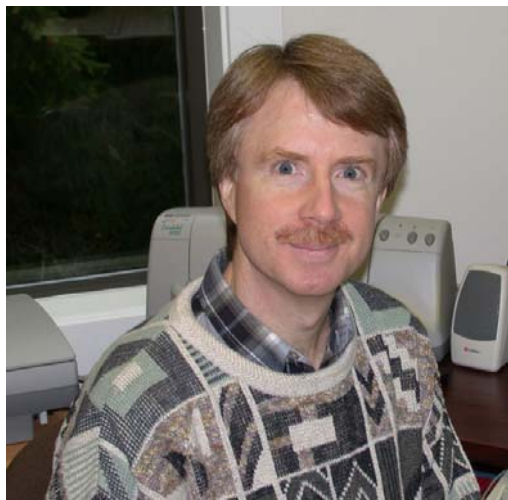

The state of PICES science – 2002

R. Ian Perry
PICES Science Board Chairman
Fisheries & Oceans Canada
Pacific Biological Station,
Nanaimo, B.C., CANADA. V9T 6N7
E-mail: perryi@pac.dfo-mpo.gc.ca



Dr. Ian Perry is a research scientist with Fisheries and Oceans Canada, at the Pacific Biological Station, Nanaimo, B.C., Canada. He is presently the Chairman of the Science Board, the top scientific committee of PICES. He is also an active member of the IGBP/SCOR/IOC GLOBEC program, having been its Vice-Chairman for the past 6 years, past-Chairman of GLOBEC Focus 1 Working Group on Retrospective and Time Series Analyses, and present Co-Chairman of GLOBEC Focus 4 Working Group on Feedbacks from Changes in Marine Ecosystem Structure. His research specialty is fisheries oceanography, with particular interests in how environmental changes affect fish population dynamics and distributions, and developing ecosystem-based approaches to managing marine living resources (which include the human dimensions).

PICES continued to be a very busy and productive international marine science organization during 2002. Seventeen workshops and symposia were held in addition to the Annual Meeting, and eight volumes of scientific papers were published, three of which were volumes of primary papers that were first presented at the Tenth Annual Meeting in October 2001. PICES continues to be a leader in the marine sciences in the North Pacific and globally, with active programs to:

- investigate mechanisms by which natural and human-induced changes affect marine ecosystems, from physics and phytoplankton to whales and seabirds;
- develop models of these processes that are useful for understanding and for forecasting; and
- develop efficient systems for long-term monitoring of the North Pacific.

After 10 years of building the organization, PICES is now ready to look forward to new issues and problems facing the North Pacific in the next 5-10 years, and to understand and offer advice on dealing with these problems. The development of the North Pacific Ecosystem Status Report, which began in 2002, is a major initiative to identify such problems.

The Annual Meetings are where many of these discussions start, but they continue in smaller committee and working group sessions. The PICES Eleventh Annual Meeting (PICES XI) provided a good sample of the breadth of these issues and discussions.

Highlights from the Annual Meeting

PICES XI, held October 18-26, 2002, marked the return of PICES to the seaside city of Qingdao, People's Republic of China. PICES last met in Qingdao in 1995 and, just like the spectacular growth and changes that this city has undergone over the past 7 years, PICES is also now a considerably larger and more active organisation. The room that held the Opening Ceremony in 1995 was, in 2002, large enough for just one of the several concurrent sessions. PICES XI was hosted by the Government of China in coordination with the PICES Secretariat, with local arrangements by the Yellow Sea Fisheries Research Institute. There were 14 scientific sessions, 5 workshops, and several Working Group meetings, with a total of 176 oral presentations and 145 posters (including 13 electronic posters). The meeting was closely coordinated with, and linked to, the GLOBEC 2nd Open Science Meeting, such that some PICES presentations were jointly sponsored with the GLOBEC meeting (see report elsewhere in this Newsletter).

The keynote lecture, titled "*The ocean's role in global change: Global oceanography has come*", was presented by Prof. Dun-Xin Hu of the Institute of Oceanology, Academia Sinica. He reviewed the major issues of global change such as climate change, the hydrological cycle, carbon cycle, and living resources. He concluded that the oceans are crucial to all these issues, and that this provides a renewed and wonderful opportunity for oceanography to expand and "go global".



Prof. Dun-Xin Hu giving the Keynote Lecture at the Opening Session.

The Keynote Lecture was followed by the theme session for PICES XI, titled “*Technological advances in marine scientific research*”. Papers dealt with aspects of new technologies in physical and biological oceanographic observations, new methods for tracking movements of fish and other large organisms, and new approaches to integrate and visualize the large volumes of data that result from these new observing techniques. The current trend is to use smaller and faster devices and to integrate multiple sampling systems, both resulting in ever larger volumes of data. Biological observation systems are taking novel approaches which use the organisms themselves as platforms to sample their environment; however, the ability of biological systems to sample rapidly over a wide range of spatial scales currently lags that of physics. Models which integrate these biological observations are also lacking. The greatest challenge to all of oceanography, however, may be outreach to the scientific community and the behaviour of individual scientists and organizations with respect to data management issues.

In recognition of this data management problem, PICES convened an electronic poster session and a joint PICES-GLOBEC workshop at PICES XI to examine data issues. The E-Poster Session, titled “*Data systems to support technological advances in observation systems*”, presented computer-based demonstrations of innovative data acquisition systems, web pages, databases, and tools for analysis and visualization. Many of these presentations are currently on the web at tcode.tinro.ru/tcodes12.html. The PICES-GLOBEC Workshop, titled “*Data management: Exchange, inventory and archival of GLOBEC data*”, discussed the inducements and barriers to the exchange and archival of oceanographic data, with a specific focus on GLOBEC data (see report elsewhere in this Newsletter). The PICES Technical Committee on Data Exchange should play a major role in facilitating the exchange of data from the North Pacific, but ultimately each researcher must



Attentive audience at the joint PICES/GLOBEC Workshop on Data management of GLOBEC data.

realize that it is their own responsibility to contribute to the global science legacy.

A session on “*Eutrophication, harmful algal blooms, and nutrients*” (co-sponsored by PICES and Chinese National Harmful Algal Bloom project) examined the global increase in harmful algal blooms (HABs), in particular when and how eutrophication affects the dynamics of these blooms. The session recognized two different impacts of eutrophication on HABs: increases of high-biomass-nontoxic blooms which lead to oxygen depletion *versus* low-biomass-toxic blooms. In addition, the session concluded that future studies should examine the whole planktonic ecosystem, since changes in nutrient delivery patterns can have profound effects on food web structure and on the fate of the bloom through grazing. From the other end of the trophic spectrum, the session on “*Comparison of the productivity of marginal seas with an emphasis on the western Pacific (Japan/East Sea, Yellow Sea and East China Sea) with a focus on small pelagics*” examined some of the most productive areas of the world ocean. The emphasis was on understanding and comparing factors affecting the production of small pelagic fishes and zooplankton among these three regional ecosystems. Presentations demonstrated the importance of these small pelagic species to these ecosystems, and how their variability can be connected directly with changes in system productivity and with climate. The next steps will need to consider age information, and ways to differentiate fishing effects from natural variability.

The session on “*Responses of upper trophic level predators to variation in prey availability: An examination of trophic level linkages*” considered predator responses to prey variability, and the implications of using high trophic level predators as indicators of ecosystem change. Presentations described a wide range of individual-level responses such as body size, stress hormone levels, diet composition,

foraging behaviour, habitat use, feeding efficiency and growth; and population level responses such as adult survival, reproductive success, juvenile survival and overall population growth or decline. Some presentations also showed that prey variability and predator responses were linked to climate variability at interannual and inter-decadal time scales, leading authors to suggest that predators can serve as indicators of ecosystem change. The session raised several important questions that could guide future research in this area, including:

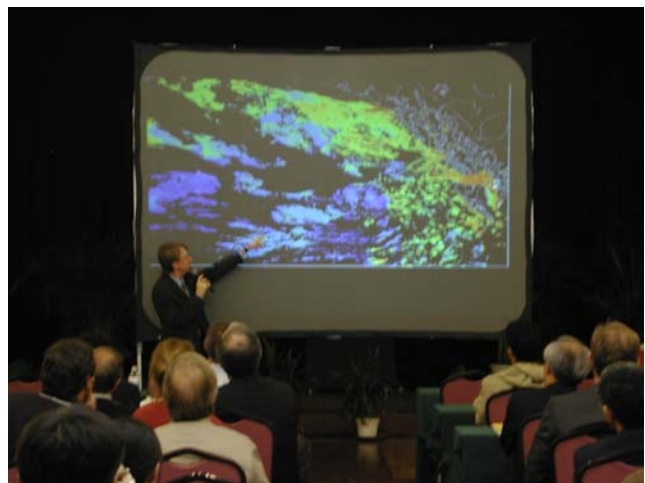
- Which life history stages are most sensitive to changes in prey availability?
- How and why do different species in the same system respond differently to changes in prey availability?
- What are the important spatial scales of prey variability?
- Is the mean or the variance in prey abundance most important in driving predator responses?
- What oceanographic processes drive the prey aggregations exploited by predators?

The theme of climate variability and marine ecosystem impacts in the North Pacific has been a very important one for PICES. Three major sessions were held during PICES XI to discuss aspects of this theme. PICES and CLIVAR co-convoked a joint workshop titled “*Climate variability in the Pacific and its impact on the marine ecosystem*”. The workshop explored the present understanding of climate phenomena in the PICES area and their links to the ecosystems of the region. It was intended to identify ways in which collaboration between CLIVAR and PICES can further understanding and aid the implementation of observational and modeling activities in the wider Pacific. The workshop attracted a large audience and examined the physical, biogeochemical, and ecosystem aspects of climate variability in the Pacific. The workshop concluded there is a need for a more mechanistic approach to establishing the causal links between variation in the Earth’s climate and the marine ecosystem. Most studies to date have relied on statistical correlations between climate indices and abundances of species. This, of course, is one of the major challenges of the GLOBEC program, in the North Pacific through the PICES Climate Change and Carrying Capacity Program, and one in which the co-participation of CLIVAR is highly welcome. Further joint workshops are planned.

The MONITOR Task Team held a workshop on the “*Requirements and methods for ‘early detection of ocean changes’*”. It addressed such questions as “How we can we best design our monitoring programs to reduce the time lag between event and detection?” and “What are the relative costs of false alarms *versus* missed detections?” The workshop concluded that having a broad diversity of measured variables is good, and combining them into a single index is not recommended; biological variables may have higher “signal-to-noise” ratios than physical variables at interannual time scales, possibly due to stronger autocorrelations; having a diversity of analytical methods

is also good, in particular those that complement strengths and weakness of each method; and that opportunities for monitoring are increasing with new time series, new technologies, and a greater awareness of ocean changes. Further work on this theme is planned.

A more theoretical approach to this problem was the focus of the session titled “*Detection of regime shifts in physics and biology*”. The focus was on retrospective and numerical models which describe the nature of regimes and on conceptual models of the underlying mechanisms connecting physical dynamics to biota. Invited presentations included a coupled atmosphere-ocean model in which the ocean acted to either restore the atmosphere to its present state or, if the ocean exceeded a threshold, to force the atmosphere into a second stable state. The other invited presentation suggested that regime shift signals are stronger in biota such as euphausiids and dissipate at higher trophic levels. The session concluded that, despite the apparently synchronous global patterns, the details at regional scales can be very complex which can make the broad scale patterns unrecognizable. And echoing a conclusion from the PICES-CLIVAR Workshop, there is a need to move from a research focus on correlative pattern recognition to the determination of mechanisms.



Dr. Perry summarizing PICES scientific achievements of 2002 at the Closing Session.

Congratulations are in order for winners of the Best Presentation Award at PICES XI. These awards are given to scientists, nominated by each PICES Scientific Committee and the Science Board, who gave the best presentation in a topic or paper session sponsored by the committee or board. Here are the 2002 winners: the BIO Award to Kohei Mizobata (Japan) for his talk entitled “*Impact of the eddy field on phytoplankton distribution along the shelf edge in the southeastern Bering Sea 1998-2000 using SeaWiFS and TOPEX/ Poseidon time series data sets*” (co-authored by S.-I. Saitoh); the FIS Awards to Alexey Baitalyuk (Russia) for his paper entitled “*Contemporary stock status, distribution, place and role of*

Pacific saury in the Japan Sea/East Sea” and honourable mention to Kyung-Mi Jung (Republic of Korea) for her paper entitled “*Ecological characteristics of walleye pollock eggs in the south-eastern Bering Sea during the 1970s regime shift period*” (co-authored by S. Kim and S. Kang); the MEQ Award to Sheng Liu (People’s Republic of China) for presentation of the paper entitled “*Feeding and reproductive responses of marine copepods in South China Sea to toxic and nontoxic phytoplankton*” (co-authored by W.-X. Wang); the POC Award to Shuhei Masuda (Japan) for his paper entitled “*A model of regime transitions in the North Pacific*”; the TCODE Award to Andrew Golik (Russia) for his E-Poster entitled “*Development of Geographic Information System of Northwestern Pacific based on Internet/Intranet*” (co-authored by V. Fischenko); and the Science Board Awards to Sukyung Kang (Korea) for her presentation entitled “*The analysis of trace elements in chum salmon otoliths using laser-ablation technology: habitat characteristics and stock identification*” (co-authored by S. Kim, D. Welch, K. Telmer and Y.-H. Lee) and to Olav Ormseth (U.S.A.) for his poster entitled “*Interannual variability in the distribution of spawning Pacific cod in Alaska: the influence of ocean temperature*” (co-authored by B. Norcross).

Additional highlights from 2002 and features for 2003

In addition to the Eleventh Annual Meeting, PICES also co-sponsored 5 symposia: “*The causes of marine mortality of salmon in the North Pacific and North Atlantic and in the Baltic*” (with NPAFC, NASCO, and IBSFC; March, Vancouver, Canada); “*North Pacific transitional areas*” (with CIBNOR and CICIMAR; April, La Paz, Mexico); “*Recent progress in studies of physical processes and their impact to the Japan/East Sea ecosystem*” (with CREAMS; August, Seoul, Korea); “*Synthesis of JGOFS North Pacific process study*” (with JGOFS; October, Sapporo, Japan), and the GLOBEC 2nd Open Science Meeting. Particularly noteworthy was the joint “*Transitional areas*” symposium convened in Mexico, which was highly successful and represented the first formal event held by PICES in Mexico; a volume of papers in *Journal of Oceanography* is in progress. The year was also busy with meetings and workshops of specific groups within PICES. These included the various Working Groups and CCCC Task Teams (notably two workshops dealing with lower and upper trophic level models in the North Pacific, and monitoring systems).

PICES has in place two field projects, both of which were very active in 2002. The Continuous Plankton Recorder (CPR) Program conducted surveys from merchant marine vessels along meridional transects in the eastern North Pacific (Alaska to California) and zonal transects from

Canada/U.S.A. to Japan. Results from these and earlier surveys are now in press in the scientific literature, and further publications are being prepared. The Iron Fertilization Experiment Panel (IFEP), an Advisory Panel under the CCCC-BASS Task Team, conducted a collaborative (Canada-Japan) iron enrichment experiment in the Northeast Pacific during summer 2002. This experiment was so successful that the resulting phytoplankton bloom was visible from the SeaWiFS satellite, and was observed and puzzled over by remote sensing laboratories in North America.

Two major projects were also begun during 2002. One was the CCCC Integration Workshop, which was held just prior to PICES XI to review the accomplishments of the CCCC Program and to consolidate its next steps. The initial results of this workshop are reported elsewhere in this Newsletter. The other major project is the development of the North Pacific Ecosystem Status Report. This is a major effort to integrate and assess the ecosystems of the North Pacific, identify critical factors causing changes, and to try and forecast the consequences of these changes. A “draft for discussion” Ecosystem Status Report was prepared prior to PICES XI, and received considerable comment. The Ecosystem Status Report activity will be closely linked with a parallel collaborative project between the Census of Marine Life and PICES to report on “*Marine life in the North Pacific: The known, unknown, and unknowable*”. These will be major initiatives for PICES during 2003.

Other major PICES activities in 2003 include several symposia and workshops, such as a MODEL Workshop to *Embed the NEMURO and NEMURO.FISH models into a 3-D circulation model* (March, Yokohama, Japan); the international symposium on the *Role of zooplankton in global ecosystem dynamics: comparative studies from the world oceans* (May, Gijon, Spain); the 3rd PICES Workshop on the *Okhotsk Sea and adjacent areas*, as well as workshops relating to the North Pacific Ecosystem Status Report. Workshops to be held just before PICES XII include “*Harmonization of Harmful Algal Bloom data*”, “*Examining and critiquing a North Pacific Ecosystem Status Report*”, and “*Distribution and diets of marine birds and mammals*”. Among other topics, sessions are planned during PICES XII on the “*Human dimensions of ecosystem variability*”, on “*Linkages between open and coastal systems*”, on the “*Influence of fishing and/or invasive species on ecosystem structure in the coastal regions*”, on “*Latitudinal differences in responses of productivity and recruitment of marine organisms to physical variability*”, and on “*Ecosystem-based management*”. Readers are invited to visit the PICES web site regularly for more details on these and the other sessions during PICES XII in Seoul, Korea.