PICES hosts an ESSAS workshop in St. Petersburg, Russia

By Kenneth Drinkwater and George Hunt

The first ESSAS (Ecosystem Studies of Sub-Arctic Seas) workshop was held from June 12 to 14, 2006, in St. Petersburg, Russia, to lay the ground work for developing comparative studies of the subarctic seas. To this end, 27 scientists from 6 nations (Canada, Greenland, Japan, Norway, Russia and U.S.A.) were in attendance. Four subarctic ecosystems were selected for the first comparison: two from the Pacific (the Sea of Okhotsk/Oyashio region and the Bering Sea) and two from the Atlantic (the Newfoundland/Labrador region and the Barents Sea). The workshop was co-sponsored by GLOBEC International and PICES, both of whom contributed travel funds, while the latter, with assistance from the Pacific Scientific Fisheries Research Center (TINRO-Center), also arranged and provided logistical support at the meeting. Our local host was the State Scientific and Projecting Institute "Giprorybflot".

Participants of the first ESSAS workshop in the main hall of the State Scientific and Projecting Institute "Giprorybflot", June 2006, St. Petesburg, Russia.

The primary objective of ESSAS, a GLOBEC regional programme, is to understand how climate variability affects the productivity of subarctic ecosystems and their ability to support sustainable commercial and subsistence fisheries. The ESSAS Science Plan outlined a 5-stage implementation strategy (Hunt and Drinkwater, 2005) consisting of (1) ecosystem summaries, (2) regional programmes, (3) comparative analyses, (4) prediction, and (5) synthesis. The first major ESSAS activity was the symposium on "*Climate variability and subarctic marine ecosystems*" held in Victoria, Canada, in May 2005, which brought together over 220 scientists from different subarctic regions to present their recent work and understanding of their particular seas (see the report by Hunt and Drinkwater in the GLOBEC Newsletter Vol. 11, No. 2 and in PICES Press Vol. 13, No. 1). The symposium largely addressed item (1). Newly funded ESSAS research programmes in Japan, Iceland, Norway and U.S.A, with some activities also initiated in Canada, Russia and West Greenland, provide a strong start to the development of regional programmes (item 2). Comparative studies between different subarctic ecosystems (item 3) are a major focus of ESSAS. Therefore, building on the Victoria symposium and other recent research, an ESSAS workshop was convened in St. Petersburg to explore how fruitful comparative studies should be developed.

Many excellent compendia of information about particular subarctic ocean basins are available, although few have explicitly compared mechanisms and responses to climate forcing across basins or between Atlantic and Pacific systems. For the comparative method to be used successfully, it is necessary to identify important underlying structuring features of the ecosystems, and then to determine how climate forcing, acting on those mechanisms, will result in ecosystem change. It is also necessary to develop datasets that can be used to parameterize, test and validate models. Although each system is unique, ESSAS seeks to search for those basic elements common to many, if not all, subarctic seas.

The workshop began with a presentation by James Overland on atmospheric forcing over the four subarctic regions. He showed that all regions have decreasing trends in sea level pressure (more wind forcing), but with no link in the phasing between the basins. Of particular note was the different decadal forcing between the Barents Sea and the Newfoundland/Labrador region in the Atlantic, with surface air temperature associated with variability in the North Atlantic Oscillation out of phase between the two sides of the Atlantic until recently, when both regions showed enhanced warming. In the Pacific, the Bering Sea and the Sea of Okhotsk have experienced enhanced heating in winter and spring since 1970. Next, Wieslaw Maslawski gave a talk on a physical model for the Arctic and subarctic regions. He stressed the importance of the circulation and sea ice on ecosystem structures, and showed that many of these features are well represented in existing models. However, he noted that other important processes, such as baroclinic coastal currents and eddies, need increased horizontal and vertical resolution before they can be adequately simulated.

These two talks were followed by several presentations covering the ecosystems of each of the four regions. Several interesting comparisons were made. In the Labrador region, with the collapse of the Atlantic cod stocks in the early 1990s, no cod-like species appeared to fill the niche left vacant by the disappearance of cod, unlike

in some more southern systems such as Georges Bank. There was an increase in invertebrates, in particular, snow crab and northern shrimp, but their biomass was much lower than that of the cod that was formerly present. A similar change occurred off West Greenland in the late 1960s, where northern shrimp increased when the cod disappeared. These responses appear to be the flip side of what happened in the eastern Bering Sea where, when the climate changed in the late 1970s and early 1980s, populations of crabs decreased and pollock increased.

Recently, all regions except the Sea of Okhotsk, have experienced warmer than normal sea temperatures and reductions in sea ice coverage. In the Barents Sea, there have been distributional shifts in the fauna, with the appearance of large numbers of blue whiting, traditionally a more southern species. Also, the spawning grounds of cod off the coast of Norway have shifted more northward.

In the southeastern Bering Sea, years with cold temperatures and extensive sea ice have led to earlier phytoplankton blooms and more benthic production, while years with warm temperatures and less ice have resulted in later blooms, higher abundance of copepods and less benthic production. These responses were not observed in the Barents Sea, however, and the question arose as to why not? Is it related to the more northern location and the fact that the seasonal cycle in temperature is delayed in the Barents Sea by about a month relative to the Bering Sea? The warm conditions in the northern Bering Sea in recent years have led to a significant reduction in benthic production and an increase in the pelagic production, but information is lacking for the southeastern Bering Sea.

The workshop participants recognized the importance of understanding the roles of mesopelagic organisms and forage species. For example, we found that there were interesting parallels between the roles played by squid in the Oyashio Current system, and their roles in waters offshore of the continental shelves of eastern Canada.

In addition to the regional presentations and discussions, the workshop developed tables listing the dominant species in the food web (both as prey and predators) for some of the major commercial fish species (or their prey), from nanoplankton up through to their marine mammal predators, as a means of focusing the comparisons. Another table listed the major climate processes that affect each of these species. This led to discussions centered on the mechanisms linking climate to the ecosystems, followed by evaluation of modelling strategies that could be employed to elucidate how climate variability may impact these marine ecosystems.

The workshop then developed possible ways forward for ESSAS. The idea of focused working groups was adopted. Three working groups were suggested: modelling, climate change predictions, and biophysical coupling. The Modelling Working Group would deal with the various modelling strategies (conceptual, mechanistic and statistical) as part of the comparisons. Questions arose as to whether to integrate the various methods or to pursue them separately. The Predictions Working Group would guide ESSAS through developing likely ecosystem responses to future climate change as taken from the most recent IPCC (International Panel on Climate Change) climate scenarios, and thereby also addressing part of item 4 in the ESSAS Implementation Plan. The Biophysical Coupling Working Group would compare different subarctic ecosystems through annual workshops. Each workshop would focus on a particular climate variable, for example sea ice, to see how the ecosystems were affected by this variable. Emphasis would be on developing papers that compared all or as many of the ESSAS regions as possible. Further implementation of the Working Groups was left to the ESSAS Scientific Steering Committee.

A presentation captures audience attention.

Enjoying fine food and wine during a cruise on rivers and canals of St. Petersburg with Vasilevskiyisland in the background.

In addition to plotting the future of ESSAS, workshop participants were asked to assess how the next edition of the PICES North Pacific Ecosystem Status Report might be modified to increase its utility to scientists developing

comparative studies of the PICES regions in the North Pacific. The general feeling was that the present format and content were valuable, and that increased standardization of the content of regional reports would facilitate comparisons. In addition, the development of some tabular comparisons in the Synthesis Chapter could be of value. Although difficult to develop, such tables help to sharpen the focus on the important elements, as was found in the ESSAS workshop when we attempted to develop tables for the four regions comparing trophic linkages and biophysical coupling mechanisms vulnerable to climate variability.

Participants at the meeting also took advantage of the wonderful surroundings, warm weather and delicious food in the many restaurants of St. Petersburg. Most of the participants and several accompanying spouses enjoyed a scenic evening cruise on rivers and canals, complete with food and beverages. St. Petersburg offered lots of nightly entertainment with several workshop participants attending one or more of the many ballet, opera and concert performances. The Hermitage Museum, which houses the largest art collection in the world and is located in the former palace of the Russian Czars, was probably the number one attraction, although some of us also had a pleasant time wandering around the gardens and fountains at Petergof, the royal summer residence of Peter the Great.

We, the conveners, would like to thank all of the participants for making our first ESSAS workshop a great success. Special thanks go to Alex Bychkov, Executive Secretary of PICES, for his support and efforts in arranging the venue and logistics for the meeting, and to those at the "Giprorybflot" who also helped, especially Ludmila Zaslavskaya, who did an excellent job of seeing that we were well taken care of throughout our stay in St. Petersburg.

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Dr. George Hunt (left) (geohunt2@u.washington.edu) joined the School of Aquatic and Fishery Sciences at the University of Washington as a Research Professor after retiring from the University of California, Irvine. For many years, George studied the reproductive and foraging ecology of seabirds in various regions. More recently, he has participated in ecosystem-level studies of the southeastern Bering Sea and the Aleutian Archipelago. He chairs the BEST (Bering Sea Study) SSC and co-chairs the SSC of ESSAS. He is also a member of the PICES CFAME (Climate Forcing and Marine Ecosystems) Task Team.

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Some of our most important knowledge of the ocean has come from long-term measurements at particular sites or from repeated measurements along sections. Knowing accurately the time variability in even a few locations around the world is important, as very long records are needed to determine the difference between multi-decadal cycles and climate trends. Line-P is a program highly regarded by the scientific community, and has itself benefited from numerous collaborations and partnerships with the national and international research communities. Since its initiation, it has been a multi-disciplinary program including oceanic and atmospheric research, and physical, chemical and biological studies of the upper mixed layer dynamics. Another strength has been its flexibility to allow the integration of many process studies. During the panel discussion, concerns were raised regarding the continuation of Line-P given the limitation of ship time and personnel. Several challenges were identified, including continuity, innovation, funding, and the need to provide results useful for management and policy. Both academics and government scientists are needed in the Line-P program. The Canadian and international scientists at this symposium agreed on the need to continue the Line-P series indefinitely, as it is the only series of observations that allows scientists to determine climate change events and processes in the northeastern subarctic Pacific.

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