

## Ecosystem Studies of Sub-Arctic Seas (ESSAS): Upcoming meetings and recent activities

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Since its 2008 annual meeting in Halifax last September (Hunt *et al.*, 2008), ESSAS has been active on several fronts. Foremost amongst these is the planning of this year's annual meetings as well as workshops at the GLOBEC Open Science Meeting.



Figure 1. The ESSAS Annual Science Meeting and Scientific Steering Committee meetings will be held in Seattle, 17-20 June 2009. Seattle Lake Union and Mt Rainer photograph courtesy of Tim Knight, University of Washington.

### 2009 ESSAS Annual Meetings

ESSAS will hold its 2009 Annual Science Meeting (ASM) and Scientific Steering Committee (SSC) Meeting 17-20 June in Seattle, Washington, USA, the week prior to the GLOBEC Open Science Meeting in Victoria, BC, Canada. Activities planned for the ESSAS 2009 Annual Science Meeting (Fig. 1) include:

- George Hunt (USA), host for the meeting and ESSAS Co-Chair, will convene a session on ongoing work initiated at annual ESSAS meetings held in Hakodate, Japan (2007) and Halifax, Canada (2008). This will include a presentation on "Hotspots: Areas of High Biomass Concentrations in sub-Arctic Seas" that focuses on where hotspots are located, and the physical/biological processes that determine such hotspots. Also, a report on the progress of a paper on ecological thresholds in sub-Arctic marine ecosystems will be given.
- Ken Drinkwater (Norway) will convene a half-day workshop on Advective Processes that will be conducted jointly with scientists from the Arctic Sub-Arctic Ocean Fluxes (ASOF) programme, a subprogramme of International Study of Environmental Arctic Change (SEARCH). ASOF has been measuring volume, heat, and salt exchanges between Arctic and sub-Arctic regions. In addition to presentations on advection and its effects on by both ASOF and ESSAS scientists, discussions will be held to develop greater cooperation and collaboration between ESSAS and ASOF.
- Earl Dawe (Canada) and Franz Mueter (USA), Co-Chairs of the new ESSAS Working Group on Climate Effects at Upper Trophic Levels, will co-convene a half-day workshop on gadoid-crustacean interactions. A number of sub-Arctic ecosystems have experienced major 'regime shifts' in fishery resources between demersal fish and crustaceans. The workshop will review gadoid-crustacean dynamics and the possible role of physical forcing and fisheries on population shifts between demersal and crustacean species in several of the sub-Arctic regions. A half-day closed session will be convened for Working Group members to initiate a comparative study of gadoids and crustaceans across multiple sub-Arctic marine ecosystems with the goal of producing one or more peer-reviewed publications.
- Jim Overland (USA), Chair of the Working Group on Regional Climate Prediction, will present results of their research conducted on issues related to climate change, including the International Panel on Climate Change (IPCC) model-selection techniques for downscaling. In addition, Mike Wallace of the University of Washington will give an invited presentation on climate prediction issues.
- Bernard Megrey (USA), Chair of the ESSAS Working Group Modelling Ecosystem Response, will convene a workshop to report on the design and construction of a state-of-the-art, fully integrated biophysical ecosystem model. The proposed model will use a general ocean circulation model based on the Regional Ocean Model System (ROMS), include biogeochemical cycles, nutrient dynamics, and primary and secondary production using multiple functional groups and a spatially explicit individual-based model to represent upper trophic levels. The latter will initially include only fish but could be extended to include birds and marine mammals. A proposal to build such models for the eastern Bering Sea and the Barents Sea will be explored. In addition, this workshop will present an update on development of a manuscript to report comparative ECOPATH modelling results initiated at the 2008 Annual Science Meeting.

The ESSAS Scientific Steering Committee (SSC) will meet in Seattle on 17 June just prior to the (ASM), and for a half-day on 20 June. Major topics of discussion at the 2009 SSC meeting will include: proposal to join IMBER when GLOBEC officially comes to an end in 2009, planning for the ESSAS Open Science Meeting in Spring 2011, future funding for ESSAS, and planning for ESSAS activities in 2010.

**ESSAS participation at the 2009 GLOBEC OSM**

ESSAS will also be active in the 2009 GLOBEC Open Science Meeting (OSM) in Victoria, BC, Canada, 22-26 June 2009.

The workshop on "Comparison of processes and climate impacts in sub-Arctic and Antarctic marine ecosystems: observations and modelling approaches" was initiated by ESSAS and is co-sponsored by ESSAS and the Integrating Climate and Ecosystem Dynamics (ICED) programme, which focuses on the Antarctic. It takes place 22-23 June with convenors from the ESSAS SSC, George Hunt (USA), Bernard A. Megrey (USA), Hyoung-Chul Shin (Korea), as well as Sei-ichi Saitoh (Japan), and ICED co-chairs Eileen Hofmann (USA) and Eugene Murphy (UK). The workshop will consist of open papers and discussion to compare (or facilitate comparison) between maritime Antarctic and sub-Arctic seas including observations, modelling of ecosystem processes, and impacts of climate on higher trophic levels (fish, seabirds, marine mammals, and fisheries). Focus will be placed on mechanisms, expected changes, and identification of non-linear forcing factors (thresholds) of ecosystem change. Added focus will be given to physical and biotic themes such as: climate effects on stratification/mixing/frontal structures with implications for biota. Case studies will be used to examine the effects of physical processes (sea ice, wind, and advection) on lower and higher trophic levels, and their effects on interactions between trophic levels. This workshop will provide an opportunity for ecosystem modellers in Antarctic and sub-Arctic research communities to compare approaches and progress toward developing functional end-to-end models to illustrate the effects of climate change on marine ecosystems, and the ability of these models to support management of upper trophic level organisms, including sustainable fisheries. Comparisons at this level will help to establish baseline topologies of marine ecosystem useful to future GLOBEC and IMBER studies.

An ESSAS sponsored workshop on "Climate impact on ecosystem dynamics of marginal seas" will be held on 23 June. Co-chaired by ESSAS SSC member Yasunori Sakurai (Japan) along with Christian Möllman (Germany), it will examine the impact of climate (climate variability/climate change as observed through phenomena such as the North Atlantic Oscillation, the Arctic Oscillation and the Pacific Decadal Oscillation) on marginal seas and semi-enclosed ecosystems, which contribute substantially to world fisheries. Results from GLOBEC studies, mainly focusing on higher trophic levels (zooplankton and fish), will be presented. The goal is to facilitate synthesis of these results through comparison of ecosystems such as the Barents Sea, North Sea, Mediterranean Sea, Baltic Sea, Black Sea, East China Sea, Yellow Sea, Sea of Okhotsk, Sea of Japan, Georges Bank, Bering Sea, Gulf of Alaska, Scotian Shelf, and others.

In addition several ESSAS members will be participating in the workshop on "Modelling ecosystems and ocean processes: the GLOBEC perspective of the past, present and future" during 22-23 June. It will be chaired by ESSAS representative Enrique Curchitser (USA) along with Alejandro Gallego (UK), Michio Kishi (Japan) and Emanuelle Di Lorenzo (USA) and structured along four sub-topics: physical and biophysical models

from regional to basin scale; advanced ecosystem models, statistical biological/physical models, and future modelling frontiers. The workshop will describe, compare, and contrast these different modelling approaches, and their ability to elucidate physical/biological dynamics. Invited speakers will discuss results from various GLOBEC regional programmes, national activities, and multinational programmes, as well as future directions in modelling. Speakers will also present modelling strategies to investigate critical aspects of ecosystem dynamics such as climate change and resource management.

Attendance at these workshops is open to all registered participants at the GLOBEC Open Science Meeting.

**ESSAS activities at the PICES 2008 Annual Meeting**

ESSAS was also busy on several different fronts during the last six months including involvement at the 17th Annual Meeting of the North Pacific Marine Science Organization (PICES) held 23 October - 2 November 2008 in Dalian, People's Republic of China.

***IPY Workshop***

ESSAS co-sponsored the workshop on "Status of marine ecosystems in the sub-Arctic and Arctic seas – Preliminary results of International Polar Year (IPY) field monitoring in 2007 and 2008". ESSAS Co-Chairs, Ken Drinkwater and George Hunt joined Sei-ichi Saitoh (Japan) and Jinping Zhao (China) convened the workshop which consisted of 17 presentations and 4 posters. Dr. Bob Dickson (UK), the keynote speaker, discussed the Integrated Arctic Ocean Observing System (IAOOS), providing a synthesis of physical oceanographic data collected in Arctic and sub-Arctic regions as part of IPY. He stressed that collaborative efforts of nations participating in IPY allow us to view the Arctic ocean-atmosphere-cryosphere system as a complete unit for the first time. Of particular importance is the close connection and interaction between Arctic and sub-Arctic regions.

ESSAS coordinates the multinational IPY consortium, Ecosystem Studies of Subarctic and Arctic Regions (ESSAR), which includes 11 projects being conducted by 8 different nations plus one international programme. Most of the workshop's talks and posters presented results from projects within the ESSAR consortium, including studies by China, Japan, USA, Norway and the international Trans North Atlantic Sightings Survey (T-NASS) that focused on cetaceans. An overview of the work being carried out within ESSAR was presented by Ken Drinkwater.

T-NASS presented results from the first North Atlantic-wide cetacean survey in the North Atlantic and comparisons with earlier surveys (since the late 1980s and conducted approximately every 5 years). China reported on recent data collected during their 2008 survey crossing the Bering Sea and reaching into the Arctic to over 80°N, which illustrated the importance of inflowing Bering Sea water in modifying Arctic water mass conditions and structure. Of particular importance, the heat carried by this flow has played a significant role in the rapid melting of Arctic ice in recent years. Hydrographic data collected in the Bering Sea



by China during 2008 indicate a large quantity of cold water below 40 m on the northern Bering Shelf between the 40-100 m isobaths that extends south onto the continental shelf. It was speculated that this cold water formed either in Anadyr Bay or south of St. Lawrence Island. Dr. Mizobata (Japan), an invited speaker, presented 2008 observations that extended north to 71°N in the western Arctic. He discussed the role of circulation and eddies in transporting shelf water into the Arctic deep basin and confirmed the role of heat flux through the Bering Strait on ice retreat in the Arctic. Other speakers noted increased primary production in open Arctic waters that were previously ice covered and that Arctic cod decreased in abundance and moved farther north in 2007. Another Japanese study noted the importance of Sea of Okhotsk as an important source of iron for the western sub-Arctic Pacific. Norway's IPY ecosystem programme in the Barents and Norwegian Seas examined the fronts between the cold Arctic waters and warm Atlantic waters and found the hydrography of the fronts seems to structure the biology, including fish and their feeding patterns. Dr. Lee Cooper (USA), another invited speaker, discussed approaches used in two US-based IPY programmes affiliated with ESSAS: the Bering Sea Ecosystem Study (BEST); and the Bering Sea Integrated Ecosystem Research Program (BSIERP). He highlighted the large changes since 1970 in benthic biomass and community structure in the Bering Sea, and discussed changes in primary production and biomass under different oceanographic conditions.

A short discussion at the end of the workshop focused on the need for scientists to meet to compare and contrast their data, and that these meetings should include not only scientist from NESSAR projects, but also scientists from other IPY programmes as well. ESSAS looks forward to promoting such collaboration.

On the social side, Dr. Jinping Zhao, who grew up near Dalian, treated the other co-convenors, the invited speakers and several of his Chinese colleagues, to a special Chinese meal at one of the best restaurants in Dalian (Figs. 2 and 3). The meal truly was a delight to both the eye and the palate and allowed us to become more acquainted with one another.

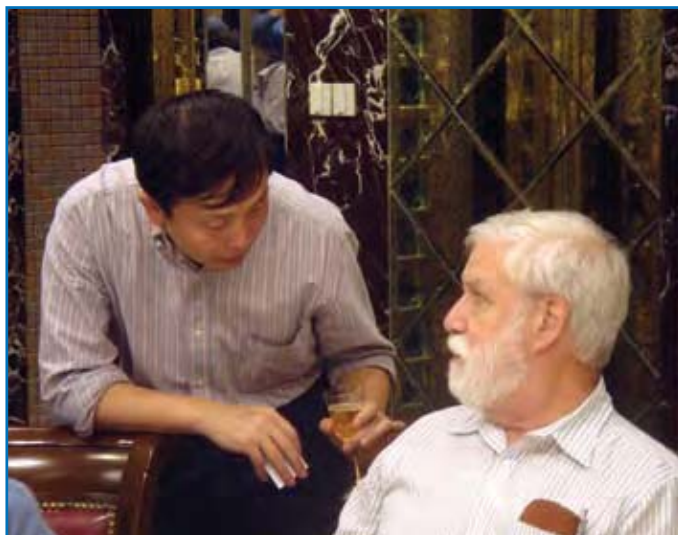


Figure 2. Jinping Zhao and George Hunt in discussions over dinner.

**Modelling workshop**

ESSAS also co-sponsored the workshop on “Marine Ecosystem Inter-Comparisons” with co-convenors Bern Megrey (Fig. 4) and Masahiko Fujii and Shin-ichi Ito (Japan). This workshop was also part of the PICES working group on Marine Ecosystem Model Inter-Comparison, which was meeting for the first time. Comparative analysis is a powerful technique for understanding the important similarities and differences between and among ecosystems. The working group was organised to promote model comparisons using different models to develop forecasts of different ecosystems. The intention is to develop ensemble model forecasts to compare predicted and observed responses of marine ecosystem types to global changes.



Figure 4. Bernard Megrey (modelling “Cranberry”), Chair of the ESSAS Working Group on Modelling Ecosystem Response who led the Modelling Workshop at the PICES 2008 Annual Meeting.

The keynote presentation was by Dr. Fei Chai (USA) who discussed a model comparison conducted under US-JGOFS in which 12 lower trophic level biogeochemical models of varying complexity were objectively assessed in two distinct regions (equatorial Pacific and Arabian Sea). Dr. Icarus Allen (UK), an invited speaker, introduced the topic of model skill assessment and described several objective approaches of assessing model skill. Bill Petersen (USA), Hal Batchelder (USA), and Toru Kobari (Japan) reviewed krill and copepod biology and ecology. After the presentations, a lengthy discussion took place on five main questions intended to frame the preparation of a work plan: 1) identifying the objective of the models used for inter-comparison, 2) which models to compare, 3) identify location(s) for comparison, 4) identify comparison



Figure 3. Sei-ichi Saitoh and his wife enjoying the dinner in Dalian.

protocols (model skill assessment), and 5) identify indicator species. Plans were developed to solicit both active participation in the working group and model contributions. The objective of the model inter-comparison will be to apply several models to one location to identify important mechanisms that control secondary production abundance and variability as well as bounding the levels of uncertainty in model predictions by calculating ensemble statistics. This approach can be applied to several places simultaneously. The working group will hold future discussions to identify suitable locations where the models can be applied. During the meeting a schedule of activities was proposed and accepted. A hands-on modelling workshop will be convened at the next PICES Annual Meeting October 2009 in Jeyu, Korea to compile observational data and begin model construction, parameterisation, and comparison.

**Session on end-to-end food webs: impacts of a changing ocean**

Although not formally co-sponsored by ESSAS, George Hunt joined Hiroaki Saito (Japan) and Sinjae Yoo (Korea) to co-convene a day and a half PICES theme session that was co-sponsored by IMBER. The session consisted of four invited speakers, Chang-Keun Kang (Korea), Orio Yamamura (Japan), Angelica Peña (Canada), and William Sydeman (USA) plus 22 contributed talks and ten posters. The session focused on the need for a holistic end-to-end approach to study the impacts of global change in marine food webs, including the influences on biogeochemistry and feedbacks to climate. This food web approach includes the energy transfer and nutrient cycles of traditional food webs, but emphasizes the importance of understanding food web dynamics simultaneously at all levels and scales, including the activities of humans.

**ESSAS contributions to ICES**

During the 2008 ICES Annual Science Meeting in Halifax (Fig. 5), Nova Scotia, Gary Stenson (Canada), Ken Drinkwater and Kai Wieland (Denmark) co-convened a theme session on the role of sea ice in polar ecosystems with Gary Stenson



Figure 5. Michio J. Kishi and Bernard Megrey discussing business at the Halifax meeting.

(Canada). It consisted of 15 papers and 8 poster presentations, of which 5 presentations and 1 poster were products of the ESSAS Workshop on the role of sea ice in sub-Arctic seas that was held in Hakodate, Japan, in June 2007. Current climate models (and observations) indicate that polar ecosystems are rapidly changing are predicted to continue to lose sea ice. The reduction of ice cover has significant impacts on marine organism including: increased wind-induced vertical mixing, loss of habitat for ice-dwelling organisms, increased surface layer temperatures; lower salinity due to melting, higher stratification, and increased primary production. The meeting provided the opportunity to facilitate interaction between the ICES and IPY communities.

**ESSAS affiliated programme (MENUII)**

The MENU (comparative studies of Marine Ecosystems in Norway and the US) project was one of the multinational activities within ESSAS, and part of the Norway-US bilateral agreement on cooperative research. The project consisted of a workshop funded by the Research Council of Norway that was held just outside Bergen Norway in 2006. The overall goal of the workshop was to initiate a comparative study largely based on observed data of variability in marine ecosystem structure and function in eastern Bering Sea/Gulf of Alaska, Georges Bank/Gulf of Maine, and Barents Sea/Norwegian Sea regions. From this workshop five comparative papers were written that will appear in a special volume of Progress in Oceanography in 2009.

Building upon this work, participants submitted full proposals to their national funding agencies in Norway and the United States during 2008 in an attempt to further these comparative studies, this time with a focus on modelling. The model comparisons fell within four categories: previous developed ECOPATH studies of different sub-Arctic regions; production models used in fisheries assessment such as virtual population models; biophysical models that consider 3-D hydrodynamic models and the lower ends of the food chain (phytoplankton and zooplankton); and system models that include fish and fisheries, in particular the ATLANTIS model.

The Norwegian proposal, entitled MENUII, has been funded (2009–2011) by the Norwegian Research Council. A similar US proposal was submitted under the NSF/NOAA CAMEO call for proposals but although it received high praise by reviewers, it was not funded. This was in part due to the much reduced funding for CAMEO in 2008 than expected. The US participants are planning to resubmit the proposal and are hopeful that funding will be secured this year. The two proposals contained extensive collaboration by jointly undertaking comparative studies. Such comparative studies are delayed but it is hoped that they will begin in 2010. Meanwhile the Norwegians will begin development of the ATLANTIS model for the Barents Sea and the Norwegian Sea, and begin comparative model studies between these seas and the North Sea.

**Reference**

Hunt G., K. Drinkwater and M. McBride. 2008. Ecosystem Studies of Sub-Arctic Seas (ESSAS) programme update. GLOBEC International Newsletter 14(2): 34-35.