

Update on recent ESSAS activities

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ESSAS 2009 Annual Science Meeting

The Ecosystem Studies of Sub-Arctic Seas (ESSAS) programme convened its 2009 Annual Science Meeting (ASM) 18–19 June at the University of Washington in Seattle, Washington, USA, and was attended by 70–80 scientists from at least eight different countries. The ASM began with a half-day workshop on “Gadoid-Crustacean Interactions” sponsored by the ESSAS Working Group on Climate Effects at Upper Trophic Levels. This, the newest ESSAS Working Group (WG), is conducting comparative studies between different sub-Arctic seas to elucidate the processes that lead to population shifts between demersal fish (particularly gadoids such as cod and pollock) and crustaceans (such as shrimp and crabs). Two keynote addresses on crab dynamics presented by David Armstrong (USA; Fig. 1) and Svein Sundby (Norway) were followed by regional reviews of gadoid-crustacean dynamics, environmental conditions, and the effects of targeted fisheries for several ESSAS areas including: the Oyashio, Bering Sea, Newfoundland/Labrador, West Greenland, Iceland, and the Barents Sea.

In contrast to the results of previous studies that suggest top-down control of shrimp populations by cod, these overviews revealed no general pattern across the six regions. Rather, they suggest relatively little control by cod on either shrimp or crab populations. The reviews also revealed substantial variability across ecosystems: some systems exhibiting fluctuations of shrimp and cod that were in phase; other systems showed out-of-phase relationships. The WG agreed that more research was needed to establish the extent of spatial overlap among gadoid and crustacean stocks, and that the extent of match or mis-match between populations should be quantified. Other areas of research needed include: the influence of alternative prey on the temporal variability in predation by gadoids on shrimp and crab; and changes in the diets of gadoids as a function of size and season. The WG will follow up on these issues, and is considering writing a paper comparing gadoid-crustacean interactions in the different regions.



Figure 1. A canary in the cold pool: majid crabs reflect shifts in climate and community structure. From: “General overview of crab dynamics” by David Armstrong (University of Washington, USA).

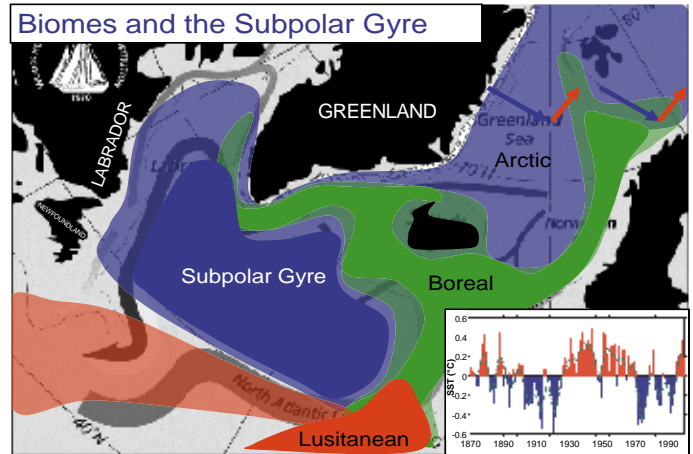


Figure 2. North Atlantic sub-polar gyre variability. From: “Sub-polar gyre variability and its effect on blue whiting” by Hjálmar Hátún (Faroe Marine Research Institute, FO).

Next was a half-day workshop on the “Role of Advective Processes in Sub-Arctic Ecosystems” conducted jointly with scientists from the Arctic Sub-Arctic Ocean Fluxes (ASOF) programme. The aim was to exchange information between ASOF and ESSAS, and to explore potential for future collaboration between the two programmes. ASOF has measured exchanges between Arctic and sub-Arctic regions over the last five years, and is now moving into phase two of its research programmes; through collaboration with ESSAS they wish to investigate the effects of these exchanges on the flora and fauna. Nine presentations were made on various aspects of transport and their effects - three by ESSAS and six by ASOF. Topics included physical oceanographic dynamics, circulation patterns, and flows in the Bering Sea/Bering Strait, the Barents Sea, and the North Atlantic sub-polar gyre (Fig. 2).

Circulation patterns in the Sea of Okhotsk were shown to carry significant quantities of iron into the northwest Pacific, with increases to primary production in the region. At West Greenland, offshore transport of low salinity water into the northeastern Labrador Sea leads to an early spring bloom in the region – by establishing sufficient vertical stratification for the phytoplankton to grow. Initial results from the Atlantic Bloom Experiment southeast of Iceland were presented using state-of-the-art sampling platforms with gliders to follow the initiation and development of a bloom. An example of the role of advection on zooplankton distribution in the Oyashio region off Japan was given, and a talk on the effects of changes in circulation of the sub-polar gyre on blue whiting in the northeast Atlantic. Following the presentations, a discussion of potential future collaborations between ESSAS and ASOF was conducted. Possibilities included: placing biological sensors on ASOF moorings; use of ASOF transportation estimates to determine biological fluxes; developing joint proposals for new field research aimed at determining processes through which advection influences biota; and cooperative modelling studies. These possibilities will be further explored during the coming year.

The ESSAS Working Group on Regional Climate Prediction presented its final report. James Overland (WG Chair, USA) opened the morning session of the final day with a presentation on “Climate Forcing of Marine Ecosystems”, explaining that this WG’s charge was to determine which of the International Panel on Climate Change (IPCC) Global Circulation Models (GCMs) could most usefully be downscaled to regional models of sub-Arctic seas. Based on how well the GCMs performed in hindcasting recent climate scenarios, a review of GCMs was published for several sub-Arctic seas with the selected GCMs differing between regional seas (Bond and Overland, 2007; Wang *et al.*, 2007, 2010).

It was also suggested that a suite of GCMs should be used when downscaling to regional models. A “best practices” manual for downscaling is also being written. Subsequently, Mike Wallace (USA) gave an open lecture entitled “Global modes of climate variability on regional ecosystems”. The global modes included the Northern and Southern Annular Modes centred over the Arctic and the Antarctic, respectively, as well as the *El Niño*-Southern Oscillation (ENSO) and the Pacific-North America (PNA). These modes were shown to impact regional coastal systems such as the sub-Arctic ecosystems, through their effects on winds, precipitation, and temperature patterns.

George Hunt (ESSAS co-chair, USA) provided an update on work initiated at the ESSAS 2007 ASM on biological hotspots in sub-Arctic seas, i.e. areas of high biomass concentrations. A paper on the location of biological hotspots, and the physical/biological processes which determine them, is being written and should be completed by next year’s meeting. Mike Sigler (USA) presented a paper on forage fish hotspots in southeast Alaska, and their influence on Stellar sea lions. He showed that geographical persistence of the prey may be just as important as density of prey aggregations to predators, particularly for predators that do not have the ability to search large areas efficiently.

The final ASM workshop was sponsored by the ESSAS Working Group on Modelling Ecosystem Response to discuss development of different end-to-end models, and methods to compare and

contrast different models. Presentations were given on three different types of end-to-end models:

- The Bering Sea Model called FEAST (Forage and Euphausiid Abundance in Space and Time) is an upper trophic level model that includes zooplankton and fish. FEAST connects to a lower trophic model, and also provides input to a fisheries and economic model;
- The ESSAS Modelling WG is developing a fully integrated biophysical ecosystem model that will be coupled to a hydrodynamic model using the Regional Ocean Model System (ROMS). It will include biogeochemical cycles that support biological production (nutrient dynamics), primary/secondary production using multiple (nutrient, phytoplankton, zooplankton) functional groups, and a spatially explicit individual-based model to represent upper trophic level functional groups – initially fish, but could be extended to include birds and marine mammals; and
- ATLANTIS – an end-to-end model developed in Australia – that incorporates physics, fish, fisheries, and economics. ESSAS was informed about the application of ATLANTIS in the California Current to explore different fishery management scenarios, and the planned development of an ATLANTIS model for the Barents Sea (Fig. 3);
- A final presentation was given on minimal ecosystem models to remind us that sometimes simple models may be the best way to answer some fishery questions.

These presentations were followed by a lively debate on various aspects of ecosystem modelling, and how to carry out comparative modelling studies.

ESSAS 2009 Scientific Steering Committee meeting

The annual meeting of the ESSAS Scientific Steering Committee (SSC) was held 17–20 June in Seattle, Washington, USA. The SSC guides ESSAS and plans/carries out ESSAS programmes and activities. The most important issue addressed was the future of ESSAS after the Global Ocean Ecosystem Dynamics (GLOBEC) project sunsets at the end of 2009. Following

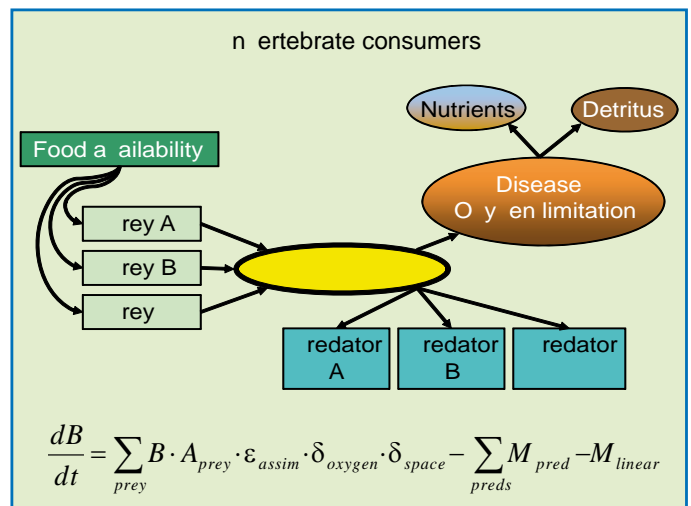
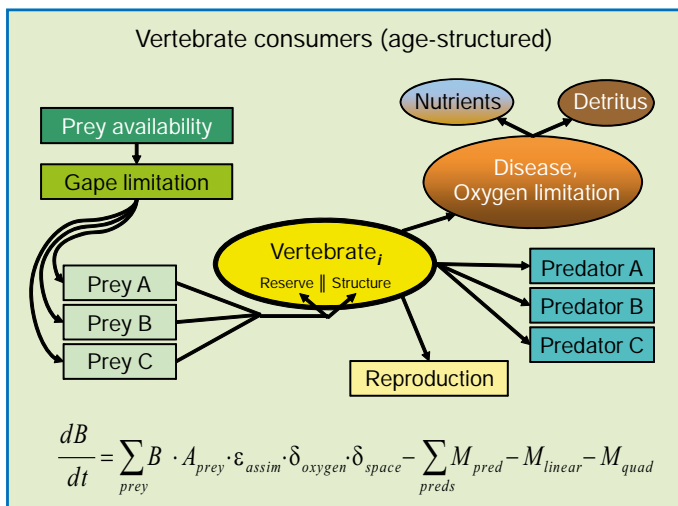


Figure 3. Modelling of invertebrate groups as biomass pools. From: “Atlantis ecosystem models for the California Current” by Isaac Kaplan (NOAA NW Fisheries Science Center, USA).

a presentation by Julie Hall, Chair of Integrated Marine Biogeochemistry and Ecosystem Research (IMBER), the ESSAS SSC voted unanimously to join IMBER. ESSAS looks forward to working within IMBER, and with the other regional IMBER programmes.

Discussions also concerned the future of ESSAS WGs. The WG on climate predictions has now fulfilled its terms of reference, and has been terminated. The possibility of forming a new ESSAS WG to investigate the ecological impacts of future climate change on the sub-Arctic seas was discussed. A motion passed to postpone any decisions on what the terms of reference should be for such a WG until after the PICES/ICES Symposium on Future Climate Predictions takes place in Sendai, Japan in the spring of 2010. The ESSAS Working Group on Biophysical Coupling will terminate with its completion of the paper on hotspots. Work on the role of advection in sub-Arctic ecosystems will continue and may form the basis of a new WG. The WG on Modelling will continue its development of an end-to-end model, as well as its comparative modelling studies between regions and between different types of models. The Working Group on Climate Effects on Upper Trophic Levels, having gathered relevant data sets – describing the environment, fish, and invertebrate species – for many of the sub-Arctic seas, will undertake extensive comparative studies to understand the processes linking climate variability and gadoid-crustacean dynamics.

Planning for the ESSAS 2011 Open Science Meeting

Another important issue discussed by the SSC was planning of the ESSAS Open Science Meeting in 2011; further work on this has been carried out since the SSC meeting. Given that ESSAS is now mid-way through its cycle, a meeting would be an opportunity to present ESSAS results and determine new avenues of research for the coming years. It was decided to hold the meeting in Seattle, pending exploration of costs and meeting facilities. The PICES secretariat has offered to help with logistics for the meeting. The North Pacific Research Board, the Alaska Fisheries Science Center and ICES have agreed to provide financial support for the meeting and the latter has also agreed to provide a special volume of the ICES Journal of Marine Research. An SSC for the meeting has been established, conveners identified and several different theme sessions have been proposed with potential co-chairs, and potential venues being explored. Decisions on the sessions and venue will be made soon.

Planning for the ESSAS 2010 Annual Science Meetings

Planning of next year's Annual Science Meeting is well underway. It will be held in Reykjavik, Iceland from 30 August to 1 September, with the annual meeting of its Scientific Steering Committee held during the following two days. These meetings will be hosted by the Iceland's Marine Research Institute. Tentative plans include workshops on comparing ecosystem changes in the Iceland Sea, off West Greenland, and in the Labrador Sea; on modelling sub-Arctic marine ecosystems; and on gadoid-crustacean interactions. Tentative plans for workshops and activities have been made. Planned

ESSAS activities were presented to the ICES Regional Seas Steering Committee; resulting in an agreement to collaborate and be associated with this committee. Consequently, ICES has proposed that ESSAS become an ICES Expert Group, and that the 2010 ESSAS ASM become an ICES Workshop, with a request that outcomes of the ESSAS 2010 ASM be reported at the ICES 2010 Annual Science Conference in Nantes, France. ESSAS has agreed to this, particularly in recognition of ICES support for the ESSAS 2011 Open Science Meeting (OSM). As result, ICES will advertise the ESSAS OSM, and encourage member countries to send scientists to Reykjavik.

Other results and activities

- Important ESSAS publications in 2009 include five papers from its MENU (Marine Ecosystem Comparisons of Norway and the US) project, other papers from the MENU-sponsored ICES theme session on comparative studies published in *Progress in Oceanography*, as well as the Barents Sea ecosystem book edited by E. Sakshaug, G. Johnson, and K. Kovacs that was partly supported by N-ESSAS, the Norwegian ESSAS project.
- ESSAS co-chair (George Hunt) led the drafting of the Bering Sea chapter of the PICES North Pacific Ecosystem Report update which is due to be published in 2010.
- ESSAS WG3 met twice in a joint effort supported by the US Comparative Analysis of Marine Ecosystem Organization (CAMEO) programme and ESSAS to develop an end-to-end model of marine ecosystem response to climate variability that will incorporate climate, fish, and fisheries.
- A special issue of *Progress in Oceanography* has been set aside for papers from the Norway-Canada Comparisons of Marine Ecosystems (NORCAN) project which hopefully will be published late in 2010. Guest editors for this issue are Pierre Pepin (Canada) and Ken Drinkwater (Norway).

Thanks to GLOBEC

In this the final issue of the GLOBEC Newsletter, we at ESSAS want to express our gratitude and sincere thanks to GLOBEC and its International Project Office for the support and encouragement over the past years. Without this support, ESSAS would not have been able to accomplish much of what it has to date. They have helped to provide for us a solid foundation on which to head into our future as part of IMBER. GLOBEC will be gone, but not forgotten. We extend many thanks and all the best to GLOBEC scientists and visionaries, and a special thank you to those at the GLOBEC IPO.

References

- Overland J.E., and M. Wang. 2007. Future regional Arctic Sea ice declines. *Geophysical Research Letters* 34(17): L17705, doi: 10.1029/2007GL030808.
- Wang M., N.A. Bond and J.E. Overland. 2007. Comparison of atmospheric forcing in four sub-arctic seas. *Deep-Sea Research II* 54(23–26): 2543–2559.
- Wang M., J.E. Overland and N.A. Bond. 2010. Climate projections for selected large marine ecosystems. *Journal of Marine Systems* 2(3–4): 258–266.