



PICES-GLOBEC Climate Change and Carrying Capacity Program



The PICES-GLOBEC Climate Change and Carrying Capacity Program (co-chairmen: Yutaka Nagata and Patricia Livingston) is on the verge of entering a new phase in the program, a phase where we are moving away from planning and beginning to undertake cooperative research activities. All our Task Teams (BASS, MODEL, and REX) have held workshops or symposia to outline the current state of knowledge in their area of interest and to identify areas for cooperative research experiments in support of the CCCC Program. The cooperative projects that have been identified are in various stages of implementation and we have a new task team, MONITOR, formed at the last annual meeting that will be just beginning to define its program of work in the coming year. In this newsletter we hope to bring you up to date with the activities of the CCCC Program by giving you a historical perspective on how the program was formed and an idea of where we are headed. We will also report on the REX Workshop and the BASS Symposium held in conjunction with the PICES Sixth Annual Meeting in Pusan, Korea, and summarize task team plans for 1998.

A Historical Perspective on the CCCC Program

In a workshop held in Seattle in December 1991, the year before PICES was formally established, scientists agreed that an underlying scientific question of concern to the new organization was:

What is the nature of the subarctic Pacific ecosystem (or ecosystems) and how is it affected over periods of months to centuries by changes in the physical environment, by interactions among components of the ecosystem and by human activities?

Recognition of that focus was reflected in two working groups established in October 1992 by PICES in its first Annual Meeting. One, WG 3, was concerned with the dynamics of small pelagics in coastal ecosystems, the other, WG 6, on the subarctic gyre, was explicitly charged to determine the relationship between PICES interests and those of GLOBEC, the Global Ecosystem Dynamics Program under development by the Scientific Committee on Oceanic Research and other international

organizations. It was WG 6 that raised three questions that led to the development of the new PICES scientific program:

How do the various scales of physical variability affect biological processes and productivity of the subarctic North Pacific ecosystem?

What is the structure of the food web in subarctic waters and what controls its spatial, seasonal, and interannual variability?

What physical and biological oceanographic processes affect the production and carrying capacity of salmon and other nekton in the subarctic North Pacific?

The question of limitations to carrying capacity arose because of the decreasing size-at-age of returns in some salmon stocks suggesting that a finite carrying capacity was being exceeded. In light of this suggestion, a decision was reached at PICES II to organize a workshop to develop a PICES-GLOBEC program on Climate Change and Carrying Capacity (CCCC). Workshop participants were charged to:

- Develop a strategy for determining the carrying capacity of the subarctic Pacific for salmon and other high-trophic level, pelagic carnivores and its changes in response to climate variations;
- Develop a plan for a cooperative study of how changes in oceanic conditions affect the productivity of key fish species such as salmonids in the subarctic Pacific and clupeoids and scombrids in the coastal zones of the Pacific Rim.

The workshop was held in October 1994, just before PICES III, and was the culmination of an interactive process whereby a Science Plan, published in the report of PICES III, was developed. A committee structure was established by which an Implementation Plan was to be developed. That plan was adopted during PICES IV, in October 1995, and is published together with the Science Plan in PICES Scientific Report No. 4. Given that the ultimate goal of the CCCC Program is to forecast the consequences of climate variability on the ecosystems of the subarctic Pacific the following Central Scientific Issues or questions were identified in the Implementation Plan:

What are the characteristics of climate variability, can interdecadal patterns be identified, how and when do they arise?

How do primary and secondary producers respond in productivity, and in species and size composition, to climate variability in different ecosystems of the subarctic Pacific?

How do life history patterns, distributions, vital rates, and population dynamics of higher trophic level species respond directly and indirectly to climate variability?

How are subarctic Pacific ecosystems structured? Do higher trophic levels respond to climate variability solely as a consequence of bottom up forcing? Are there significant intra-trophic level and top down effects on lower trophic level production and on energy transfer efficiencies?

It was recognized that the comparative approach would be a key ingredient to the study of these Central Scientific Issues, particularly, comparative studies of the ecosystems along the continental margins of the subarctic Pacific and east/west comparisons of the subarctic gyres. The first two task teams of the program were formed to provide that key ingredient: REX, to consider regional experiments to compare findings of coastal GLOBEC and GLOBEC-like programs, and BASS, to consider development of comparative research studies in the open ocean subarctic gyres. Subsequently, two more task teams were established; MODEL, to consider modeling requirements; and most recently, at PICES VI, MONITOR to review monitoring requirements of the program. The Implementation Panel of the program (which consists of two co-chairmen, four task teams, and an executive committee) oversees and performs the work of the program. The CCC Program's goal is to integrate and stimulate national activities on the effects of climate variations on the marine ecosystems of the subarctic North Pacific through the oversight of its coordinated implementation plan. As can be seen from the recent activities of the task teams, we have many activities underway or planned for the near future designed to achieve this goal.

Recent Task Team Activities

MODEL Task Team (co-chairmen: Ian Perry and Sinjae Yoo) held a workshop in Nemuro, Japan, in June 1996, to review the roles and limitations of modeling for the CCC Program, propose the level of modeling required, and provide a plan for how to

promote these modeling activities. The results and recommendations of this workshop have previously been reported (PICES Press, vol. 4 No 2; PICES Scientific Report No. 7, 1997). Since the workshop, MODEL has been refining its role in the CCC Program and has developed the following approach. The task team recognized that many modeling activities are already taking place regarding North Pacific physics and biology. But what seems to be lacking is the awareness and communication among these activities, and the possible linkages among physical and biological modelers, and the awareness and communication with field programs. Therefore, the primary role of MODEL has been identified as:

- Facilitate communication among modeling studies, and with field programs;
- Identify and stimulate areas of modeling that are significant to the CCC Program but which are not presently addressed; and
- Assist field programs of CCC's (e.g. REX, BASS) with model-related needs.

MODEL has recently completed several activities related to these goals. In the past year, an opportunity to explore simple mass-balance models was presented and a topic session on "Models for Linking Climate and Fish" was convened at PICES VI. In addition, North Pacific circulation modelers were contacted to explore possibilities of making model results widely available to the PICES community. An inventory and description of these North Pacific circulation models have been prepared, which includes contacts for access to results. This information will soon be available on a page within the PICES web site or by request to the Secretariat. In 1998, it is planned that this web page will be expanded to include biological models and modeling activities in the PICES areas, to serve as an information exchange for North Pacific modeling activities. Another hoped-for addition to the web page is an inventory of important but often missing components of models, such as parameterization of vertical mixing and diffusion and representations of vertical migration by zooplankton.

MODEL will be convening a small workshop in 1998 to compare lower trophic level physiological models. The purpose of this workshop is to facilitate standardization or intercalibration of these process models in order to aid comparison of ecosystem responses. It is also hoped that a nutrient database will be assembled at this workshop for modeling new production in PICES regions.

REX (Regional EXperiment) Task Team (co-chairmen: Anne Hollowed, Vladimir Radchenko, and Tokio Wada) convened a workshop October 17-18, 1997, just prior to PICES VI in Pusan, Korea. The purpose of the workshop was to review the status of national research programs and to identify areas for cooperative research experiments in support of the CCCC Program. Over 50 scientists participated in the workshop, representing approximately 40 research institutions. The focus of the workshop was to examine the possibility of applying the comparative approach to address the Central Scientific Issues identified by the Program. The workshop began with a review of the GLOBEC and GLOBEC-like research programs planned or on-going in each of the six PICES member nations. Subsequently, participants discussed coastal research programs in breakout sessions targeting forcing, lower trophic level response, higher trophic level response, and ecosystem response. The higher trophic level response sessions were further divided into four major species groups: salmon, mid-water and demersal fish, pelagic fish, and crustaceans. In each breakout session, participants were asked to review the Central Scientific Issues that pertained to the focus of the particular breakout group and to develop specific hypotheses related to these issues. Participants were also asked to discuss existing or potential research approaches to test these hypotheses and to identify barriers to implementation. A complete summary of the workshop proceedings and all of its recommendations will be prepared and published later this year in the PICES Scientific Report Series. Workshop recommendations that the team has adopted for the near future include:

- PICES member nations should compile a catalogue of historical samples and data sets which are not yet analyzed or readily available;
- Issues of standardization of sampling and analysis methods for comparative studies should be addressed;
- A two-day symposium and workshop on climate effects on small pelagic species should be convened prior to the PICES Seventh Annual Meeting in Fairbanks, Alaska; and
- A scientific session that highlights research findings of GLOBEC and GLOBEC-like programs in the North Pacific should be convened as part of the PICES Seventh Annual Meeting.

The first recommendation is a facet of the Planning and Data Assimilation Phase of the CCCC's

Implementation Plan wherein compiling a complete set of historic data for some species may need to be completed before a comparative study can begin. The second recommendation with regard to standardization or intercalibration of sampling is also an important requisite to performing certain comparative studies and the new MONITOR task team will be addressing this issue as part of its terms of reference. The last two recommendations are actions that reflect the increasing maturity, not only of the CCCC Program but also the national GLOBEC and GLOBEC-like programs operating in the regions of the North Pacific. Now that the national GLOBEC and GLOBEC-like programs have been operating for a while, researchers in these programs are ready to present some of their findings. Providing a forum for these researchers to discuss and compare research findings is a very important piece of the CCCC Program and an indication that we are entering the second phase of our Implementation Plan where observing, process studies, and modeling are being performed.

The two-day workshop and symposium on small pelagic species to be held just prior to PICES VII marks the beginning of what may become an ongoing comparative research project of the CCCC Program. It builds on the scope of the GLOBEC International Small Pelagic Fishes and Climate Change (SPACC) group, which is examining retrospective and process studies for sardines and anchovies, by including herrings, mackerels, squids, and others in its study objectives. Small pelagics are an ideal group for comparative ecosystem studies because of their wide distribution in the Pacific Rim, large fluctuations in abundance and habitat, short plankton-based food chains, and possible teleconnections between different ecosystems. Holding the workshop / symposium in cooperation with GLOBEC-SPACC forges a new link between the PICES CCCC Program and GLOBEC International, which sponsors SPACC

BASS (Basin Scale Studies) Task Team (co-chairmen: Dick Beamish, Makoto Terazaki) took a large step forward this year to meet the challenge of identifying comparative research projects in the North Pacific subarctic gyres. In order to develop plans for intensifying research in the subarctic gyres of the northern North Pacific, BASS considered it desirable to review present scientific knowledge of these features, with particular attention being given to comparisons of the eastern and western sides of the ocean basin. For this purpose, a symposium was

organized for PICES VI in Pusan on “Ecosystem dynamics in the eastern and western gyres of the subarctic Pacific.” Nine invited papers were scheduled, to start with climate and oceanic forcing of these systems and to include the several trophic levels from phytoplankton and nutrient dynamics to marine birds and mammals. Conveners were R. Beamish (Canada), M. Terazaki (Japan), S. Kim (Korea), and W. S. Wooster (USA). The presentations were followed by a discussion session in which speakers set forth their views on desirable future research. There were several recommendations on modeling and physical oceanographic research that involved mixed layer dynamics. Particularly, the importance of more small scale examination of the mixed layer, models which consider day-to-day variability in the mixed layer, and information on regional, seasonal, and interannual variation in mixed layer depth were cited as important research issues. Ocean chemistry and primary production research speakers emphasized the importance of understanding the role of iron in influencing productivity and of understanding mechanisms of nutrient transport into the area. There were a number of research recommendations involving zooplankton but one that has the most potential for comparative study was the suggestion of expanding the comparisons between eastern and western gyres to include zooplankton species composition, seasonal timing and study of life history strategies. Monitoring zooplankton species composition and examining macrocrustacea with single annual breeding seasons were also suggested areas of research. Areas that needed further study with regard to upper trophic level animals, including fish, seabirds and marine mammals, included obtaining seasonal distribution and abundance of fish inhabiting surface waters, standardization (or intercalibration) of methods for studying and sampling midwater fish, and updating data bases of seabird distribution in the North Pacific.

The BASS Task Team will be considering these research recommendations this year and deciding how they can be implemented in the near future. A discussion paper will be prepared by the symposium organizers and will be the basis for the development of a long-term work plan for BASS. Some of the

recommendations are already being implemented, such as the methods for studying and sampling midwater fish, which will be addressed by a new PICES Working Group 14 on “Effective Sampling of Micronekton to Estimate Ecosystem Carrying Capacity.” Also, some of the issues on modeling lower trophic level dynamics that were brought up at the symposium will be partly addressed by the upcoming MODEL workshop this spring.

BASS Task team also initiated some activities regarding study of the 1997/1998 El Niño. They proposed a symposium to be held in 1998 at PICES VII in Fairbanks, Alaska, to provide opportunities for researchers to present initial research findings of impacts from this event. After this preliminary opportunity to present research, it is hoped that there will be another symposium to be held sometime in 1999, to provide opportunities for more complete reporting of impacts.

The formation of a new MONITOR Task Team was approved at PICES VI in Pusan, Korea. The terms of reference for the new task team are:

- Review existing activities of PICES member nations and to suggest improvements in the monitoring of the Subarctic Pacific to further the goals of the CCCC Program.
- Consult with REX, BASS and MODEL Task Teams and TCODE on the scientific basis for designing the PICES monitoring system. Questions of standardization and intercalibration of measurements, particularly in the area of biological collections, should be addressed.
- Assist in the development of a coordinated monitoring program to detect and describe events, such as El Niño, that strongly affect the Subarctic.
- Report to CCCC IP/EC on the monitoring in the Subarctic to be implemented in the international Global Ocean Observing System (GOOS) or other related activities.

The co-chairmen of MONITOR will be Drs. Yasunori Sakurai and Bruce Taft. The rest of the Task Team members will be selected early this year and plans for implementing their terms of reference will begin.

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