US taxonomist shall be involved for the identification of algal samples.

Measurable outcomes

The following lists the measurable outcomes that were achieved:

- The international workshop to advance knowledge of the Arctic Ocean biodiversity was held in April 2003 in Fairbanks, Alaska
- The contributions of the workshop participants including the background paper provided by the workshop initiators were published through the Alaska Sea Grant Program as a workshop proceedings volume. A copy of the proceeding volume is attached.
- An interim Scientific Steering Committee was build to work on organizing a US follow-up workshop. Leaders of the interim SCC are Russ Hopcroft, Rolf Gradinger and Bodil Bluhm with the assistance of Katrin Iken and Brenda Konar. The US workshop is planned for Fall 2004, and so far several agencies have agreed to contribute partial funding: NOAA Ocean Exploration, NOAA Arctic Research Office, National Underwater Research Program (NURP), Alaska Sea Grant Program.
- A website about the Arctic Biodiversity Transect was installed (website coordinator: Rolf Gradinger). The website features the Fairbanks workshop but leaves room for other initiatives which will contribute to the overall goal of identifying what lives in the Arctic Ocean.
  http://www.sfos.uaf.edu/research/arcdiv/workshop/index.html
- Several proposals were submitted to various funding agencies under the umbrella of the Arctic Ocean Biodiversity Transect, which will contribute to the knowledge of life in the Arctic Ocean:
  - Iken, Bluhm, Dunton: Benthic diversity and food web structure in the western Chukchi Sea – submitted to CIFAR for the planned 2004 RUSALKA initiative
  - Hopcroft: Diversity of the pelagic community in the western Chukchi Sea – submitted to CIFAR for the planned 2004 RUSALKA initiative
  - Bluhm, Iken: Benthic diversity and food web structure in the deep Canada Basin – submitted to NOAA Ocean Exploration for 2005
  - Gradinger, Bluhm, Iken: Sea ice communities of the deep Canada Basin – submitted to NOAA Ocean Exploration for 2005
  - Hopcroft: Pelagic community diversity of the deep Canada Basin – submitted to NOAA Ocean Exploration for 2005
- The joint US-Russian BS&I proposal was submitted to NSF in June 2003. It has since been declined, but Konar and Iken are working on revisions so it can be re-submitted for the next June deadline.