

PICES hosts GLOBEC Symposium on “Climate Variability and Sub-Arctic Marine Ecosystems” in Victoria



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Dr. Kenneth Drinkwater is a fisheries oceanographer conducting research on climate variability and its effects on the marine ecosystem, with a special interest in fish populations. Having worked many years at the Bedford Institute of Oceanography in Canada, he is now working at the Institute of Marine Research in Bergen, Norway. Ken is a member of the GLOBEC Focus 1 Working Group on Retrospective Analysis, and Co-Chairmen of the Scientific Steering Committee (SSC) of a new GLOBEC regional program on Ecosystem Studies of Sub-Arctic Seas (ESSAS).

Dr. George Hunt has 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. He received his BA (1965) and PhD (1971) in Biology from Harvard University, and began teaching and research at UCI in 1970. Now he divides his time between Seattle and Friday Harbor, Washington. George started his career studying the behavioral and reproductive ecology of gulls in southern California and British Columbia. This work led to studies of seabird reproductive ecology on the Pribilof Islands and the foraging ecology of seabirds in the Bering Sea, the Barents Sea, the North Water Polynya, and the Southern Ocean. 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 the past Co-Chairmen of PICES WG 11 on “Prey consumption by marine mammals and seabirds in the PICES area”, and is a newly appointed member to the CFAME (Climate Forcing and Marine Ecosystems) Task Team.

The Sub-Arctic seas support stocks of commercial fish that generate a major portion of the fish landings of the nations bordering them. They also support subsistence fishers along their coasts, and vast numbers of marine birds and mammals. Several factors make these seas unique: seasonal ice cover, large quantities of freshwater from ice-melt and runoff, dramatic seasonality, reduced sunlight and low biodiversity. Climate-forced changes in these systems will have major economic and societal impact.

In recent decades, components of Sub-Arctic sea ecosystems have shown unexpected changes in abundance or distribution that, in many cases, correlated with physical variability. The high spatial and inter-annual variability of the Sub-Arctic seas provide the opportunity to use short-term variability as a proxy for studying their responses to variability at longer time scales. There is growing concern about the expected level of anthropogenic-induced climate change in the Sub-Arctic seas: these areas are forecast to

undergo the largest changes outside of the high Arctic. Understanding the underlying processes responsible for ecosystem responses is the basis for providing good stewardship as these dynamic regions evolve.

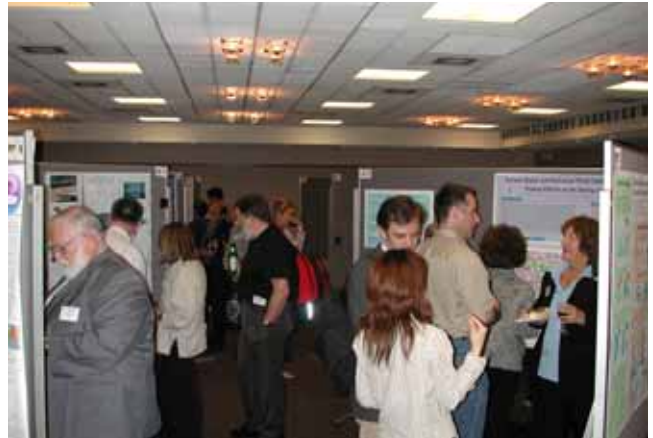
With this background, a new GLOBEC regional program, Ecosystem Studies of **Sub-Arctic Seas** (ESSAS), has recently begun, whose objectives are to compare, quantify and predict the impact of climate variability and global change on the productivity and sustainability of Sub-Arctic marine ecosystems. Improved insights into the role of climate variability on Sub-Arctic marine ecosystems will be sought through comparative studies between the Sub-Arctic regions.

To kick off ESSAS, GLOBEC organized a symposium on “Climate Variability and Sub-Arctic Marine Ecosystems” at the magnificent Conference Centre in Victoria, B.C., Canada, on May 16-20, 2005. The Symposium’s scientific

Highlights of the ESSAS Symposium



Panel-led discussion on regional comparisons on the first day of the Symposium.



Participants mingle at the Poster Session.



Drs. Ken Drinkwater, Francisco Werner and Keith Brander at the Museum Reception.



Drs. Takashige Sugimoto, Sanae Chiba, Masahide Kaeriyama, Yasunori Sakurai and Alexander Bychkov at the Poster Session.



On-site symposium staff: Jin-Yong Lee (PICES), Dawn Ashby (GLOBEC), Christina Chiu (PICES) and Edmand Fok (DFO). [Not in photo: Jill Bell (DFO) and Julia Yazvenko (PICES)]



Closing Session summary discussion panel: Drs. Anne Hollowed, Richard Beamish, Svein Sundby and Egil Sakshaug.

objective was to present current knowledge of the effects of seasonal to multi-decadal climate variability on the structure and function of Sub-Arctic marine ecosystems. A total of 224 scientists from 16 countries participated in the meeting. The meeting began on Monday (May 16) with a one-day workshop on the new U.S. Bering Sea STudy (BEST) attended by 132 scientists, the majority of whom were from the United States. The workshop focussed on the Implementation Plan for BEST, and will help to develop the future structure of the program.

After the workshop, there was a splendid reception for all symposium and workshop participants in the First Nations Gallery of the Royal British Columbia Museum. This reception afforded participants the opportunity for informal visiting among a spectacular collection of artefacts from

the civilizations that have lived along the shores of the Pacific Northwest coast of North America.

The BEST workshop was followed by the 3-day symposium consisting of 69 oral presentations and 105 posters. The oral presentations began with a keynote talk by Richard Barber (U.S.A.) on how ocean warming in the next 50 years will affect Sub-Arctic marine ecosystems. Based on the output of 6 coupled climate ocean models with identical CO₂ forcing, the results suggested that the region between 40 and 60 degrees North would experience the most rapid warming (Fig. 1), and that there would be increased primary production levels in the Sub-Arctic and Arctic regions. These increases in primary production will be offset by reductions in the tropical and temperature oceans, resulting in little or no net change globally.

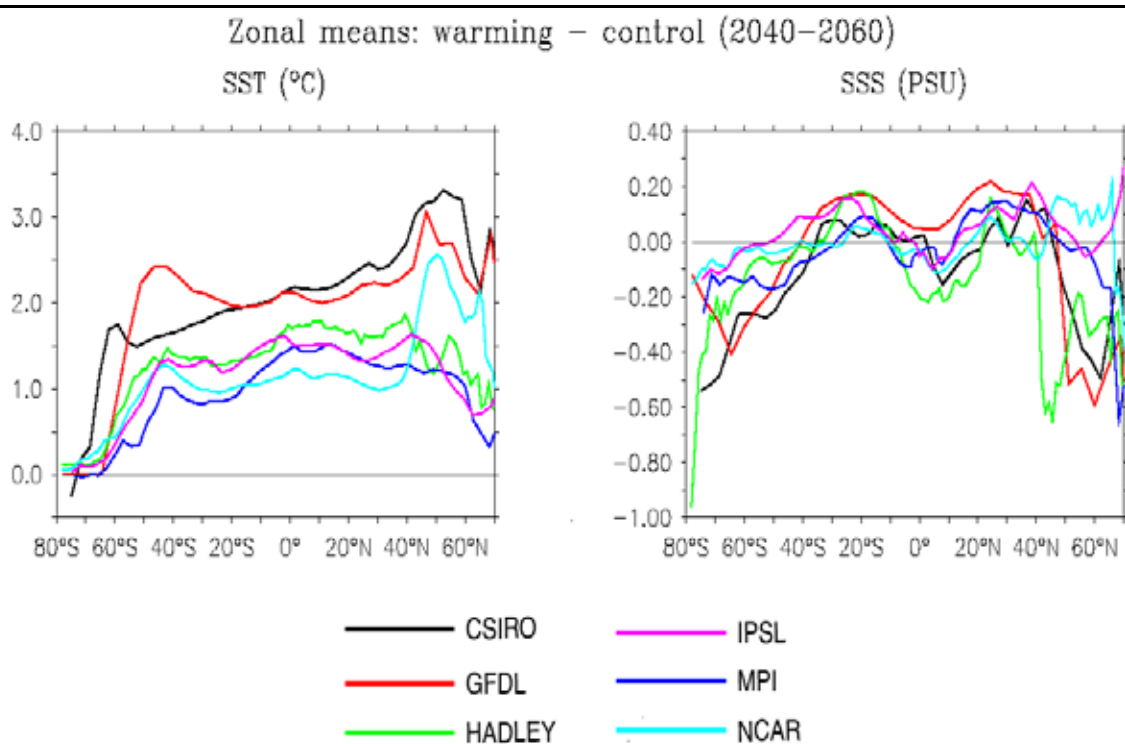


Fig. 1 The results of 6 models showing expected mean change in the Pacific Ocean SST and SSS as a function of latitude. All models predict that the greatest change in ocean temperatures will be in the northern Hemisphere between 40 and 60 degrees North (from the presentation of Barber et al. at the ESSAS Symposium).

Regional reviews on the physical oceanography and biology of 6 major Sub-Arctic regions (Barents/Norwegian Sea, Iceland, Labrador/Newfoundland, Bering Sea, Sea of Okhotsk and Oyashio) and the Antarctic were then given to provide background information and highlight similarities and differences between regions. In these talks and in presentations later in the program, several authors provided information showing increased secondary production by zooplankton and warmer temperatures (e.g., Fig. 2). A panel discussion followed to focus attention on what and how comparisons should be undertaken.

The second and third days were taken up with plenary theme sessions dealing with such issues as: what are the major biological responses in the water column to physical forcing; how will climate warming impact trophic coupling; will climate change affect the potential for trophic cascades; and what have been some of the recent climate-related changes in ecosystem structure or function. In addition, Wednesday (May 18) afternoon was spent on 4 disciplinary parallel sessions on: physics and chemistry; primary production; secondary production; and fish, shellfish, seabirds and mammals. The final theme session

of the symposium dealt with the human dimension side of climate variability in the Sub-Arctic regions. We heard from sociologists, native leaders, archaeologists and geographers on the socio-economic impacts of climate covering time periods from thousands of years ago to the present.

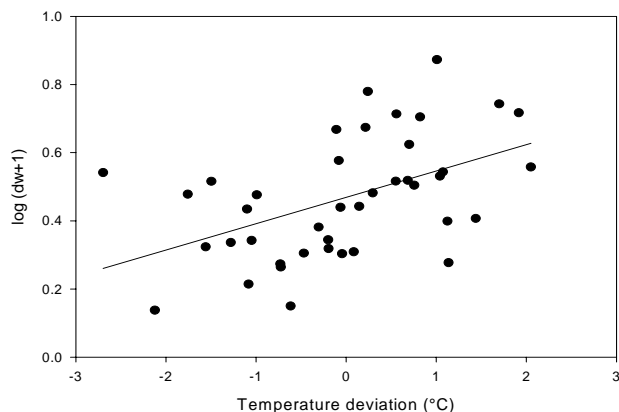


Fig. 2 Biomass of zooplankton north of Iceland as a function of temperature deviation from the long term mean (from the presentation of Astthorsson et al. at the ESSAS Symposium).

While it is impossible to highlight all of the results, it was clear that there has been strong warming with subsequent reductions in sea ice in recent years in most Sub-Arctic seas, the Sea of Okhotsk being an exception with notable cooling. In this and former periods of regional warming, northward shifts in the distribution of several plankton and fish species, and earlier spring and later autumn migrations of fish were observed. Major changes in community structure are occurring, as well as changes in the productivity and abundance of major commercial fish species. Given that modest levels of warming are expected to lead to higher primary production, and with warmer temperatures, also higher secondary production, it seems possible that production of temperate-zone fish may shift northward and increase in the Sub-Arctic seas, while more Arctic species will retreat to higher latitudes.

Large-scale atmospheric forcing of the Sub-Arctic regions was documented that can account for similar responses in widely separated Sub-Arctic seas, and opposite responses between other regions. Physical and biological data suggest a direct influence of the Pacific on the Sub-Arctic seas in the Atlantic. Biophysical models have made great strides during the past 5 to 10 years in their ability to simulate the observations and offer even greater potential within the lifetime of the ESSAS program to improve our understanding and predict future changes.

A panel discussion at the end of the presentations and reflections by Victor Smetacek (Germany) highlighted several important points. While it is clear, from the work presented, that climate variability affects the marine ecosystems, it is also equally clear that man, through industrial fishing, has played a major role in the restructuring of these ecosystems. One challenge to the scientists within ESSAS will be not only to better understand the ecosystem responses to climate forcing, but also to evaluate how these natural forcing factors interact with fishing to produce the changes that we observe. A second major challenge is to make the results of the research understandable and relevant to the communities affected, including fisheries management.

Arrangements have been made to have about 45 papers from the Symposium published in a quadruple volume of *Progress in Oceanography*. Guest editors for the volume will be Kenneth Drinkwater, George Hunt, David Mackas and Skip McKinnell. Manuscripts are due September 15, 2005, and it is hoped to have the volume published by late 2006.

The last day of the meeting was taken up with a workshop to discuss implementation plans for ESSAS. Eighty-eight enthusiastic participants heard from 12 national and international representatives on various Sub-Arctic ecosystem studies and how they might fit into the ESSAS program. In the afternoon, breakout groups provided their suggestions on how ESSAS should approach the comparison between Sub-Arctic regions and what topics should be given priority. Their ideas will be summarized and will help to formulate a way forward for ESSAS.

As convenors, we were delighted with the high quality science and the excellent presentations. The enthusiasm for the programs, and the congenial nature of the participants added greatly to the events of the week. We wish to thank all those who participated, and in particular the invited speakers and the panellists. We send a special thank you to the co-sponsors, including the U.S. National Science Foundation (NSF), the National Oceanic and Atmospheric Administration (NOAA), the Alaska Fisheries Science Center (AFSC), the North Pacific Research Board, (NPRB), Fisheries and Oceans Canada (DFO), the North Pacific Science Organization (PICES), the Global Ocean Ecosystem Dynamics Program (GLOBEC) and the Norwegian Research Council (NRC). The PICES and GLOBEC offices provided vital support, and their dedication and help were critical in making the meeting a great success.