PICES Science Board and Governing Council hold their first joint meeting

In the over 10 year history of PICES, there has never been a joint meeting of the two senior committees of PICES, Science Board and Governing Council – that is until early April of this year. They have not met together for the simple reason that the busy schedules of the Annual Meetings do not provide enough time, nor is there time for Science Board to discuss broader issues of PICES business. There have been several disadvantages of not meeting together, including a lack of understanding on the part of Governing Council for the directions that Science Board is heading, and a lack of understanding on the part of Science Board of the issues and constraints that face Governing Council. This is why this first-ever joint meeting of Science Board and Governing Council, held April 7-9, 2003, in Victoria, Canada, was so important. It provided the time to discuss larger issues for PICES, in particular relating to future directions of the Organization, and it provided the new PICES Chairman and Governing Council with an opportunity to better understand the bases for the recommendations of Science Board.

The meeting reviewed updates from the Scientific and Technical Committees and the CCCC Program, and reviewed an excellent preliminary report from the PICES Study Group on *Capacity Building*. The Study Group was formed at PICES XI under the able chairmanship of Dr. Warren Wooster to (1) identify the capacity building needs of PICES; and (2) develop a proposal to address the capacity building needs of PICES, including consideration of possible collaborations with other organizations. The final report of this Study Group is expected prior to PICES XII, for distribution to the standing Committees for their consideration and comments.

Science Board Vice-Chairman

Science Board and Governing Council also recognized the work and numerous meetings associated with serving as Science Board Chairman, and the difficulties that would arise should the Science Board Chairman be unable to carry out his or her duties. Therefore, by the recommendation of Science Board, Governing Council established a position titled Vice-Chairman of Science Board. The following rules were approved for the position of Science Board Vice-Chairman:

- The Vice-Chairman of Science Board shall be elected from the members of Science Board;
- Duration of the appointment shall be for 1 year (18 months for the first Vice-Chairman). Re-election for an additional term is permitted;
- The Vice-Chairman will normally reside on the opposite side of the Pacific to the Chairman;

- When the position of Science Board Chairman becomes (or will become) vacant, the incumbent Vice-Chairman does not automatically succeed the Chairman; elections will proceed according to regulations;
- The Vice-Chairman will prepare meeting materials and chair the meetings of Science Board in the absence of the Chairman, as required;
- The Vice-Chairman will assist the Science Board Chairman by: (i) preparing material for meetings (Science Board, PICES Annual Meetings, etc.); (ii) representing PICES at meetings and conferences of other organizations; (iii) consulting on Chairman's decisions that must be taken between normal meetings of PICES committees; and (iv) representing PICES member countries on the Vice-Chairman's continent.

It was also noted that a major role of the Vice-Chairman of Science Board is to assist with the co-ordination of the scientific activities of PICES. I am pleased to announce that Dr. Vladimir I. Radchenko (Russia), the present Chairman of the Biological Oceanography Committee, was elected Vice-Chairman of Science Board. His term will expire at the conclusion of PICES XIII.

Communications

There was considerable discussion of the communications strategy of PICES, foremost of which is the PICES website. Science Board and Governing Council agreed that this form of communication is extremely important, and should be a priority within PICES. However, it was recognized that this website is badly out-dated and in need of a major overhaul, but that PICES Secretariat staff do not have the time or capabilities to do this task on a regular basis at present. There are three issues: immediate updating of material, ongoing updating of material, and longer-term re-design of the website. Discussion focussed on how these might be accomplished, considering the limited resources available. The Secretariat was requested to develop a plan (for discussion at PICES XII) to maintain the website which could include reallocating duties of current employees. In addition, a member of Governing Council volunteered to identify what is required to develop 2 levels of website design for PICES: a "top-level" site, and a "basic level" site. The Committees and Programs of PICES have been requested to identify what information is necessary to include on the PICES website, and how this information should be provided (i.e. the "flow" of information from Committee to web page). All of this is to be available for discussion by the standing Committees and the CCCC Program prior to PICES XII.

A PICES "vision"

An issue that has not been discussed during the (rushed) Science Board meetings that take place during the PICES Annual Meetings, but that was identified by the PICES Review Committee as important, is a long-term "vision" or Strategic Plan for the Organization. PICES does have a Strategic Plan, but it is more of an operational or implementation plan which describes the roles and responsibilities of the Committees, Programs, and "Officers" of PICES. It is mostly "backward-looking", in that it describes what has happened in the past and how the present activities derive from past activities. In contrast, ICES has recently approved a new Strategic Plan which is more encompassing. It has an overall mission statement "*to advance the scientific capacity to give advice on human activities affecting, and affected by, marine ecosystems*" and has 10 goals which are divided into 5 sections: producing the scientific advice decision-makers need; building a foundation for science; fostering partnerships; the added value of ICES; and informing the public. PICES Science Board and Governing Council recognized the value of such a plan, but also noted that there are important differences between PICES and ICES, in particular that the ICES plan emphasizes stability, while the PICES plan needs to consider the development of the Organization. Science Board and Governing Council agreed to form a Study Group on *PICES Strategic Issues*, under the Chairmanship of the PICES Chairman, to develop a Strategic Plan which has the following elements:

- A PICES vision statement;
- The purposes of PICES (including identifying the emerging issues in marine science of interest to PICES member countries);
- Long-term goals;
- Steps to implement the vision, purposes, and goals of PICES (which would consider regional as well as thematic approaches).

These tasks will be accomplished by:

- Reviewing scientific plans / vision statements of similar organizations
- Working primarily by correspondence
- Examining the existing Strategic Plans of the Scientific and Technical Committees of PICES
- Requesting input from Governing Council and Science Board members as to regional issues

The membership of this Study Group consists of Dr. Ian Perry and Dr. Vladimir Radchenko representing Science Board, and Prof. Vera Alexander (Chairman), Dr. Laura Richards (Canada), Mr. Qian-Fei Liu (China), Dr. Tokimasa Kobayashi (Japan), Dr. Hyung-Tack Huh (Korea) and Dr. George Boehlert (U.S.A.) representing Governing Council. Once the PICES Strategic Plan has been developed, the Scientific and Technical Committees of PICES will be asked to discuss and examine this plan to determine how it might be implemented by each Committee. A draft is expected to be available for discussion by the standing Committees and the CCCC Program prior to PICES XII.

Aquaculture

The subject of aquaculture is an important one in the North Pacific, but one which does not have an obvious home in PICES at present. There is considerable interest in this topic, particularly in China and Korea, and the lack of a clear place for aquaculture within PICES is sometimes seen to be a disadvantage in attracting participation from these member countries. A Working Group on *Scientific Issues of Aquaculture* was suggested as a means to focus and define the scientific issues associated with aquaculture within PICES, which would include both the science of production and the science of marine environmental issues associated with aquaculture. Science Board and Governing Council recommended that the Marine Environmental Quality and Fishery Science Committees lead joint discussions about forming such a Working Group, with additional input from the Biological Oceanography Committee and possibly the Physical Oceanography and Climate Committee. They have been requested to develop the potential issues and questions that such a Working Group might address, to draft potential Terms of Reference, and to provide a report to Science Board for consideration at PICES XII.

New major programs

After almost 10 years of activity, the PICES Climate Change and Carrying Capacity Program is now considering how to synthesize and conclude many of the initial questions posed in the CCCC Science and Implementation Plans. Developing a new scientific program, or extending the CCCC Program in new directions, will take time and need considerable discussion amongst the scientists of PICES. Therefore, Science Board is now beginning to consider what types of new programs might follow the completion of this phase of the CCCC Program, and how these new programs should be discussed and developed. Dr. Makoto Kashiwai made a superb presentation at this joint Science Board/Governing Council meeting, which is published in a more complete fashion elsewhere in this issue of PICES Press. General issues for discussion of such programs include whether they are single or multiple programs, and whether they will need special funding. Procedures include:

- Convening a workshop to develop the key scientific questions for a Science Plan, criteria for prioritization and scientific strategy;
- Structuring and prioritizing the scientific questions;
- Learning from the CCCC Program experience; and
- Developing an Implementation Plan.

The Science Board and Governing Council joint meeting recommended that the Study Group on *PICES Strategic Issues* should develop its report prior to extensive work on developing new PICES programs, and that PICES standing Committees and the CCCC Program should discuss what they see as possible new issues/topics for a major PICES program. In addition, the North Pacific Ecosystem Status Report can be expected to identify gaps in information and understanding in the North Pacific that might be good candidates for future major PICES programs.

In summary, this first-ever joint meeting of PICES Science Board and Governing Council was a success, and met its objectives of engaging both committees in discussions of broad and long-term importance to PICES. It is hoped that the initiatives taken during this meeting will provide guidance to the many activities of PICES, and will result in new directions and further involvement in PICES activities of scientists from all our member countries. A second joint meeting, held inter-sessionally between the Annual Meetings, is being considered for 2004.

Dr. Harold Batchelder (U.S.A.), Dr. Michael Foreman (Canada), Mr. Qian-Fei Liu and Mr. Si-Xi Qu (China) considering the business at hand.

Participants

Canada	Laura Richards, Douglas Bancroft, Michael Foreman
China	Qian-Fei Liu, Jin-Ping Zhao, Si-Xi Qu
Japan	Tokimasa Kobayashi, Makoto Kashiwai, Yukimasa Ishida
Korea	Hyung-Tack Huh
Russia	Vladimir Radchenko, Igor Shevchenko
U.S.A.	George Boehlert, Richard Marasco, Harold Batchelder
PICES	Vera Alexander (Chairman), R. Ian Perry (SB Chairman), Alexander Bychkov & Skip McKinnell (Secretariat)

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

3rd International Zooplankton Production Symposium

Group photo taken on the grounds of the restaurant El Trole before the Welcome Reception.

The 3rd International Zooplankton Production Symposium on *The role of zooplankton in global ecosystem dynamics: Comparative studies from the world oceans*, co-sponsored by the International Council for the Exploration of the Sea (ICES), North Pacific Marine Science Organization (PICES) and Global Ocean Ecosystem Dynamics Project (GLOBEC), was held May 20-23, 2003, at the Congress Center in Gijón, Spain, gathering some 333 participants from 38 countries from around the world. The meeting was three years in planning, the first proposal being submitted from the PICES Biological Oceanography Committee to the ICES Working Group on Zooplankton Ecology in Hawaii in April 2000 (PICES Press, Vol. 8(2), pp. 10-12).

Three half-day workshops were convened on May 19, immediately prior to the Symposium:

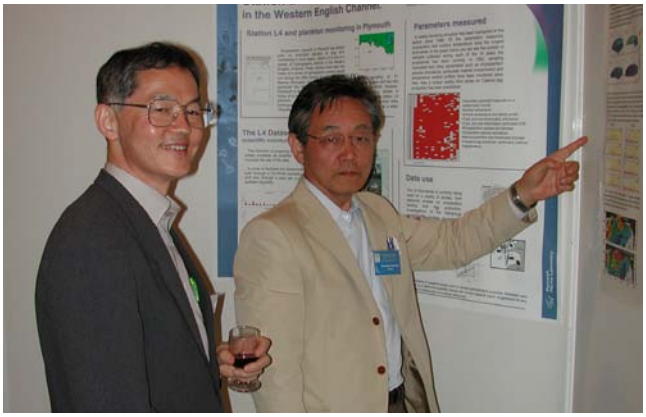
W1: Gelatinous zooplankton and fish: Predators, prey or nuisance (organized by Patricia Kremer);
W2 Meso- and bathypelagic zooplankton study: Current status and future aspects (Tsutomu Ikeda); and
W3: Climate variability, zooplankton abundance and distribution-comparative opportunities from the world's oceans (Ian Perry and Harold Batchelder).

The Symposium opened in the morning of May 20 with a warm welcome address by the Chairman of the Local Organizing Committee (Luis Valdés), followed by representatives of the Scientific Committee (Roger Harris) and Convenors (Tsutomu Ikeda) of the Symposium, the Chairman of GLOBEC (Francisco Werner), the Chairman of the Science Board of PICES (Ian Perry) and the ICES President (Prof. Pentti Mälkki). The Opening Session was chaired by the Mayor of Gijón, Paz Fernandez Felgueroso.

The session and their convenors were:

S1: Physical variability and zooplankton population dynamics (Convenors: Miquel Alcaraz and Xabier Irigoien)
S2: Role of zooplankton in biogeochemical cycles (Convenors: Hans Dam and Roger Harris)
S3: Climate influences: What are long-term zooplankton data sets telling us? (Convenors: Takashige Sugimoto and Hans Verheye)
S4: New approaches to zooplankton modeling (morning session) (Convenors: Eileen Hofmann and Michio Kishi)
S5: Progress in molecular biology (Convenors: Ann Bucklin and Serge Poulet)
S6: Application of new technologies (Convenors: Gabriel Gorsky and Peter Wiebe)
S7: Comparative life histories and life cycles of zooplankton populations within and between North Pacific and North Atlantic (Convenors: Hans-Jurgen Hirche and Tsutomu Ikeda)
S8: Microzooplankton in the marine pelagial: Recent advances from molecules to ecosystems (Convenors: Dian Gifford and Suzanne Strom).

Mingling at the Poster Session.



Professors Naonobu Shiga (left) and Takashige Sugimoto discussing North Pacific zooplankton.

Drs. Ikeda and Mackas listening to Bill Peterson's story about the size of the copepod that got away.

Dr. Luis Valdes chatting with Drs. Miguel Alcaraz, Roberto Charro and Jose María Rodríguez.

Of these, Sessions 1, 2, 3, 7 and 8 were full-day sessions, sessions 4, 5 and 6 were half-day session, accommodating a total of 136 oral presentations including 16 invited talks (2 invited talks per session). Parallel to the oral presentations, a poster session, organized by William Peterson exhibited, 243 posters during the Symposium. Travel support was given to 16 young scientists from 12 countries by the SCOR/NSF grant, 11 scientists from 4 countries by the PICES Trust Fund, 9 scientists from 9 countries by GLOBEC, and 8 scientists from 6 countries from the Symposium budget.

At the Closing Ceremony, we honored the students who gave the best talks and prepared the best posters. For Best Oral Presentations, the winners were Jaime Gomez-Gutierrez (Oregon State University, Corvallis, Mexico/U.S.A.) and Marina Marrari (University of South Florida, St. Petersburg, U.S.A.). Jaime reported on his work on a ciliate that infects euphausiids. He showed that through rapid reproduction, the ciliates increase in volume to such a point that the euphausiid host explodes. Marina reported on studies of relationships between zooplankton distribution, community structure and distribution of anchovies in shelf waters off Argentina. Best Poster Awards were presented to Ruthy Zahelm (The Hebrew University, Eliat, Israel) and Soultana Zervoudaki (National Center for Marine Research, Athens, Greece). Ruthy's poster discussed her work in the Red Sea on transport on/off coral reefs at night by predators and their prey. Soultana compared feeding and population dynamics of *Oithona* in three locations that differed along a eutrophication gradient. Each winner was presented with a beautiful large format photograph of a zooplankter (Limacina, Oikopleura, Euchaeta and Meganyctiphanes) that were donated by photographer Per Flood (Norway).

Zooplankton photos by Per Flood at the book exhibition.

There were so many good student talks that we created an "Honourable Mention" category, and those selected were Yuichiro Nishibe (Hokkaido University, Hakodate, Japan), Ebru Unal (Middle East Technical University, Mersin, Turkey), Lindsay Sullivan (University of Rhode Island, Narragansett, U.S.A.), and Kristina Skebo (University of Victoria, Victoria, Canada).

Gijón is the oldest city of Asturias, founded during the Roman Empire, and its beautiful beach is filled with people enjoying sun and swimming in summer. Except for one rainy day, fine weather continued during the 4-day symposium. The Congress Center in Gijón, where the symposium was held, is a modern, well-facilitated building complex located within walking distance from most of the hotels where participants stayed at. In the evening of the first day, participants were invited to a traditional local feast as part of a Welcome Reception hosted by the Mayor of Gijón at an old style restaurant (El Trole) in the suburbs of the city. Here all enjoyed a local favourite drink, cidra, ('hard cider') and many local cheeses and tapas. We enjoyed also a traditional Asturian feast at an informal Symposium Dinner at Hotel Begona Park on May 23.

Drs. Peter Wiebe, Ann Bucklin, Bill Peterson (left three), Dr. Roger Harris, Ms. Lotty Ireland and Dr. Skip McKinnell (right three) at the Symposium Dinner.

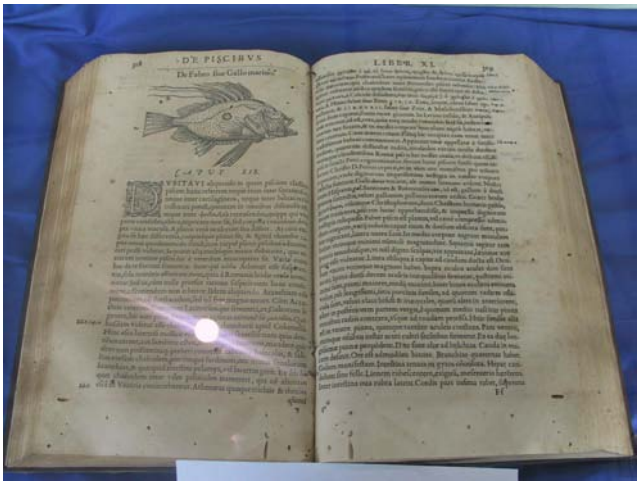
Those of us crazy and hungry enough to spend more money than a hotel room on a single dinner were treated regally to a magnificent extravaganza of gourmet food, wine and a live quartet in Oviedo as the grand finale of the Symposium. The Extravaganza Dinner was held at the historic Hotel de la Reconquista, in the Salon Covadonga, a chapel in the 17th century, where the gala dinner of the Principe de Asturias Awards of Science, Literature and Fine Arts is held annually.

The Local Organizing Committee also held a terrific rare book exhibition for the public titled "Plankton: Life adrift" at the Congress Center during the Symposium. On display were precious copies of old books like the one where the Symposium poster image came from, and "*Libri de Pifcibus marinis, in quibus verae Pifcium effigies expressae funt*", by Gulielmo Rondeletii and published in 1554, about marine fishes and other species such as sea urchins, crabs, marine mammals, and even marine monsters.

Salon Covadonga of the historic Hotel de la Reconquista, Oviedo, where the Extravaganza Dinner took place.

The PICES Secretariat enjoys a precious regal and relaxing moment at the Extravaganza Dinner.

The exhibition of rare books: "Plankton: Life adrift".



The oldest book on display (published in 1554) at the exhibition "Plankton: Life adrift".

Illustration of the image used for the Symposium poster from an old book published in 1892 displayed at the book exhibition.

By the request of the Symposium Convenors, Dr. Charles Miller summarizes the Symposium at the Closing Ceremony.

Everyone agreed that this was the largest and most exciting zooplankton symposium that has ever been held. In particular, it was a rare occasion that zooplanktologists living in North Pacific and North Atlantic could meet and discuss the common issues. The major objectives of the Symposium, *i.e.* exchange of views, ideas and data by zooplanktologists from six continents facilitated development of new research directions and ideas. For PICES, this is the first and firm step toward close cooperation with ICES and GLOBEC. All agreed that we should endeavor to expand to other research areas in the future.

The symposium papers will be published in the ICES *Journal of Marine Science* in late 2004, invited Guest Editors are Roger Harris (GLOBEC) and Luis Valdés (ICES) and (Tsutomu Ikeda and William Peterson (PICES).

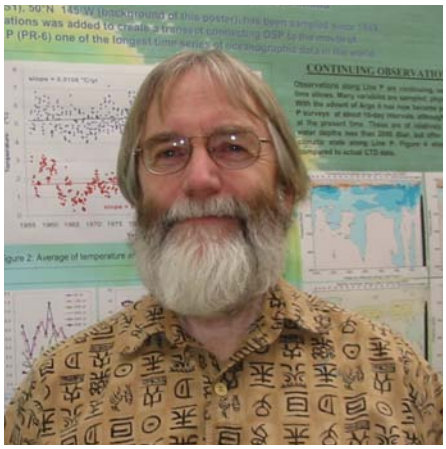
Finally, as the Symposium convenors representing PICES, we are most proud of the PICES Secretariat who provided professional assistance in the planning and development of the Symposium; designing and production of the symposium poster and brochure, on-line registration at PICES Homepage, correspondence with contributors, and providing travel support for PICES scientists for the Symposium and so on. We also wish to thank Dr. Roger Harris and Ms. Lotty Ireland of GLOBEC for their share of the organization, and especially their support at the Registration Desk, and Dr. Luis Valdes who was at the helm of the Local Organizing Committee and put a tremendous amount of time and efforts into making this Symposium a wild success.

Tsutomu Ikeda
Faculty of Fisheries
Hokkaido University
1-1 Minato-cho, 3-chome,
Hakodate, Hokkaido, Japan 041-5541
E-mail: tom@pop.fish.hokudai.ac.jp

William T. Peterson
Hatfield Marine Science Center
National Marine Fisheries Service
2030 South Marine Science Drive
Newport, Oregon, 97365, U.S.A.
E-mail: *Bill.Peterson@noaa.gov*

The state of the eastern North Pacific entering spring 2003

Frank A. Whitney
Institute of Ocean Sciences
Fisheries & Oceans Canada
P.O. Box 6000, Sidney, B.C.,
Canada. V8L 4B2
E-mail: WhitneyF@pac.dfo-mpo.gc.ca



Frank A. Whitney has led the Line P program for the past 10 years, carrying out repeat oceanographic sections for WOCE (1991-97) and hosting the Canadian JGOFS program (1992-97) on these cruises. Through this time, his main research interest has been in understanding processes which control nutrient supply to the upper ocean. He has also surveyed mesoscale eddies several times in an attempt to estimate offshore transport of coastal waters in the Gulf of Alaska. Frank has been working in oceanography on the British Columbia coast since 1969.

The NE Pacific is experiencing perhaps its strongest physical anomaly in almost 50 years of oceanographic observations. The mixed layer depth (MLD) at Ocean Station Papa (OSP) was remarkably shallow this winter (Fig. 1), the result of a cold layer which developed in the thermocline the previous year. MLD has ranged between 90 and 140 m over the past 5 decades at OSP, but was only 70 m in February 2003.

Stronger stratification in the past is evident during the El Niño events of 1982 and the 1990s. Although this past year saw a weak El Niño develop in the equatorial Pacific, there has been no evidence of oceanic transport of heat northward along the Oregon and British Columbia coasts as was observed during the 1998 El Niño. So present conditions do not appear to be El Niño-induced.

The cold layer which currently underlays the mixed layer has an uncertain origin. Possibilities are strong cooling in the Gulf of Alaska in winter 2002, or advection from the western subarctic Pacific. This layer, however, has had a dramatic influence on nutrient dynamics and productivity in the surface waters of the NE Pacific.

In HNLC (high nitrate low chlorophyll) waters, new production and carbon export is largely the result of diatom growth. Diatoms rely on silicate (Si), as well as other macro- and micro-nutrients, to produce cell structure. Under some conditions, Si becomes a growth-limiting nutrient for diatoms.

A clear trend towards Si-limitation was observed along much of Line P during summer 2002 (Fig. 2). Previously, low Si concentrations have been sporadically observed in this area and were attributed to atypical injections of iron. Our data from this past summer suggest that stronger stratification, with ensuing increases in mixed layer light, may be sufficient to induce Si-limitation. Figure 2 shows that coastal waters are replete with Si because of rich river and sediment sources. On the north coast of BC,

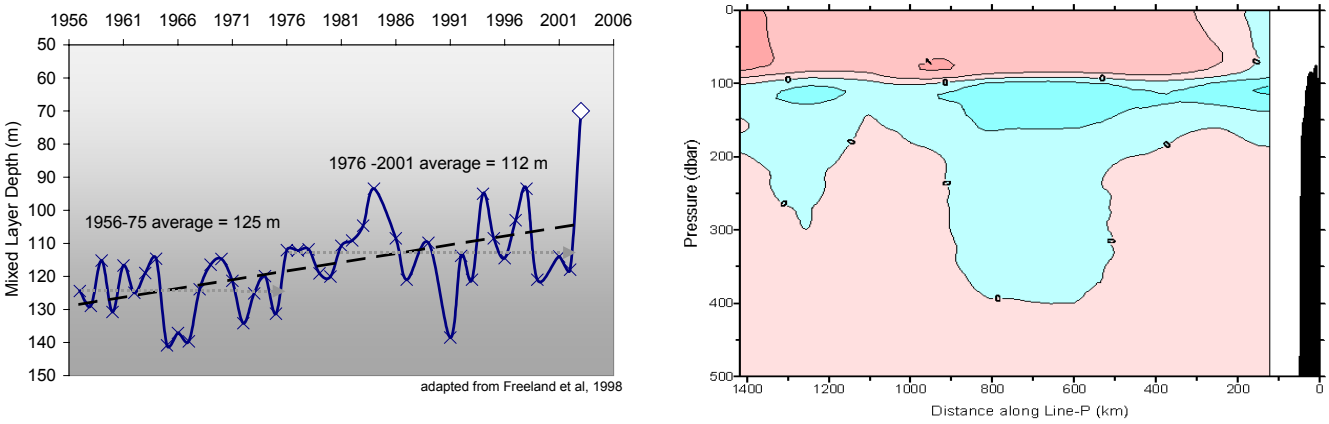


Fig. 1 Winter mixed layer depth at OSP from 1956 to 2003 (left panel), showing both a shoaling trend and a step change in 1976. The right panel (from H. Freeland) shows that, in March 2003, thermal stratification is enhanced both by surface warming and by the development of a cold layer below the mixed layer.

nitrate depletion is observed some distance offshore, perhaps because of Si transport by outflow from Hecate Strait. HNLC waters are likewise well defined as regions in which neither Si nor NO_3 is depleted (iron being the limiting nutrient in these waters).

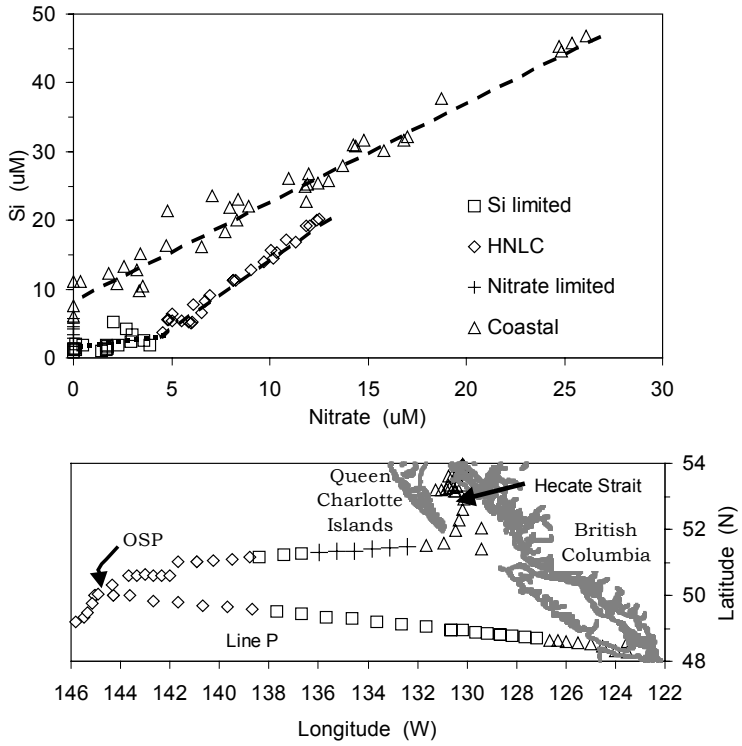


Fig. 2 Silicate vs. nitrate for surface waters of the Gulf of Alaska during September 2002 (upper panel). Several water types are defined and their positions shown in the lower panel.

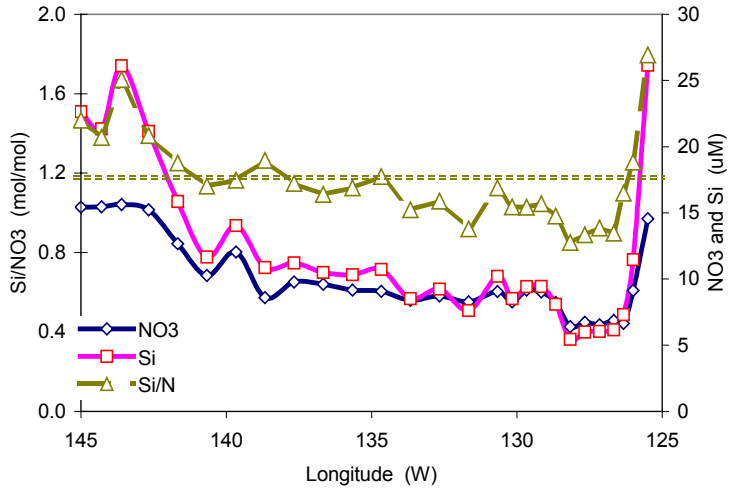


Fig. 3 Nitrate and silicate in surface waters along Line P in February 2003. The ratio of these nutrients is also shown along with a dashed line which estimates the drawdown ratio for Si and NO_3 during diatom growth.

Between coastal and HNLC waters, a broad area exists in which Si was the depleted nutrient in 2003. It is generally accepted that Si hinders diatom growth before being completely utilized. In the NE Pacific, it appears that a concentration of 2-3 uM Si limits diatom growth.

Abnormally high Si drawdown is a feature of Haida eddies (mesoscale eddies which form along the coast of British Columbia each winter), presumably because they transport coastal iron as they leave the continental margin for the Gulf of Alaska. Also, the SERIES (Subarctic Ecosystem Response to Iron Enrichment Study) iron enrichment experiment which was conducted near Ocean Station Papa (50ºN, 145ºW) in summer 2002, resulted in Si-limitation of diatoms with nitrate still remaining (PICES Press 11(1), 2003).

Wide spread Si limitation has not been observed previously along Line P. With the strong stratification of the upper ocean persisting through this past winter, it is possible that Si depletion could be even more widespread and persistent during the coming summer. Nutrient levels along Line P in February 2003 (Fig. 3) show that winter mixing has increased nitrate to levels similar to those seen in past years, but has not enriched Si to as great an extent. Usually, the Si/NO_3 ratio along Line P varies between 1.2-1.4 at this time of year. This winter, most of this survey line found less than the ~1.2 ratio needed to support diatom growth to nitrate depletion. A combination of strong stratification and low Si/NO_3 ratios in mixed layer waters may result in a short period of spring growth and a subsequent prolonged inhibition of diatoms in the oceanic waters of the southern Gulf of Alaska. In the Gulf of Mexico, a decline in the Si/NO_3 ratio has been correlated with a shift away from a copepod dominated zooplankton community to one with more gelatinous organisms.

The underlying cool layer, on the other hand, is relatively rich in nutrients. Patricia Wheeler (Oregon State University, U.S.A.) found much higher productivity along the Oregon coast as these waters outcropped during seasonal upwelling in summer 2002. She suggested that the resultant 2- to 5- fold increase in phytoplankton biomass on the Oregon shelf lead to higher remineralization at depth, oxygen depletion and possibly fish kills. With the cold nutrient layer still present in the Gulf of Alaska, similar conditions could occur this coming summer.

The state of the western North Pacific in 2002

Toshiyuki Sakurai
Office of Marine Prediction, Climate and Marine Department
Japan Meteorological Agency
1-3-4 Otemachi, Chiyoda-ku,
Tokyo 100-8122, Japan
E-mail: tsakurai@met.kishou.go.jp

Mr. Toshiyuki Sakurai is a scientific officer of the Office of Marine Prediction at the Japan Meteorological Agency (JMA). He is working as a member of a group in charge of oceanic information in the western North Pacific. Using a new "Ocean Comprehensive Analysis System" (in operation since January 2001), this group produces surface and subsurface temperature, salinity and current maps with 0.25×0.25 resolution in waters adjacent to Japan. Monthly averaged fields obtained from the system are included in the "Monthly Ocean Report" published by JMA. Mr. Sakurai is now involved in developing a new daily analysis system for sea surface temperature in the global ocean, using in situ *observations and data from several satellites with infrared and microwave sensors.*

Sea surface temperature

Figure 1 shows monthly mean sea surface temperature (SST) anomalies in the western North Pacific in 2002, computed with respect to JMA's 1971-2000 climatology. Both NOAA/AVHRR satellite data and *in situ* data are used for the area between 20ºN and 50ºN from 120ºE to 160ºE, and only *in situ* observations are used in other regions.

It is remarkable that negative SST anomalies exceeding -2ºC were observed in the southern part of the Sea of Okhotsk and south of the Kuril Islands in August. Negative anomalies in these regions persisted to September.

SSTs around Japan were generally above normal in May and June. Positive SST anomalies exceeding +2ºC were found in the Japan Sea, in the southern part of the Sea of Okhotsk and south of Japan in May, and in the Japan Sea in June. In the seas far-east of Japan, positive SST anomalies exceeding +1ºC prevailed zonally along 30ºN from February to August.

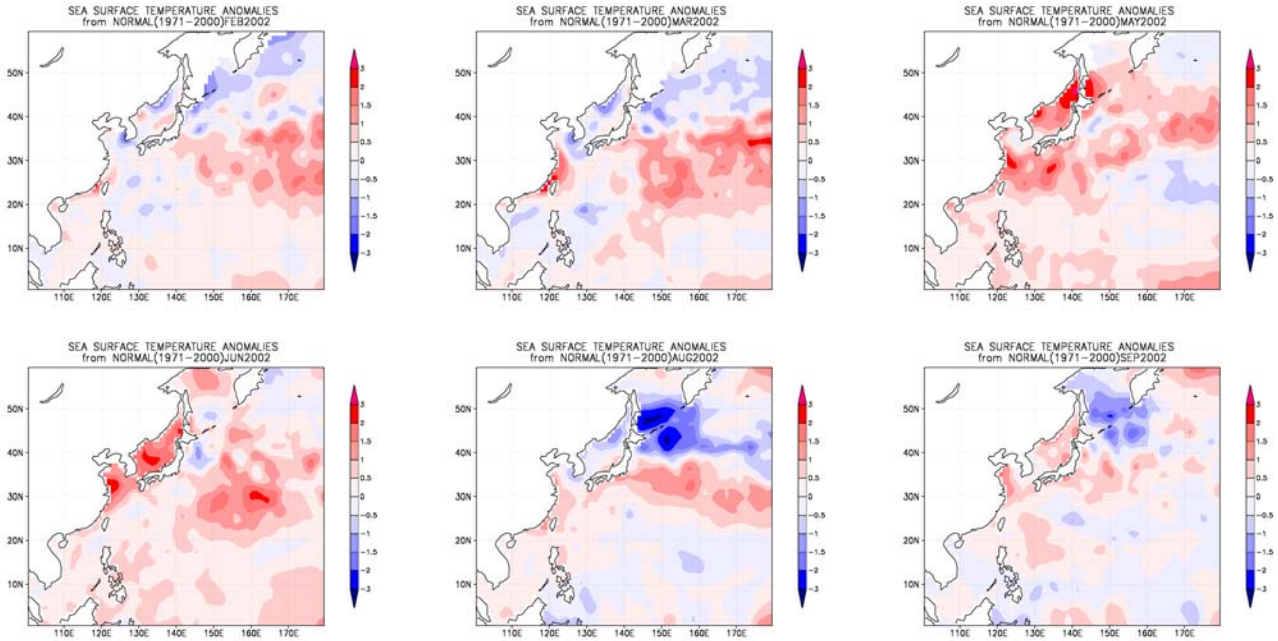


Fig. 1 Monthly mean sea surface temperature anomalies (ºC) in 2002: February, March and May (top row), and June, August and September (bottom row). Anomalies are departures from JMA's 1971-2000 climatology.

Kuroshio and Oyashio

Location of the Kuroshio axis was determined based on *in situ* currents, SSTs, subsurface temperatures and sea surface heights. The Kuroshio took a straight path off Tokai throughout 2002, except during May, when it took a non-large meandering path (Fig. 2).

Figure 3 shows subsurface temperature distributions at a depth of 100 m east of Japan for March and July 2002. These charts are based on JMA's Ocean Comprehensive Analysis System. The System includes objective analyses and a numerical ocean data assimilation model with 0.25×0.25 resolution adjacent to Japan, using Jason-1 altimeter observations and *in situ* water temperature data from ships and buoys.

The Oyashio cold water (area colder than 5ºC in Fig. 3) is known to extend southward at its southernmost position in spring, and return northward from summer to autumn. In spring 2002, the coastal southward intrusion was prevented by a warm eddy around 40ºN, 143ºE. Off-coastal Oyashio cold water extended southwestward from 40ºN, 146ºE in July, and water with temperature around 7ºC prevailed along the coast.

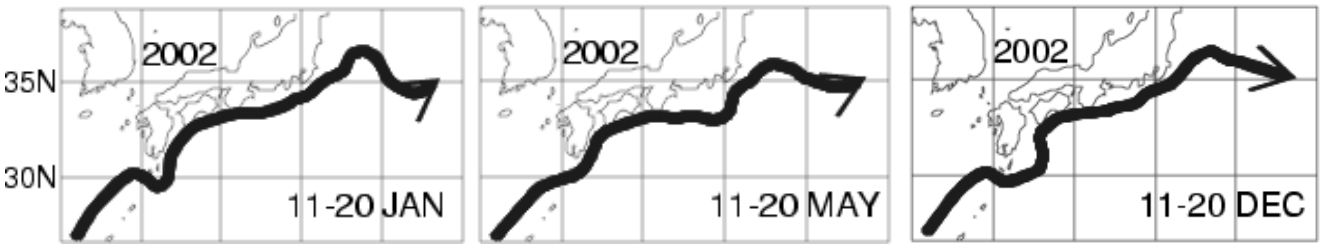


Fig. 2 Location of the Kuroshio axis in the second 10 days of January, May and December 2002.

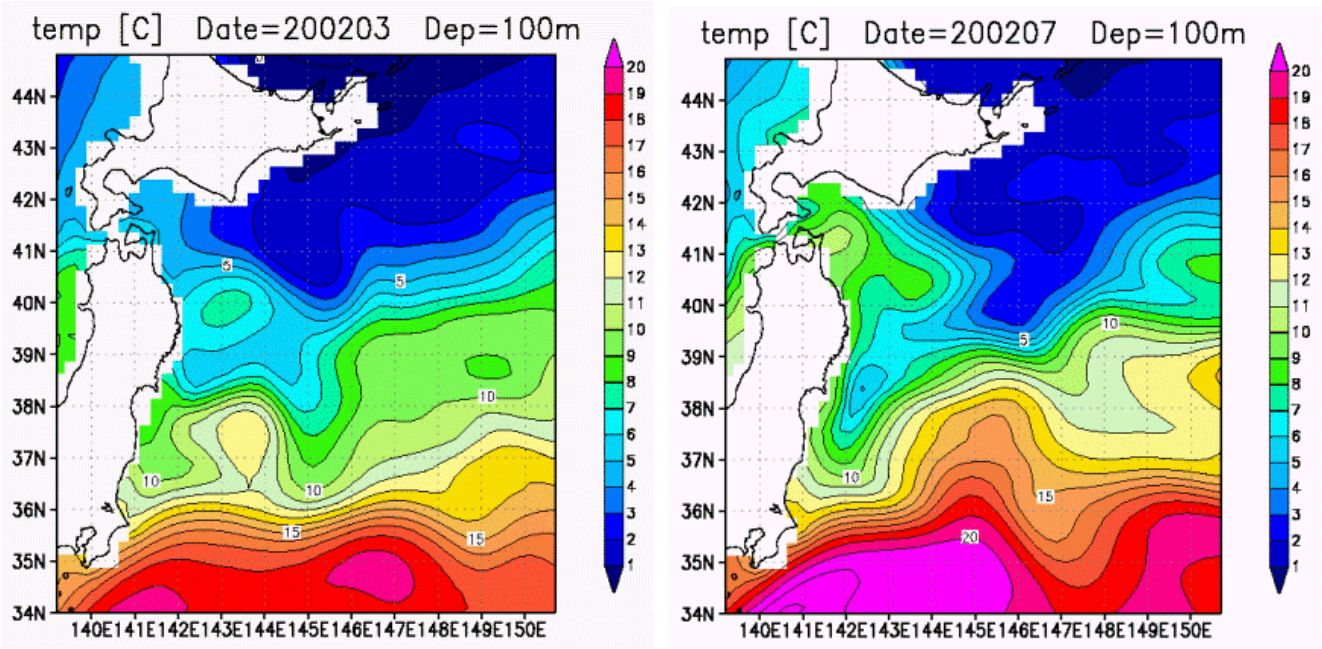


Fig. 3 Subsurface temperature at the depth of 100 m east of Japan in March 2002 (left) and July 2002 (right).

Subsurface temperature along 137ºE

JMA conducted oceanographic observations along 137ºE in the western North Pacific on board the R/V *Ryofu Maru* and R/V *Keifu Maru* (Fig. 4). The depth of the thermocline along 137ºE in the tropical region varies with ENSO conditions. After the onset of El Niño in spring 2002, the thermocline was shallower than normal, and negative anomalies of temperature were found around 5ºN and 9ºN in July-August 2002, and negative anomalies exceeding -5ºC were found from 4ºN to 8ºN in January-February 2003.

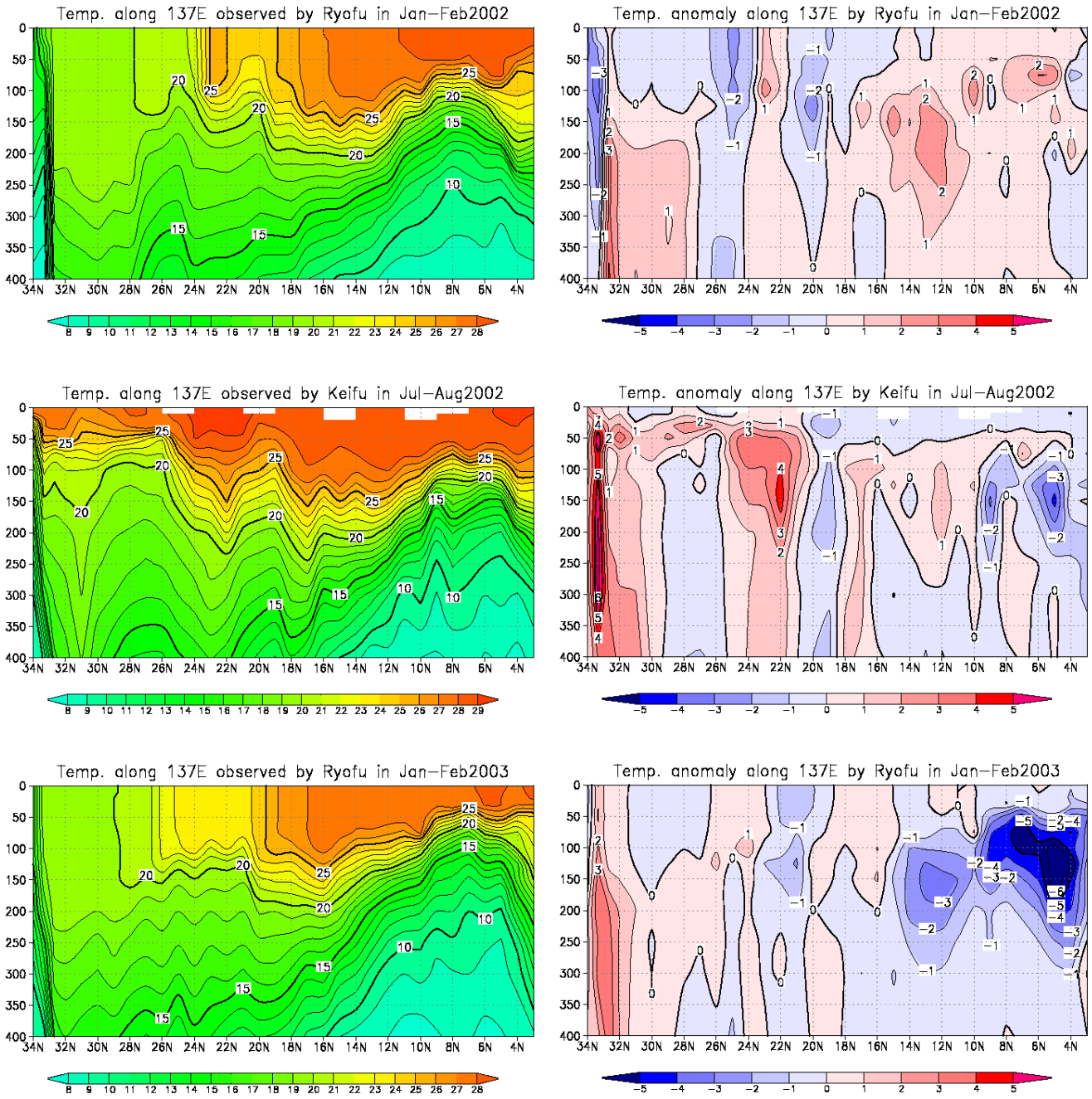


Fig. 4 Vertical sections of water temperature (left) and temperature anomalies (right) along 137ºE observed by the R/V Ryofu Maru *and R/V* Keifu Maru *from January 2002 to January 2003.*

Sea ice in the Sea of Okhotsk

Sea ice conditions are analyzed based on visible and infrared satellite images. The sea ice extent in the Sea of Okhotsk was near normal (30-year averaged values from 1971 to 2000) throughout the last sea ice season, but was below normal in early January and above normal in March (Fig. 5). Sea ice area came to a maximum on March 20, about half a month later than normal, and its value was 1.2858×10^6 km^2, larger than normal. This means that 82% of the Sea of Okhotsk was covered with sea ice (Fig. 6).

Drift ice in the Sea of Okhotsk flowed into the Pacific in mid-January and from February to March. The amount of drift ice into the Pacific was smaller than normal, so it was not observed at Kushiro for the first time in four years, and at Wakkanai for the first time in two years.

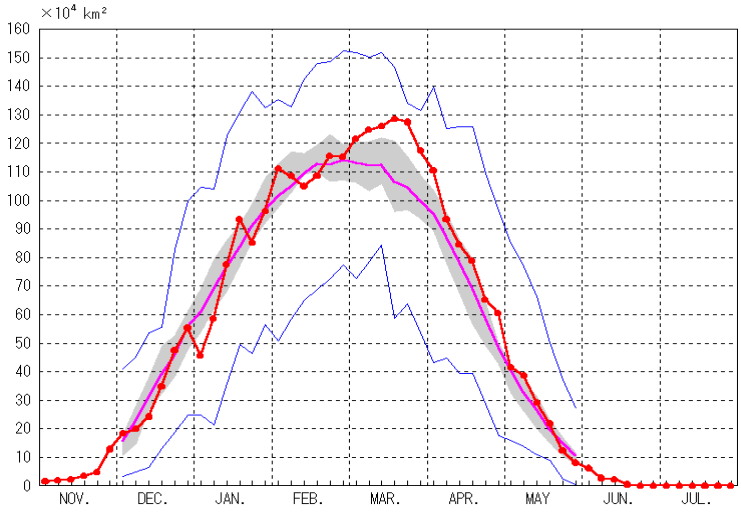


Fig. 5 *Time series of sea ice area in the Sea of Okhotsk from November 2001 to July 2002.*
time series of sea ice area; normal
near normal; maximum/minimum

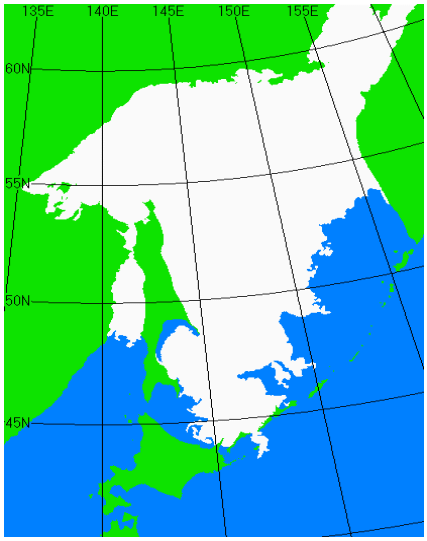


Fig. 6 *Sea ice extent (white area) in the Sea of Okhotsk on March 20, 2002.*

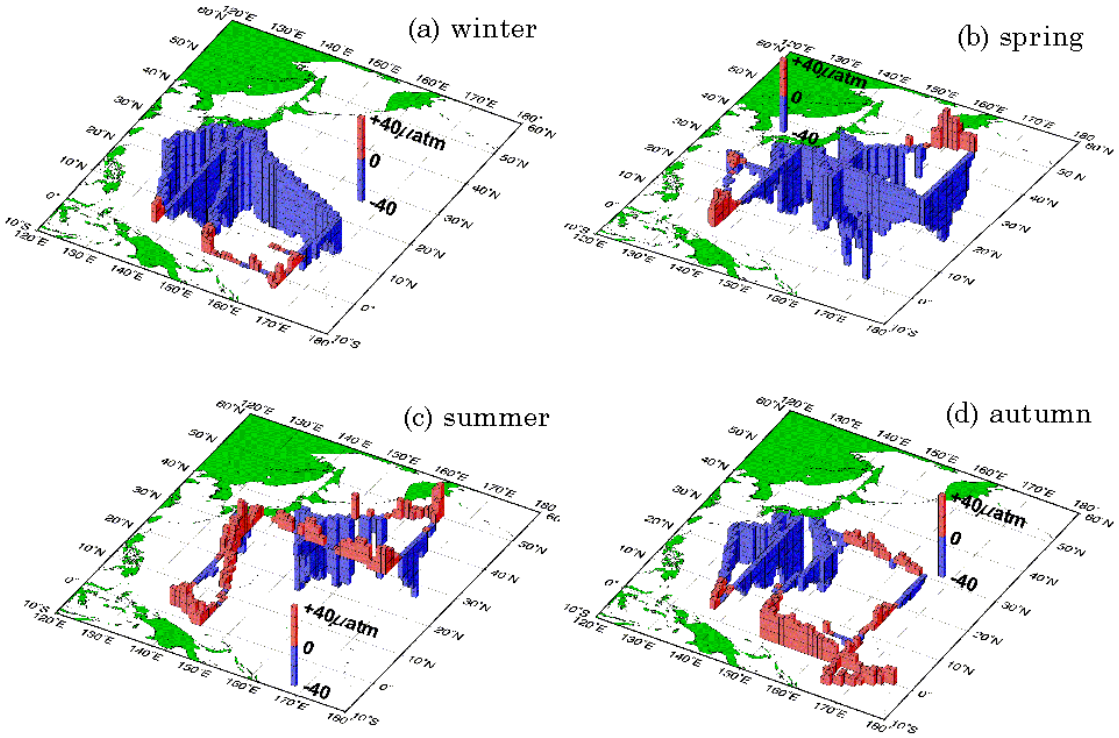


Fig. 7 *Difference in the carbon dioxide partial pressure in ppm between ocean and atmosphere in the western North Pacific in 2002. Red/blue pillars show that oceanic pCO_2 is higher/lower than atmospheric pCO_2.*

Carbon dioxide

JMA has been conducting observations for carbon dioxide (CO_2) in the air and the surface seawater in the western North Pacific, on board the R/V *Ryofu Maru* and R/V *Keifu Maru* (Fig. 7). In the subtropical region, oceanic CO_2 partial pressure (pCO_2) was lower than atmospheric pCO_2 in winter, spring and autumn 2002, implying that the ocean acted as a sink for atmospheric CO_2. Whereas this region changed to be a source in summer. The subarctic region was a source of atmospheric CO_2 in spring and summer. The equatorial Pacific acted as a source in all seasons, however, the difference between oceanic and atmospheric pCO_2 was smaller than that of a normal year.

The Bering Sea: Current status and recent events

Jeffrey M. Napp
NOAA – Fisheries/Alaska Fisheries Science Center
7600 Sand Point Way NE,
Seattle, WA 98115-0070, U.S.A.
E-mail: Jeff.Napp@noaa.gov

Dr. Jeffrey (Jeff) Napp is a Biological/Fisheries Oceanographer at the Alaska Fisheries Science Center of NOAA-Fisheries. He is Head of the Recruitment Processes Program at the Center and co-leader (with Dr. Phyllis Stabeno) of NOAA's Fisheries Oceanography Coordinated Investigations (FOCI). His own research is focused on physical and biological processes at lower trophic levels that affect recruitment variability in fish populations. He is active as Principal Investigator in both Bering Sea (NOAA's Bering Sea FOCI, Southeast Bering Sea Carrying Capacity) and Gulf of Alaska (FOCI, GLOBEC) Programs, and currently serves on a steering committee to organize a U.S. science initiative for the Bering Sea (BEST: Bering Sea Ecosystem STudy). Jeff participates in several PICES Working Groups and Technical Advisory Panels.

First of all, many thanks to Dr. Phyllis Stabeno of NOAA/PMEL for being the first scientist to write the PICES Bering Sea status reports. I hope to continue providing the PICES community with topical information as she did for many years.

My strategy will be to act as a reporter summarizing newsworthy information on the current status of the Bering Sea, as well as, the status of research and research programs focused on that region. The intent is to stimulate discussion both about what is presently happening in the Bering Sea and how best to study it. My goal is to present information (scientific, anecdotal, and traditional knowledge) that encompasses the scope of interest of PICES member countries. This means east and west, north and south Bering Sea, and the four disciplines into which PICES science is categorized: physical oceanography and climate (POC), biological oceanography (BIO), fishery science (FIS) and marine environmental quality (MEQ). To do this I will need your help. The Bering Sea is large and its component ecosystems are so different that it is hard for one person to know all that is happening. If you have observations about the Bering Sea that you think are noteworthy, then please send them to me at the above address. I will do my best to include in the status report as much of the submitted information as possible. I will also include a footnote in each article crediting those whose submissions are used.

Recent observations

The Pacific Decadal Oscillation has recently shifted from a short period of negative phase to the positive phase (Fig. 1). This change has not immediately led to a change in the recent trend in warmer winter water temperatures in the Bering Sea. There has been a conspicuous absence of winter sea ice in the southeast Bering Sea in recent years.

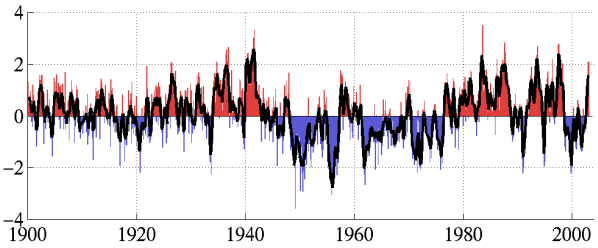


Fig. 1 Pacific Decadal Oscillation Index, 1900 – 2003. Source: http://tal.atmos.washington.edu/pdo.

In addition, the 2002/2003 equatorial El Niño appears to be influencing (through atmospheric teleconnections) the eastern Bering Sea. Last summer's water column heat content was as high or higher than that measured during the 1997/98 event (Fig. 2 top). At the start of fall the water column was much warmer than most years (Fig. 2 bottom). Subsequently, for the first time, thermal stratification was observed over the Middle Shelf Domain in February 2003.

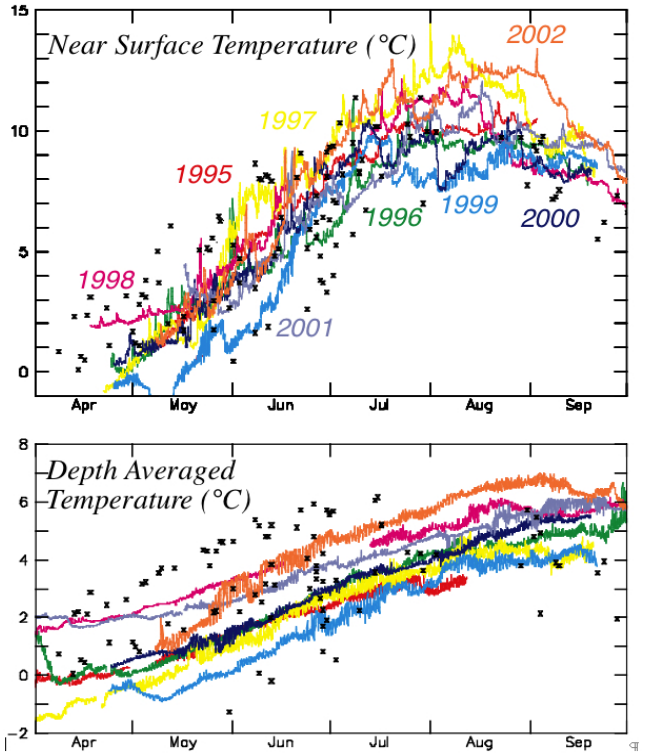


Fig. 2 Comparison of daily near surface (upper panel) and depth averaged (lower panel) water temperatures of the SE Bering Sea Shelf, 1995 - 2002. Water temperatures measured at mooring Site 2 (see PICES Press Vol. 10 (2), p. 15, Fig. 3). Data from hydrographic surveys between 1966 and 1994 shown as Xs.

Spring in Alaska appeared to start several weeks earlier than usual; high pressure atmospheric systems were present over the Bering Sea and Gulf of Alaska during the first part of May, and April air temperatures in Anchorage, Alaska, were higher than long-term maxima recently set during the 1997/1998 El Niño. Although storms did transit the region, several scientists on the water during spring made note of the unusually calm conditions.

The coccolithophore bloom, which first appeared during the 1997/1998 El Niño, failed to re-appear in the summer of 2001. Reports from at least three platforms (T/S *Oshoro Maru*, R/V *Alpha Helix*, and Dr. Vera Alexander aboard a cruise ship) were negative. Dr. Sei-ichi Saitoh onboard the T/S *Oshoro Maru* received satellite images which indicated a bloom, but when he arrived on the station, there were no coccolithophores. Another research cruise (Whitledge, Flint, Lessard and Napp) did find coccolithophores actively growing in the late summer of 2001, but at densities too low to discolor the water. To my knowledge, there have been no reports of a bloom in the summer of 2002. Will the bloom re-appear in the summer of 2003? Stay tuned for the next Bering Sea report.

Demonstrating the effect of climate on lower trophic levels has proven to be very difficult for the eastern Bering Sea shelf. Sugimoto and Tadokoro (*Fish. Oceanogr.*, 1997, Vol. 6, pp. 74-93) demonstrated low frequency variation of chlorophyll and zooplankton standing stock for the eastern Bering Sea (> 150 m water depth) using the T/S *Oshoro Maru* data set (Hokkaido University). A re-analysis of this data set for the eastern shelf was unable to show long-term effects or the influence of El Niños (Fig. 3).

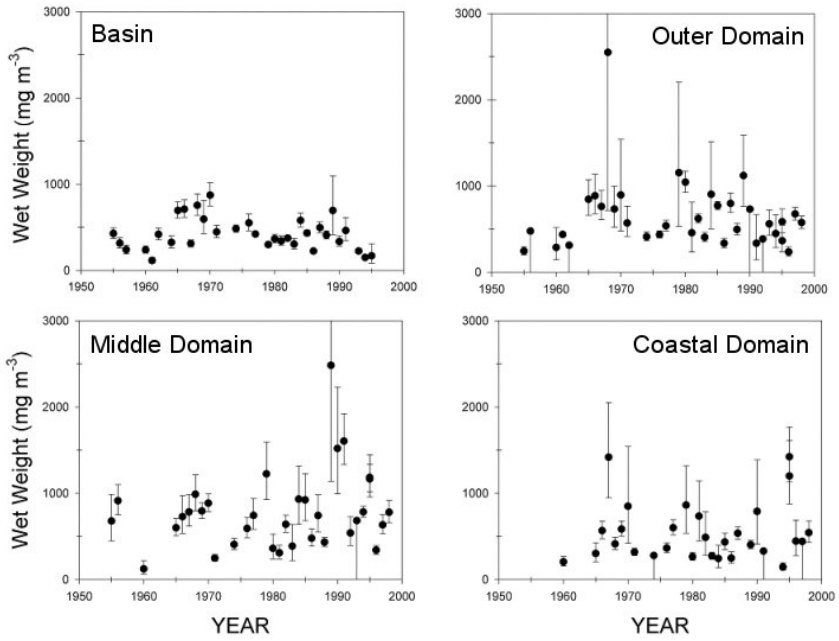


*Fig. 3 Changes in summer zooplankton biomass (means with standard errors) in the southeastern Bering Sea. Figure from Hunt et al. (*Deep-Sea Res. Part II, *2002,Vol. 49, No. 26, pp. 5821-5853).*

(cont on page 19)

Patricia Livingston

Far from the waters of the Pacific Ocean, Pat Livingston grew-up in Farmington, Michigan, where her talents as a biologist was apparent at an early age. Her interest in aquatic biology came from discovering creatures in the stream that flowed near her family's home. She conducted many sampling trips to the stream (without appropriate permits) to collect tadpoles, frogs and fish. The ecological implications of her sampling along with that of her two brothers and two sisters are still awaiting analysis. On her first fishing trip with her father, Pat also found out that the best sampling plan does not always yield the expected results – she caught a fresh water clam using hook and line gear. Having survived a strict Middle American parochial primary and secondary education, Pat became interested in biology while she attended an all-girls high school – as early as grade school, her classmates used to tell her that she was going to be a scientist because of her great interest and budding natural ability in that area. Shortly after the first Earth Day, her school offered one of the first high school level courses in ecology, which may have been the stimulus for the years of research that have followed.

As an undergraduate, she attended nearby Michigan State University because of their notable wildlife department, intending to major in the "warm and fuzzy" field of wildlife biology. The realization that many of her fellow wildlife biology majors were really "wildlife hunters" caused her to reconsider this direction. After two years, she decided that there was more job potential in the study of cold and slimy fish and computers, so she changed her major to fisheries and began taking classes in fish biology and ecosystem modeling. During this time she took her first ecosystem modeling class, contributing to the microbial loop submodel of a freshwater lake. Eager to use her newly learned skills, she rushed to finish her undergraduate work in three years so that she could get out of school and find a job in the real world. However, in the real world of 1976, jobs were somewhat scarce for the baby boom generation. Therefore, it appeared that a more viable option was to attend graduate school where she could learn more about the quantitative aspects of fish populations.

This interest brought her to the University of Washington's College of Fisheries. Here, Pat began study of a slightly larger body of water – the North Pacific, and to study the population dynamics of marine fishes. Her master's degree research involved parameterizing and sensitivity analysis of a mass balance model of the Gulf of Alaska. While she worked toward her MS degree, she started part-time work at the U.S. National Marine Fisheries Service's (NMFS) Northwest and Alaska Fisheries Center located at Montlake in Seattle. Her job involved parameterizing, running and debugging various ecosystem models for areas from the California Current system to the eastern Bering Sea for Taivo Laevastu. On the completion of her MS degree in 1980, Pat obtained a permanent position in the Resource Ecology and Modeling Task of the Center's Resource Ecology and Fisheries Management Division. In response to the results of her graduate research that highlighted the importance of fish food habits data for more accurate multi-species and ecosystem models, Pat has built a solid groundfish feeding ecology field and laboratory program within the group, designed to quantify the food web linkages that are so critical to these models.

A stylish young Pat all set for a Sunday morning ride in Michigan with her older sister, Teri.

Somewhere in the Cascades on the Pacific Crest Trail between Snoqualmie Pass and Stevens Pass with a heavy pack and sore feet in 1979. Always ambitious, Pat is pointing

at the top of the peak where she plans on having lunch!
Development of this field program gave Pat the opportunity to get away from computers for a while and get out on fishery research vessels, where she participated in cruises from Washington to the Bering Sea. The field collection program that she initiated has resulted in a food habits database that now holds diet information on over 100 fish species and 180,000 specimens collected over the last 20 years. It provides a solid basis for the present day multi-species modeling efforts of the northern California Current System, and the continental shelf and slope areas of the Gulf of Alaska, Aleutian Islands and eastern Bering Sea. Although not quite as close as the stream in her old backyard, the North Pacific Ocean has been equally exciting and daunting place to sample. In addition to sampling the groundfish communities in the North Pacific, Pat herded fur seals on Bogoslof Island, counted Steller sea lions on Ugamak (rumor had it that she was the first woman to be on the island), and even tried handlining for squid on the Bering Sea slope when the automatic jigging machines were broken. Pat still talks about the excitement of going ashore on the Pribilof Islands to see the incredible bird and mammal populations that congregate there every summer and the sad duty of escorting a fishing vessel back to Dutch Harbor in the late fall after a rogue wave broke the window of the wheelhouse and killed the vessel's skipper.

During this period, Pat received some exposure to policy analysis and public administration in the Center Director's office of the Northwest and Alaska Fisheries Center. This initial exposure sparked her interest in this different way of looking at the world and enterprise of science. So instead of following the traditional route of returning to school to obtain a Ph.D. degree in her current field of study, she decided to pursue a master's degree in public administration with an emphasis in natural resources policy and administration at the University of Washington. Her research topic describes that interesting mix of science, management, and politics that affects natural resource managers around the world. This degree serves her well in her present position as manager of the Resource Ecology and Ecosystem Modeling Program, and in her involvement in science planning and coordination activities at NMFS, NOAA and PICES. Her first taste of international science meetings was with the International North Pacific Fisheries Commission (INPFC). She still tells the story of her first INPFC meeting in Japan in 1985 when she was the only female scientist presenting a paper. Her biggest problem came when trying to find the restrooms - there were no universal signs and everything was in Japanese. She finally decided to follow the female interpreters to see if they were headed where she needed to go - luckily they were!

Over the years, Pat has been involved in a number of research planning and coordination activities, particularly involving the Bering Sea ecosystem research. She has been a key member and workshop organizer for research plans that were developed to bring an ecosystem perspective to what had formerly been a single-discipline approach to marine research

Pat on a Zodiac tour of Dutch Harbor just prior to the start of a pioneering marine mammal/fishery interactions cruise conducted by the Northwest and Alaska Fisheries Center.

Stranded in the "Gateway to the Aleutians", Cold Bay, Alaska, with colleagues trying to get to Dutch Harbor to begin the survey season.

planning. Since 1995, she has helped bring scientists together to agree on Bering Sea research priorities in response to mandates of the Marine Mammal Protection Act, inter-agency research coordination plans, GLOBEC, PICES, and now is involved in a fifth research plan for the Bering Sea being developed by Dr. George Hunt for the National Science Foundation. Pat is the author of numerous articles on groundfish feeding ecology and predator/prey models that incorporate feeding interactions. Because of her broad perspective, she has led efforts to summarize ecosystem research at the Alaska Fisheries Science Center, and testified to ecosystem advisory panels and to the U.S. Congress on

marine ecosystem research priorities. She has given numerous invited talks on the Bering Sea ecosystem and models of that system.

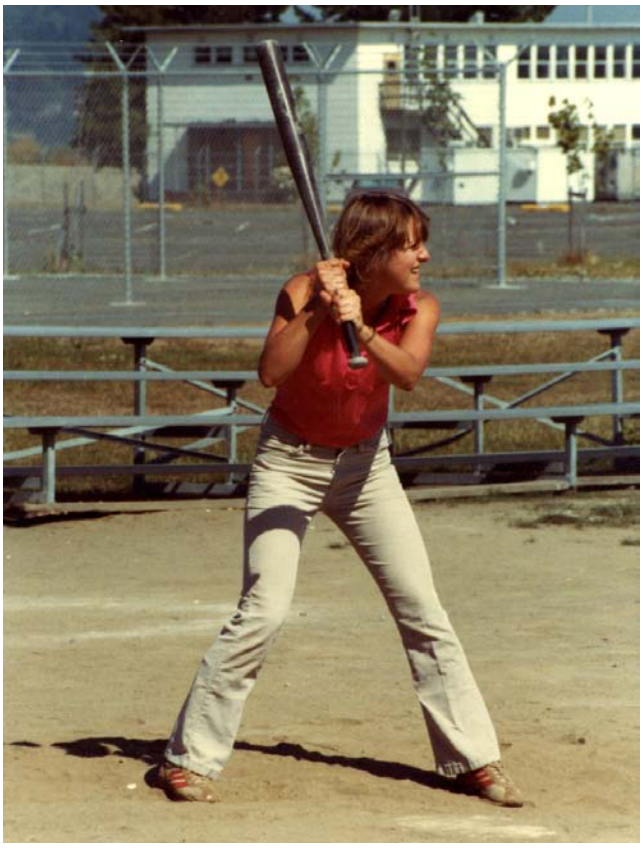
Pat is still active in the field of modeling and has made advances in quantifying and incorporating predation into single-species, multi-species and ecosystem models of the eastern Bering Sea and Gulf of Alaska. Her most recent scientific challenge has been to incorporate ecosystem considerations into fisheries management. She has worked hard to bring marine scientific research results from all the marine-related fields together into a report of ecosystem status and trends in the Alaska region that now is a regular accompaniment to the standard stock assessment documents that are presented to fishery managers. Her next challenge is to devise a standardized ecosystem assessment that will provide guidance on how to adjust fisheries to take ecosystem factors into account.

An affiliate faculty member at the University of Washington since 1989, Pat has served on many graduate student committees. She has provided guidance, data, and financial support to students over the years who have been interested in questions of groundfish feeding ecology and multi-species interactions. Her lab is known for providing the University with highly capable graduate students, who go on to successful careers.

Pat has two children, a daughter Riley aged 10 and a 12-year-old son, Paul. They are smart, fun kids who excel in sports and love fishing and the outdoors. Her husband, Jim Hughes, is an associate professor of biostatistics at the University of Washington and is the true wildlife expert in the household, famous for grueling bushwhacks in the wilderness in search of giant trout while Pat is more content to feed the campfire and sip hot buttered rum at the end of a hike. Sports are big in their household. Pat was an avid softball player until she learned soccer while in graduate school. For a while she played on two soccer teams at a time and has only recently slowed down after injuring her knee while skiing. Lately, she has been doing a bit of mountain biking with her son and is hoping to get back into hiking in the mountains.

Pat and her children show the rewards of a successful day of fishing at the family's "secret spot" in the North Cascades, Washington.

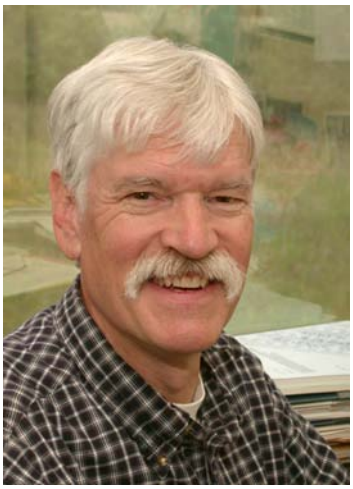
Pat and her husband, Jim Hughes, daughter, Riley, and son, Paul on vacation in 2001.



Swinging in her mom's Midwest women's league footsteps, Pat played softball in middle school and went on to star on the Northwest and Alaska Fisheries Center's softball team in the late 70s and early 80s. In turn, Pat's daughter, Riley, recently stepped up to home plate and is now swinging a big bat. Her proud mom is eager to report that Riley recently set a northeast Seattle record for the longest hit ball.

Pat has been involved in several aspects of PICES since its inception, beginning with a brief appointment to the Bering Sea Working Group (WG 5) near the end of its work, and going on to be a MODEL Task Team member of the PICES-GLOBEC Climate Change and Carrying Capacity (CCCC) Program. From 1996 to 1998, Pat served as the national representative to the Implementation Panel of the CCCC Program and as the Co-Chairman (with Professor Yutaka Nagata) of this Program. More recently, following the Seventh Annual Meeting, she served as the Chairman of the PICES Science Board (1999-2001). In addition to her involvement in PICES, Pat has been an active member of several scientific societies, including the American Fisheries Society, the Association for Women in Science, and the American Institute of Fishery Research Biologists.

Suam Kim, Pat, Jim Balsiger, Bern Megrey, Ric Brodeur, and Ian Perry enjoying the hospitality of their Korean hosts during the PICES Seventh Annual Meeting in Pusan.



Pat's biography was compiled for PICES Press by Gary Duker. He is Director of the Publications Unit of the Alaska Fisheries Science Center (NMFS, NOAA). Like Pat, Gary is a graduate of the University of Washington's College of Fisheries – having received his MS in fisheries science in 1977. He has known Pat for over 20 years, having first met her when she first worked for Taivo Laevastu. His scientific interests include chum salmon spawning behavior, salmonid evolution and fisheries history. He has been at the Alaska Fisheries Science Center for over 16 years, during which time he has studied transboundary stocks of chum salmon while at the Center's Auke Bay Laboratory and served as the Center's technical editor. For the last 15 years he has been the manager of the Center's publications program, where he has reviewed/edited countless journal articles, books, reports, etc.; overseen the production of Center publications; and authored or co-authored numerous articles on various subjects.

Acknowledgement: Many thanks to Pat for going through her photo albums and sharing these photos to help illustrate her "This is Your Life" article.

(Jeff Napp - *cont. from page 15*)

Current research in the Bering Sea

Two Bering Sea synthesis volumes were published at the end of 2002. Papers from the PICES 2001 Annual Meeting Topic Session were published in October (special issue on *Variability in the Bering Sea ecosystem*, *Progress in Oceanography*, Vol. 55, No. 1-2), and two U.S. programs (Southeast Bering Sea Carrying Capacity and Inner Fronts) collaborated to publish a synthesis in December (special issue on *Ecology of the Southeastern Bering Sea*, *Deep-Sea Research Part II*, Vol. 49, No. 26). The subjects covered in these special issues span a wide range of topics from atmospheric science to hypotheses for ecosystem control. They are excellent additions to the body of printed knowledge about the Bering Sea.

Research programs

A national/international effort to bring renewed research into the Bering Sea is being spearheaded by Dr. George Hunt, Jr. In the planning is a proposal for a U.S. program as well as an international GLOBEC project. The international component would compare and contrast arctic/subarctic ecosystems for the Pacific and Atlantic Oceans. A meeting was held May 25-28, in Bergen (Norway) to discuss the proposed GLOBEC study. In the U.S., a steering committee has conducted 2 planning meetings regarding a national Bering Sea study. The committee hopes to provide a draft science plan to the community by early 2004. Comments on the draft science plan will be solicited after public presentations at several science meetings.

Many thanks to the following people who submitted information used in this report: Drs. Janet Duffy-Anderson, George Hunt Jr., Sei-ichi Saitoh, and Phyllis Stabeno and Mr. William C. Rugen, III.

Recent changes in the abundance of northern anchovy (*Engraulis mordax*) off the Pacific Northwest, tracking a regime shift?

Robert Emmett
2030 South Marine Science Drive
Northwest Fisheries Science Center
NOAA/National Marine Fisheries Service
Newport, OR 97365, U.S.A.
E-mail: robert.emmett@noaa.gov

Robert Emmett has been working for NOAA/National Marine Fisheries Service since 1977. He currently researches fishes in Northwest estuaries and coastal marine waters. His primary focus is on the bio/physical factors that influence marine/estuarine survival of juvenile salmonids and abundance and distribution of forage fishes and large predator fishes (hake and mackerel).

Tracking the abundance and distributions of pelagic fishes is a better way to identify climate/regime shifts than just relying on measurements of physical oceanographic conditions. Fishes have different life stages (eggs, larvae, juveniles), each stage having specific environmental requirements that must be met for a species to successfully recruit. As such, the abundance and distribution of adult fishes integrates environmental conditions that affect all life stages. The northern anchovy (*Engraulis mordax*) (Fig. 1), although presently not supporting any commercial fishery, is a dominant and important forage fish off the US continental west coast, and a species whose distribution and abundance appears to be an excellent measure of ocean conditions.

Forage fishes are small schooling pelagic fishes that perform a critical link in marine food webs by transferring primary and secondary production to upper trophic levels. Other important forage fishes off the Northwest include Pacific sardine (*Sardinops sagax*), Pacific herring (*Clupea pallasi*), smelt (Osmeriidae), and Pacific sand lance (*Ammodytes hexapterus*). Forage fishes generally have very high natural mortality rates, mature within two years, are batch spawners, and can rapidly attain very large populations that often fluctuate widely. Some forage fishes are also commercially fished when abundant. For example, from 1948 through 1999, no Pacific sardines were harvested in Oregon because few, if any, were available. However, by 2002, sardines were abundant in Oregon waters and 23,000 mt of Pacific sardine were commercially landed.

Northern anchovy are important prey in the California Current for many species of seabirds, marine mammals, and large fishes, including adult salmonids. Northern anchovy populations also appear to fluctuate out of phase with Pacific sardine populations. When sardines are abundant, anchovy usually are not, and vice versa. As such, the fluctuations in the abundance and distributions of these species are probably a good indicator of climate shifts and ecosystem changes.

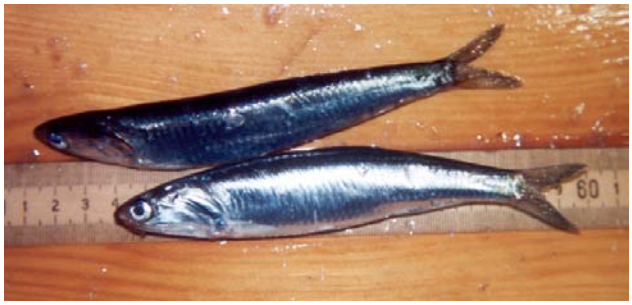


*Fig. 1 Northern anchovy (*Engraulis mordax*).*

Predation on juvenile salmonids, when they first enter the ocean, is often thought to determine marine survival. Scientists have also hypothesized that the abundance of forage fish plays an important role in regulating juvenile salmonids' marine survival by acting as alternative prey for piscivores that prey on juvenile salmonids. The basic premise is that when alternative prey (forage fish) are abundant, piscivores predators eat less juvenile salmon, thus permitting higher marine survival of juvenile salmonids. Since 1999, NOAA' National Marine Fisheries Service has been studying the abundance of northern anchovy and other forage fishes during the spring, the primary salmon smolt outmigration period, to identify if forage fishes are an important factor contributing to salmon marine survival.

Anchovy and other forage fishes are collected by surface trawling at night with a chartered commercial trawler (Fig. 2). All sampling is conducted at night to take advantage of the diel vertical migration of pelagic fishes and because surface trawls are more effective at night. The large surface trawl has a mouth opening of over 336 m^2 and is over 100 m long. The trawl is towed behind the vessel at 3.5 knots (7.4 km/hour) for 30 minutes. Densities of forage fish (number/10^6 m^3) are calculated by multiplying the distance fished by the mouth opening.

Fig. 2 A typical catch of forage fish by surface trawl at nigh.

Trawl samples are collected at 12 stations every 10 days from mid-April through early August along two transects north and south of the entrance to the Columbia River (Fig. 3) for a total of 20 sampling days/year. All forage fish species and potential salmonid predators are identified, enumerated and measured, except when large catches occurred, and then the catch is subsampled and total number of each species in a haul are estimated.

During the last four years, large changes in the abundance of northern anchovy and other forage fishes have been observed. Average densities of northern anchovy off the Columbia River rose dramatically from 1999 to 2002 (Fig. 4). In 1999 northern anchovy densities averaged only $13/10^6m^3$, by 2000 anchovy densities increased by more than an order of magnitude ($453/10^6m^3$), and more than doubled again in 2001. By 2002 anchovy reached their highest average annual densities ($1{,}878/10^6m^3$). Besides showing large annual differences in abundance, northern anchovy also showed a specific temporal abundance pattern. Starting in 2000, northern anchovy became abundant primarily in late April and May (Fig. 5). They were particularly abundant off the Columbia River in early spring 2001 and 2002, and many of these anchovy were spawning adults. This was unusual because previous research has noted that most northern anchovy spawning occurs in summer, far out in the Columbia River plume, not in spring at the mouth of the Columbia River.

A change in Pacific Ocean conditions (perhaps oceanic regime shift) occurred after the 1998 El Niño and began with the 1999 La Niña, initiating biophysical changes in coastal waters of the Pacific Northwest that led to better marine survival of salmonids. One of the largest and most obvious biological changes appears to have been the increased abundance of northern anchovy and other forage fishes.

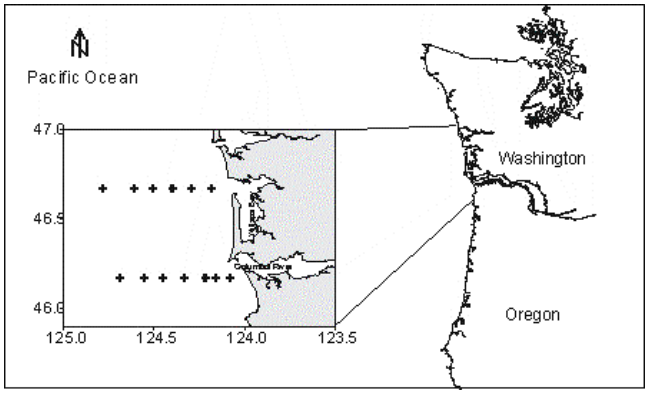


Fig. 3 Location of surface trawl sites sampled every ten days, April-early August, 1999-2002.

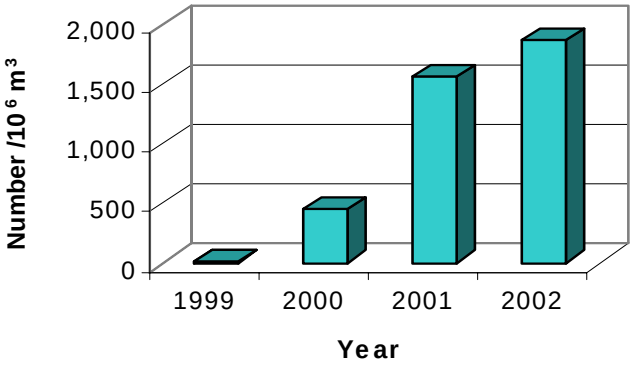


*Fig. 4 Average densities of northern anchovy (*Engraulis mordax*) off the Columbia River April-early August, 1999-2002.*

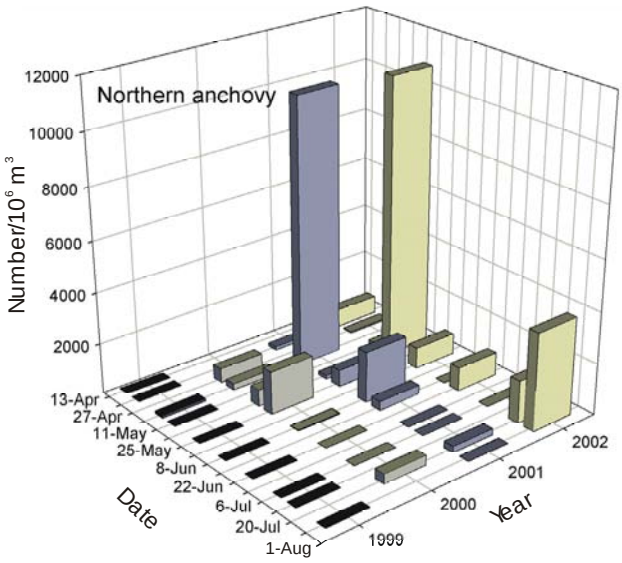


*Fig. 5 Densities of northern anchovy (*Engraulis mordax*) of the mouth of the Columbia River by date, 1999-2002.*

(cont. on page 26)

Developing new scientific programs in PICES

Makoto Kashiwai
Hokkaido National Fisheries Research Institute
116 Katsurakoi
Kushiro, Hokkaido 085-0802, JAPAN
E-mail: kashiwai@fra.affrc.go.jp

Dr. Makoto Kashiwai recently retired from the Fisheries Agency of Japan and is now a guest researcher at the Hokkaido National Fisheries Research Institute. For over a decade Makoto has been a key PICES Builder from Japan. He was the first Co-Chairman of the PICES-GLOBEC Program Scientific Steering Committee, then Chairman of the Science Board, Japanese Delegate on the Governing Council, and is currently Co-Chairman of the Implementation Panel of the PICES Climate Change and Carrying Capacity Program. But on top of everything, he is best remembered as the legend behind PICES III (Nemuro, Japan, 1994), pulling off the Annual Meeting together after a devastating earthquake damaged the meeting venue a week before the opening day (see Dr. Kashiwai's biography in PICES Press at http://www.pices.int/Library/PicesPress/Jan01/Makoto_Kashiwai.pdf.

This article was written as background for discussion at the joint meeting of the PICES Science Board and Governing Council in April 2003, in Victoria, Canada. As the PICES CCCC Program (Climate Change and Carrying Capacity) is in its mid-life, it is time to consider what, how and when, to establish a new program or programs within PICES. Many lessons have been learned through the act of implementing the first program and perhaps it is time to reflect on this history while thinking about the future. This article includes some of Dr. Kashiwai's thoughts on this topic.
Editor

Process

Before considering the process of identifying the Scientific Program(s) to follow the CCCC Program, the Organization needs to agree on a design policy that includes the following issues:

- Will it be a 2nd phase of the existing CCCC Program or an entirely new program?
- Will it consist of a single program (with multiple umbrellas), or multiple programs (each with single umbrella)?
- Will it be planned with or without special research funds or as response to a formal Request for Advice with cost sharing among the PICES member countries?
- Will it consider the output from CCCC Synthesis?

Governing Council must consider these elements of a design policy for the next PICES major scientific program.

A starting point of discussion on the procedure for development of a new PICES scientific program can be found in the *PICES Handbook for Chairmen and Convenors*, (Chapter A. Guidelines for Chairmen, Section VI. Scientific Programs), which states:

> PICES has the responsibility to identify research priorities and problems pertaining to the area of interest, as well as appropriate methods for their solution. Coordinated research programs and related activities of common interest shall be undertaken through national efforts of the Contracting Parties. The following processes should be undertaken when developing a joint research project:
>
> 1. A Workshop should be undertaken to develop a Science Plan based on identified key scientific questions.
> 2. A Workshop should be undertaken to develop an Implementation Plan based on a scientific strategy that includes program management and a schedule for the program.

The agenda and participants of each workshop must be determined based on the requirements of each plan.

Science Plan

The scientific questions that form the Science Plan are critical for the success of the research program.

> *In the world, there are many things not elucidated, or yet to be elucidated. However, for many people, it is not clear what are unknown matters. If one can clearly point out what is not known, we can say that research has already started. Furthermore, when the unknown matter is captured clearly in the form of a problem, we can see that the way to the solution is already open. Questions that already take the form of problems can, in*

most cases, be solved. But, when we solve a problem on one subject, it does not always deepen our understanding on that subject. It is up to methodology to formulate the problem such that solution results in real deepening of our understandings. (Translation from Kenichi Shiragami, 1972)

Therefore, the Science Plan cannot be an assortment of unrelated scientific questions raised by individuals seeking a funding opportunity. The answer to these questions must give the best available scientific foundation for the decisions of member countries on urgent matters of marine policy for preventing global warming or for mediating resultant disaster caused by it. The Science Plan of a major research program of a science organization must give an updated reason of existence for the organization.

Science Board should have a set of criteria for prioritizing scientific plans, *e.g.*:

- Meet needs of member countries;
- Increase value of PICES activities in support of research;
- Strengthen support of cooperative programs of PICES;
- Provide opportunity for PICES initiatives;
- Attract the interest of excellent scientists;
- Contribute to better participation in PICES activities.

These criteria should be considered during the identification of scientific questions and the development of a scientific strategy.

The national interests of PICES member countries in marine sciences of the North Pacific are not identical because of their geographical position in the North Pacific, the relation to downstream/upstream influences of the major oceanographic features of the North Pacific, and the differences in marine policy of their governments. It is therefore natural and necessary for PICES, as an intergovernmental scientific organization, that major scientific programs planned and implemented by PICES, should meet the needs of its members. To ensure that this is achieved, at least three options can be considered:

- Approval by Governing Council of the Science Plan developed through a workshop under the initiative of Science Board;
- Composition of planning workshops based on national reports of requirements of the new scientific program from member countries;
- Development of the Science Plan based on the questions posed by member countries in the form of formal written requests for scientific advice.

The first option is a standard procedure for decision-making by PICES. However, when considering that the existing scientific questions of the CCCC Program can also be found among the discussion papers that led to the establishment of PICES, the identification of scientific questions to be addressed in the next major program should proceed on broadly based intra-national discussion among marine scientists in each member country. This first option does not necessarily lead to the successful implementation of the program.

The second option outlines the minimum requirement for better participation from all member countries in a new major PICES scientific program. If it can be assumed that the major research efforts in a new program are to be covered by the activities of the national programs funded by member countries, the existence of contributing national programs is a crucial pre-condition for establishing a new major PICES scientific program. Therefore, national reports from member countries describing their requirements for a new major scientific program of PICES are required to establish and fund the component national programs.

The third option is a very strong challenge for PICES because answering such scientific questions cannot be undertaken by scratching through existing information, but requires the creative scientific production with authorship of scientists or sponsorship of the organization. Thus, even if PICES does not evolve into a science funding organization, the Organization still needs its own research money to conduct its own research program. Raising funds from outside sources for its research program may result in the implementation of scientific programs that are also of interest to outside sponsors, as in the case of the North Pacific Ecosystem Status Report.

The most appropriate way for PICES to have funds for its own research programs is via this third option. This must be considered and challenged with perspective to develop the advisory function of the Organization.

The scientific questions must be prioritized so as to increase the value of PICES activities in support of marine research. Valuable characteristics of PICES activities in support of marine research can include:

- A multi-disciplinary approach in marine science;
- Basin-scale research coordination in northern North Pacific;
- Fisheries-oriented marine science integration;
- Membership of almost all the northern North Pacific rim countries;
- 10-years experience in the study of ecosystem dynamics,
- On-going long-term ecosystem monitoring stations (more than 5),
- Well-established cooperative relations with other international fisheries organizations in the area concerned; etc.

The Science Plan of a major research program must draw on the best use of these characteristics of the Organization and make best use of, and strengthen the support of, on-

going and planned cooperative programs of the Organization, which include:

- Data exchange;
- CPR survey;
- PICES GOOS Programs;
- Iron Fertilizing Experiments;
- North Pacific Ecosystem Status Report; and
- Capacity Building Program.

The scientific scope of a new scientific program must reflect the scientific strategy of PICES, appearing in the Strategic Plan of Science Board, that can provide opportunity for PICES initiatives, which may include:

- Human dimensions;
- Ecosystem approach in resources management; and
- Marine birds and mammals.

In principle, a scientific organization consists of scientists who are led by excellent scientists. Therefore, it is crucially important for the success of a Program to keep attracting excellent scientists and to have their commitment as leaders. This situation cannot be realized without a formulated set of excellent scientific questions addressed by the Program. For the Program to be able to contribute to better participation, the scientific questions addressed by the Program need to include leading questions within the scientific scope of Scientific Committees.

We can receive potential key scientific questions with description of background, needs and seeds, from the following sources:

- PICES National Delegates with national scientific interests, concerning what scientists are requested to answer by taxpayers and decision-makers;
- Scientific Committees and their substructures;
- Remaining or new questions arising from CCCC Program synthesis
- Presentations by individual scientists at scientific sessions and workshops during the Annual Meeting, or recommendations arising from Symposia or Topic Sessions.

The structuring and prioritizing of scientific questions is the most important component of a Science Plan that can be identified as a part of the Scientific Strategy. It is tightly connected with the sub-structuring of the Program Implementation Panel. Thus, when selecting categorical items for the structuring of scientific questions, we need to select categories that are also appropriate for establishing the sub-structure of the Program Implementation Panel. In CCCC these were grouped as:

- Development of methods (*e.g.* MODEL Task Team);
- Comparative studies among national/local programs (*e.g*. REX Task Team);
- Multi-national collaboration on specific fields (*e.g.* BASS Task Team);

Others include:

- Scientific initiatives on frontier area (*e.g.* human dimension-oriented);
- Specific umbrella program-oriented (*e.g.* atmospheric transport of iron dust);
- Specific disciplinary-oriented (*e.g.* sub-arctic/sub-tropic gyre interaction); etc.

The role of model development in the CCCC Program is not only for hypotheses testing but also for sensitivity studies to identify important ecosystem processes. The most important ecosystem process is the eco-physiological response of key species to the full range of environmental variability that they will experience in the future. It means that intense laboratory rearing studies and/or special field incubation experiments are needed, as are currently being performed by China GLOBEC. These process studies are key to constructing a Mechanistic Model, by which the CCCC Program is intending to overcome the limitations of superficial empirical correlation, and to obtain predictive power beyond regime shifts.

There have been many activities of PICES Scientific Committees in support of the CCCC Program implementation. The activity and results of the Working Group on *Marine Birds and Mammals* is one of the examples. CCCC/IP needs to make an effort to incorporate marine birds and mammals into North Pacific ecosystem models, and to identify hypotheses relating to the role of marine birds and mammals in the response of North Pacific ecosystem to climate change. CCCC/IP should encourage scientists on marine birds and mammals to identify key questions and to join in the practical program implementation.

Comparative study is an efficient approach to identify the specific characteristics of the object concerned. Thus, comparative studies are listed as an important task in many international or inter-program coordinating plans. In the CCCC Program, the REX Task Team is responsible for the comparative studies among North Pacific ecosystems. However, a comparative study cannot be performed by mere exchange and comparison of outputs from separate research projects on the subjects to be compared. It needs specific scientific questions, data from common tools and protocols, common base models, and common methods of analyses.

One of the key words for the next generation of the CCCC Program may be human dimensions. The Earth system is characterized as **the Planet of Water** among the other planets of the solar system, and the existence of the human race, that has been causing the change in greenhouse gases and global warming. Thus, it is reasonable that, for the study of global climate change, we need to include human dimensions into the Earth system. What does it mean to incorporate human dimensions into the CCCC Program? In the case of science in general, to incorporate human

dimensions may mean the amalgamation of natural sciences and social sciences.

Bearing in mind the distance between, for example, biological oceanography and chemical oceanography, the distance between marine sciences and social sciences seems far beyond feasible amalgamation. Thus, at present, for PICES as a marine science organization, to incorporate social sciences will be far beyond its scientific scope. Furthermore, we cannot see the effort of constructing a human society model, while we are struggling to construct a North Pacific marine ecosystem model. A possible challenge can be the incorporation of fisheries as a component into ecosystem models.

The first challenge, associated with incorporating fisheries into an ecosystem model, is to have a system composed of components each having its own goal function to be optimized, *i.e.* shift from a mechanistic model, like an automated factory system, to an animistic model, composed of relatively independent elements with capricious interactions among them. The second challenge is to compose an ecosystem model from components having inner system dynamics that exhibit plasticity in the life cycle. Intensive biology-oriented process studies will be needed for this approach.

For the successful implementation of the next generation CCCC Program, the enhancement of scientific creativity of PICES has crucial importance. Difficulties experienced in the CCCC Program implementation, that limited scientific creativity and efficient program progress, are:

- National scientific programs do not necessarily include scientific questions on basin-scales or questions requiring comparative studies, and therefore have no funding for them;
- The CCCC Program lacks dedicated research funds except for workshops or symposia, and national programs or member countries have no funds that can be transferred to the CCCC Program;
- The contribution by scientists to the CCCC Program is, in many cases, neither authorized nor encouraged by their employer.
- PICES is an inter-governmental organization that focuses on equality among member countries rather than on performance or scientific excellence, and thus the chairmanship of the implementation structure is limited to three-year terms and leaders are not eligible for re-election. This makes it difficult to keep excellent leading scientists in key posts of the Program.

In order to overcome these difficulties, it is necessary to have strong support for the next generation CCCC Program from member countries, including high priority for the funding of CCCC contributing programs, promotion of the program by allocating transferable funds, or catering to member countries' request of advice on a specific scientific question to be addressed to the Program. At the same time, PICES needs to change its calling card from "*Inexpensive Organization*" to "*Creative Organization*" instead, and to change operational practices to fit it.

Implementation Plan

The major components of the Implementation Plan, and thus the agenda of the workshop to develop the Implementation Plan, will be:

- Establishment of an Implementation Panel;
- Action plan as an organized set of workplans for sub-structure of the Implementation Panel;
- Cooperation with other international Programs;
- Relation to international umbrella Programs; and
- Time schedule that recognizes program phases.

In the first stages of the CCCC Program, the sub-structure of the Implementation Panel was established as Task Teams, after developing an Implementation Plan, and along with separately determined terms of reference for each Task Team. Thus, the first stages of the CCCC Program lacked an organized workplan among the Task Teams, and the Implementation Plan lacked an organized research plan. Therefore, any workshop to develop an Implementation Plan must deal first with the establishment of sub-structures of its Implementation Panel. The core of the Implementation Plan must be a set of research plans to answer scientific questions given to the sub-structure of the Implementation Panel, and thus becomes the major agenda of the workshop to develop the Implementation Plan.

The CCCC Program is using models as a tool of program integration. The MODEL Task Team found it necessary to create a basic model for comparative studies and hypotheses testing, and has developed a basic lower trophic level ecosystem model, NEMURO, through a series of intensive practical workshops. The program code, parameter values and forcing factor dataset for typical stations, are open for use by the scientific community on the NEMURO Website.

This model is one of the major achievements of the CCCC Program and is evolving to include higher trophic level models, and to be embedded into a 3-dimensional ocean circulation model. The family of NEMURO models is expected to be the major tool in the CCCC Integration Plan. For this family of NEMURO models to be a community tool for ecosystem studies, there must be consistency among models of different ranks, *i.e*. among box models, 1-D models, 2-D models and 3-D models. This could not be achieved during the first stage of the CCCC Program.

Among marine biologists and even among ecosystem modelers, there is recognition that ecosystem models are special tools for ecosystem modelers only. This is the largest obstacle for models to be the core of program

integration. There must be a protocol for biologists to use a sophisticated ecosystem model as scientific equipment, like a sophisticated chemical analyzer that a biologist cannot construct or repair. This will make it possible for a model-familiar biologist to be a good program synthesizer, while an ecosystem modeler cannot always be a good program coordinator.

Dr. George Hunt (University of California, Irvine) is proposing a Research Plan: *Ecosystem Studies of Sub-Arctic Seas Program*, including the Bering Sea, the Barents Sea, the Newfoundland/Labrador Shelf, the Sea of Okhotsk and the Oyashio shelf region, *i.e.* seasonally ice-covered, sub-arctic seas thought to be sensitive to decadal-scale and secular changes in climate. This proposal includes an important part of the PICES region and also encompasses PICES plans for comparative studies between ICES-CCC and PICES-CCCC Programs. We need to discuss and decide how to consider this proposal.

Judging from the sequence of discussion that led to the foundation of PICES, it is quite natural and reasonable that PICES initiated its first research program as one of the regional programs of GLOBEC. The scientific question on dynamic response of the North Pacific ecosystems to large scale climate variability, is nothing but the scientific concern that pushed member countries to establish PICES, and is also the central question of GLOBEC.

However, GLOBEC is one of the international research programs dealing with the response of the ocean to climate changes. Each of these programs has its own focal questions based upon a specific discipline. Thus the choice of GLOBEC as an umbrella automatically confined the scientific scope of the CCCC Program within that of GLOBEC, which does not necessarily have a direct focus on the response of ocean circulation to climate variability of the atmosphere, or on the response of chemical cycling to the climate variability. Therefore, although the Key Scientific Questions of the CCCC Science Plan can be interpreted as including questions on physical oceanography or chemical oceanography, the CCCC Program has been failing to attract scientists from the Physical Oceanography and Climate Committee and the Marine Environmental Quality Committee.

As a consequence, the CCCC Program lacked scientific questions and hypotheses from the point of view of physical oceanography; *e.g.* "How do the interannual or decadal changes in winter monsoon over the Subarctic Pacific affect the strength and distribution of upwelling velocity?", "How does it change the productivity, geographical extent, and seasonal cycle of subdivisions of Subarctic Pacific ecosystems?", and "How do the interannual or decadal changes in winter monsoon over the North Pacific affect the circulation and inter-gyre water-mass exchange?" We must note that the next stage of the CCCC Program may not need to limit its umbrella only to GLOBEC.

Finally, the Implementation Plan of the first stage of the CCCC Program failed to indicate the total duration of the program and the need for revision of the time schedule. I hope this article can ignite your inspiration for a new PICES scientific program.

(Robert Emmett - *cont. from page 21*)

There has been very little research into the ecology of northern anchovy off the Pacific Northwest, so it is impossible to identify unequivocally what biophysical factors precipitated the large increases in their population. However, there were some obvious major physical and biological changes off the Northwest that appear to be responsible. Most obvious has been the cool oceanic conditions that were initiated by the strong La Niña of 1999. This marked the end of a strong El Niño and a long period of warm ocean conditions that existed during most of the 1980s and 1990s. Starting in 1999, Northwest waters became cooler, sea surface height lower, and southerly current transport larger. These physical factors are indicators of increased nutrients and primary production, which evidently led to a shift in copepod composition and abundance, with subarctic species becoming abundant. At the same time, chinook and coho salmon marine survival increased significantly. Chinook and coho salmon do not feed on copepods, so the copepod species change did not affect salmonids directly. However, copepods are a primary prey for forage fishes such as northern anchovy.

Forage fishes obviously responded to these changes in primary and secondary production (copepod change) by successfully recruiting. Similar fishery recruitment responses to large-scale Pacific Ocean basin wide changes have been observed previously.

Peak Columbia River yearling chinook and coho salmon ocean entry occurs in May. At that time they are very similar in size to adult northern anchovy. Undoubtedly having an abundant "alternative prey" available to piscivorous predators, such as northern anchovy, should enhance salmonid smolt survival and benefit many other marine species such as seabirds and mammals.

Data from these surveys indicates that northern anchovy and other forage fish populations increased dramatically after 1999, and appears to be linked to salmonid marine survival. Ultimately it will only be through long-term studies of the entire California Current pelagic ecosystem will we be able to identify the bio/physical mechanisms that control forage fish abundance and salmonid marine survival.

Report of the Yokohama 2003 MODEL Task Team Workshop to develop a marine ecosystem model of the North Pacific Ocean including pelagic fishes

Bernard A. Megrey, Michio J. Kishi , Kenneth A. Rose, Shin-ichi Ito, Francisco E. Werner

The goals of the Yokohama PICES MODEL Task Team 2003 workshop were to:

- develop a dynamically coupled lower and higher trophic level marine ecosystem model which included a prey-predator system connecting the lower trophic ecosystem to pelagic fishes; and
- to build a Lagrangian model describing fish migration and population dynamics which could be embedded into a basin-scale 3-D circulation model.

The target fish species for the workshop were Pacific herring (*Clupea harengus pallasi*) and Pacific saury (*Cololabis saira*). Preliminary work by the MODEL Task Team on the development of NEMURO and NEMURO.FISH models led up to this workshop. Descriptions of these models can be found in PICES Scientific Reports No. 17 (2001) and No. 20 (2002). A full report of the Yokohama Workshop will be provided in the PICES Scientific Report No. 26 (2003). Copies of model code, reports, and output from previous workshops can be found on the CCCC MODEL Task Team web site at http://161.55.120.140/FOCI/Model/index.html.

The venue was located at the Frontier Research System for Global Change (FRSGC) in Yokohama, Japan. 24 scientists (Fig. 1) from Korea, Japan, Canada and the United States convened between March 3 and March 6, 2003, to attend the workshop. Participants consisted of plankton scientists, modelers, and individuals with knowledge of herring and saury biology and key data sets from selected regions (for now, Vancouver Island and off the east coast of Japan). The Heiwa-Nakajima Foundation of Japan provided financial support for the meeting through the efforts of Dr. Michio J. Kishi.

During the Yokohama Workshop, the herring and saury bioenergetics models were expanded to the population-level and dynamically coupled to the lower trophic levels (LTL) of the NEMURO model. The individual fish bioenergetics model and the one-way coupling to NEMURO (*i.e.* NEMURO is run first and output is used to force the fish bioenergetics model) are described in detail in PICES Scientific Report No. 20 by Ito et al. (pp. 114-119) and Megrey et al. (pp. 80-88). In the sections that follow, we present selected results for the fully coupled lower trophic level NEMURO model NEMURO.FISH (Fig. 2) applied to herring and saury.

Fig. 1 Workshop participants at the entrance hall of the FRSGC. Left to right – Top row: Goh Onitsuka, Kazuaki Tadokoro, Yasuhiro Yamanaka, Naoki Yoshie, Francisco Werner, Taketo Hashioka, Douglas Hay, Fei Chai, Kenneth Rose, Makoto Kashiwai. Bottom row: Sinjae Yoo, Michio Kishi, Shin-ichi Ito, Toshio Katsukawa, Bernard Megrey, Daiki Mukai, Sachie Yoshimoto.

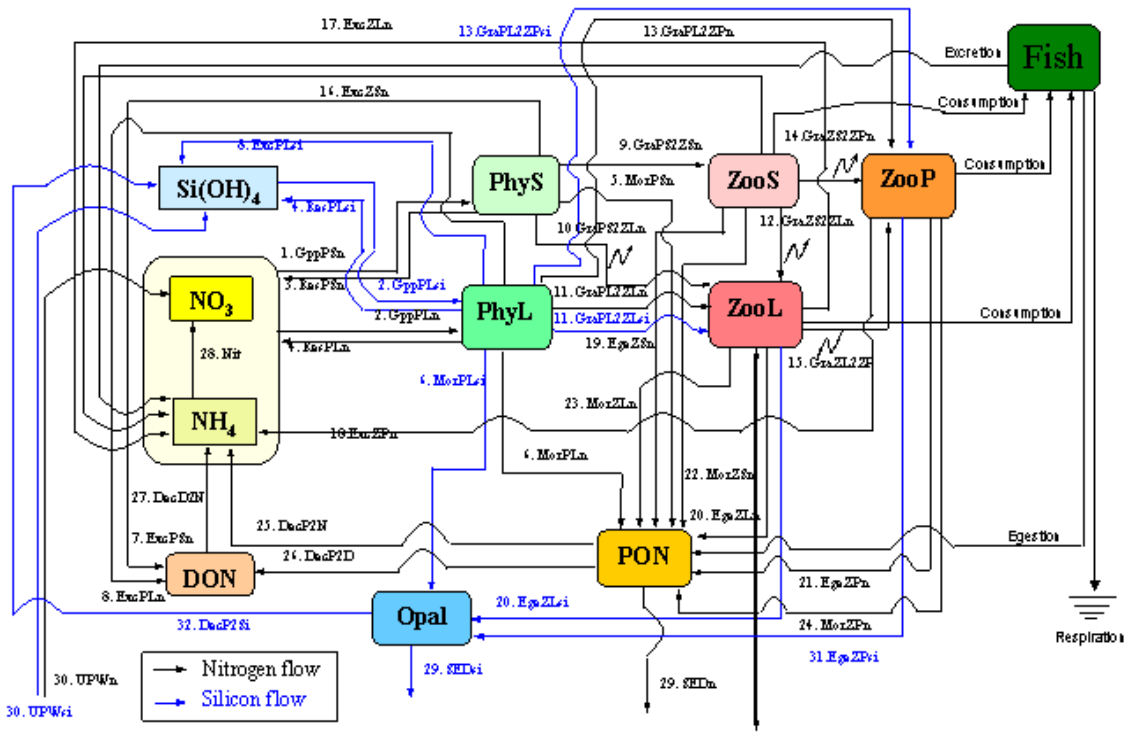


Fig. 2 Schematic of the LTL/HTL NEMURO.FISH marine ecosystem model.

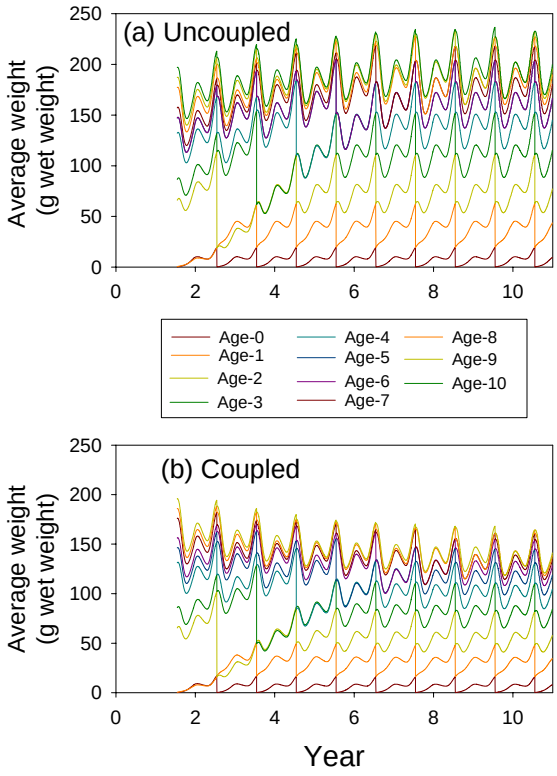


Fig 3 Predicted daily average weights per individual by age-class of herring from the 11-year (a) uncoupled and (b) coupled simulations of the NEMURO.FISH model applied to Pacific herring.

Herring model

We present two 11-year simulations of the NEMURO.FISH model applied to Pacific herring (Fig. 3). The simulations were identical except that the "coupled" simulation included dynamic feedback between the fish bioeneretics model and the LTL model. The dynamic feedback included the following processes: the three zooplankton groups in NEMURO (prey) determined the consumption rate of the average herring in each age-class (predator), and thereby influenced the growth rates and sizes of the herring; the densities of zooplankton eaten by all age-classes of herring were removed as a mortality rate on the zooplankton groups; herring excretion contributed to the LTL nitrogen dynamics by adding to the ammonia compartment; and herring egestion added to the LTL particulate organic nitrogen (PON) compartment (Fig. 2). Thus, the LTL dynamics and the herring dynamics are solved simultaneously in NEMURO.FISH. The other "uncoupled" simulation did not include the feedbacks. The NEMURO LTL component began on January 1, 1991. We did not introduce herring into the model until July 17 of year 2 to let the LTL dynamics spin up to their regular seasonal cycles. The simulations in Figure 3 illustrate the new capability of the coupled lower and higher trophic NEMURO.FISH model in a case where 10 year-classes (cohorts) of herring were considered.

Predicted herring mean weight-at-age was lower under the coupled simulation as compared to the uncoupled simulation (Fig. 3). Including herring consumption as a dynamic mortality term on the zooplankton resulted in a density-dependent feedback and lower herring growth rates in the coupled simulation.

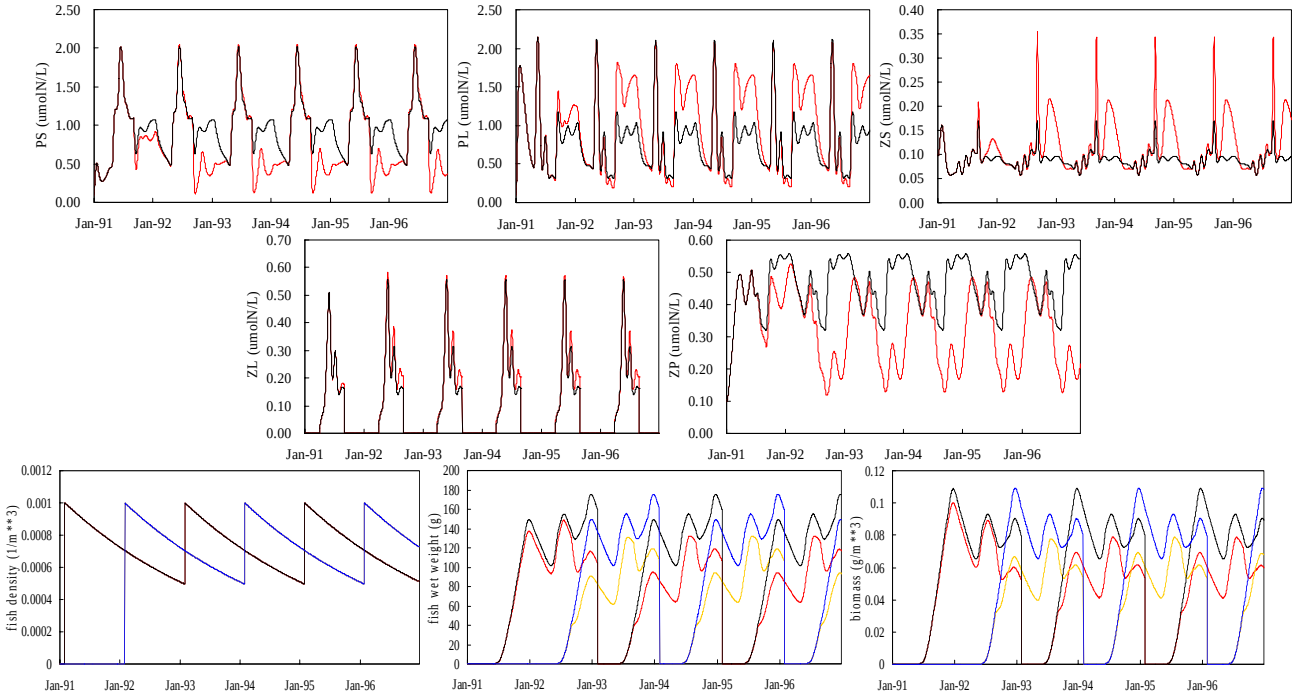


Fig. 4 NEMURO.FISH applied to saury for a six-year simulation. Plotted are phytoplankton (PS, PL) and zooplankton (ZS, ZL, ZP) density and numbers from the one-way coupling (black line) and the two-way coupling (red line). Fish density using the one-way coupling for a one-saury cohort model (black line) and a two-saury cohort model (blue line). Fish wet weight and biomass of saury calculated using the one-cohort saury model and the one-way coupling (black line) and the two-way coupling (red line) as well as the two-cohort saury model using the one-way coupling (blue line) and two-way coupling (yellow line).

The dynamics of NEMURO.FISH applied to herring require additional fine-tuning, and we are not yet ready to compare model predictions to field data for the lower trophic levels or for herring from the Vancouver Island area. We include these results to illustrate the capabilities of NEMURO.FISH and only compare predictions between the coupled and uncoupled herring simulations.

Saury model

A simulation with two-saury cohorts is shown in Figure 4. The effect of the two-way dynamic linkage is emphasized especially in the summer - autumn season. When two adult cohorts co-occur from July to January, the predatory pressure on zooplankton is high. In late winter, the temperature becomes too low to maintain a high predatory pressure, and as a result, fish growth is slowed down in comparison to cases where only one cohort is considered (additional details will be provided in the MODEL Task Team report in the PICES Scientific Report No. 26, 2003).

Concluding remarks

Applications and examples of NEMURO.FISH applied to herring and saury are planned to be the basis for a special issue of the journal *Ecological Modelling*. A proposal to the journal for a collection of papers on NEMURO and NEMURO.FISH has been submitted and accepted. The next steps to prepare these manuscripts are to: (1) synthesize the field data on lower trophic level and herring/saury dynamics from specific sites in the North Pacific; (2) continue the model calibration so that predicted dynamics better reproduce the known patterns of lower and higher trophic levels; and (3) use the model to simulate the effects of environmental changes (*e.g.*, climate change, regime shifts) on the food web (herring, saury and lower trophic levels) under a variety of biological conditions.

Work also continues to find sources of funding to support further model development and to develop the papers for *Ecological Modelling.* Two proposals have been prepared. The first, "*Development of a model to examine the coupled response of lower and higher trophic level of marine ecosystems in the North Pacific and the influence of climate variability*" by S. Ito, M.J. Kishi, B.A. Megrey and F.E. Werner, was submitted to the Japanese Fisheries Agency and funding has been approved. The second (pre) proposal, "*International Workshop on Climate interactions and marine ecosystems: Effects on the structure and function of marine food webs and implications for marine fish production in the North Pacific Ocean and marginal seas*" by F.E. Werner, B.A. Megrey, S. Ito and M.J. Kishi, was submitted to the Asian Pacific Network for Global Change Research (APN). Funding for this proposal is pending.

3rd PICES Workshop on *the Okhotsk Sea and adjacent areas*

From June 4-6, 2003, scientists from Russia, Japan, and the United States met at TINRO-Center in Vladivostok to review recent progress in marine scientific research in the Okhotsk Sea and adjacent areas. PICES has co-sponsored each of the previous meetings in 1994 and 1998, and this year added TINRO-Center and the Census of Marine Life to the list of co-sponsors.

Dr. Lev Bocharov, Director of TINRO-Center, First Vice-Governor of Primorye, Mr. Fedor Novikov, and Dr. Skip McKinnell open the workshop at TINRO-Center.

The first Vice-Governor of Primorye, Mr. Fedor Novikov, welcomed visiting participants to Vladivostok. He noted that some of the most valuable species in the Russian Far East are harvested in the Okhotsk Sea, and therefore it is important for scientists to pay attention to this region. Dr. Lev Bocharov, Director of TINRO-Center and a delegate on PICES' Governing Council, echoed Mr. Novikov's welcome, but also noted that significant decreases in productivity of the Okhotsk Sea have occurred recently because of climate-oceanographic dynamics and anthropogenic effects in the region. Our hosts were interviewed later that evening on local television, attesting to the importance of fisheries and marine science issues in the region.

The first two sessions on *climate variations* and on *physical and chemical processes* were convened by Dr. Vyacheslav Lobanov (Pacific Oceanological Institute, Russia), Dr. Yutaka Nagata (Japan), Prof. Steven Riser (University of Washington, U.S.A.) and Prof. Sei-ichi Saitoh (Hokkaido University, Japan). Presentations on synoptic climate patterns in the region, long time-series of air temperature, sea temperature, and sea ice revealed some interesting patterns. Some of the more interesting results in comparing these presentations were the lack of a significant long-term (>120 years) trend in summer air temperature (at Nemuro, Japan), the apparent lack of change in sea ice dynamics in the last 40 years, and the shift to much cooler sea surface temperatures throughout much of the Okhotsk Sea beginning in 1999. The last of these observations also appeared in the eastern coastal Pacific in the same year. While the 1999 La Niña was initially proposed to be the cause, the cool temperatures have persisted, even through the 2002/3 minor El Niño.

On the second day, the session on *biological variability* was convened by Dr. Elena Dulepova (TINRO-Center, Russia). Observations of lower trophic level biota in the Okhotsk Sea appear to have been made far less frequently than other trophic levels. Several talks focused on the testing, calibration and application of remote sensing techniques to assess surface chlorophyll concentrations, while some posters by Dr. Leonid Mitnik (Pacific Oceanological Institute) showed how measurements from various kinds of remote sensors can be compiled to learn about the Okhotsk Sea and its dynamics.

Dr. George Shevchenko (SahkNIRO, Russia) and Prof. Sei-ichi Saitoh (Hokkaido University, Japan).

On the morning of the final day, chaired by Dr. Vladimir Radchenko (SakhNIRO, Russia) and co-convened by Dr. Keiichi Mito (Hokkaido National Fisheries Research Institute, Japan) and Dr. Tatyana Belan (FERHRI, Russia), a session on *anthropogenic effects and marine ecosystem response* discussed a variety of issues related to fisheries and to oil/gas exploration in east Sakhalin. Several talks examined the levels of various species of hydrocarbon in the sediments. Sources of pollutants in the coastal ocean were both terrestrial (runoff from developments on land into rivers) and from oceanic wells. On the previous day, we learned of a survey comparing the distribution and abundance of benthic fauna on the East Sakhalin Shelf in 2002 with that observed in 1977; the same locations were sampled and it was interesting to note that the differences between the two periods were quite low for most taxa. As has been observed elsewhere in the world, *Orcinus orca* in the Okhotsk Sea have learned that longliners offer an easy source of food, in this case Greenland turbot, and have developed strategies to obtain the easy prey while avoiding the fishermen's attempts at deterring this undesirable behaviour.

A full house at TINRO-Center.

Shuichi Watanabe (JAMSTEC), Keiichi Mito (Hokkaido National Fisheries Research Institute), Jiro Seki (National Salmon Resources Center), Chizu Matsumoto (Hokkaido University), Yoshihiro Tachibana (Tokai University, Hiratsuka), Takeshi Okunishi (ECONIXE Co. Ltd., Sapporo) formed part of the Japanese attendance at the workshop.

The final hour and a half was spent discussing publication plans for the workshop and the major points to include in the Okhotsk Sea chapter of the North Pacific Ecosystem Status Report. Strong interest was expressed in publishing a special issue on the Okhotsk Sea ecosystem in a primary scientific journal. Dr. Dulepova kindly agreed to be the lead author for the Okhotsk Sea and she will coordinate the contributions from various authors during its development. The talks and posters at the *3rd Okhotsk Sea and Adjacent Areas* Workshop will make a significant contribution to that effort.

Session chairmen at the workshop had a new tool at their disposal for keeping speakers to their allotted times. Speakers whose talks began at noon were kept on schedule by the daily firing of the noon gun, which as we learned on the first morning, is located not too far from TINRO-Center. The ecological response to such a large physical forcing was the simultaneous triggering of many car alarms in the neighbourhood.

Skip M^{c}Kinnell
PICES Deputy Executive Secretary
E-mail: mckinnell@pices.int

Recent oceanographic and marine environmental studies at FERHRI

Alexander Tkalin
Marine Ecology Section
Department of Oceanography and Marine Ecology
Far Eastern Regional Hydrometeorological Research Institute (FERHRI)
24 Fontannaya Street, Vladivostok 690990, Russia
E-mail: atkalin@hydromet.com

Dr. Alexander Tkalin has been a member of the PICES Marine Environmental Quality Committee since 1994, and served as the Chairman from 1998 to 2000. His specialty is marine environment pollution, and while at FERHRI, he was involved in a few international projects with the International Atomic Energy Agency (IAEA), IOC UNESCO, NATO, Office of Naval Research (ONR) and United Nations Environment Programme (UNEP) covering the Sea of Japan, Okhotsk Sea and other areas of the North Pacific. From 2000 till 2002, he worked for the Global Environment Facility/United Nations Development Programme (GEF/UNDP) project in Beijing, China. He has published a few papers on distribution of radionuclides, organochlorines and trace metals in the marine environment.

The Far Eastern Regional Hydrometeorological Research Institute (FERHRI) of the Russian Federal Service on Hydrometeorology and Environmental Monitoring was established in 1950. FERHRI carries out extensive research on meteorology, oceanography, land hydrology, climate and ecology of the Russian Far East, Eastern Siberia, northwest Pacific Ocean and its marginal seas. The scientific fleet of FERHRI consists of a few research vessels of different classes (Fig. 1). Having this fleet, FERHRI undertook systematic studies in various parts of the Atlantic, Pacific and Indian Oceans. The Institute took part in numerous national and international research programs. In addition to field studies, FERHRI oceanographers have developed methods for prediction of the basic ocean parameters (ice characteristics, thermal conditions, storm surges, tsunamis, etc.). FERHRI researchers were also involved in tropical cyclone studies, including compiling typhoon catalogues and developing forecast methods for typhoon formation, transport and evolution.

The Institute consists of five main scientific departments:

- Department of Meteorology and Tropical Cyclones;
- Department of Long-Term Weather Forecasts and Climate Studies;
- Department of Mathematical and Automated Methods for Information Processing;
- Department of Oceanography and Marine Ecology;
- Department of Engineering Oceanography and Ecological Designing.

Meteorology and tropical cyclones. Studies of tropical cyclones and their prediction is one of the most important FERHRI research directions. FERHRI specialists develop analog and regression techniques and numerical methods for prediction of southern cyclones, typhoons and related hydrometeorological phenomena. The Institute also provides consultative forecasts of typhoon origin, intensity and movement, data on precipitation, wind intensity and damages for the given area (Fig. 2). Users can also get electronic manuals, catalogues and recommendations containing tropical cyclone characteristics that affect weather conditions in the Russian Far East and southeast Asian countries.

Fig. 1 FERHRI research vessel "Pavel Gordienko".

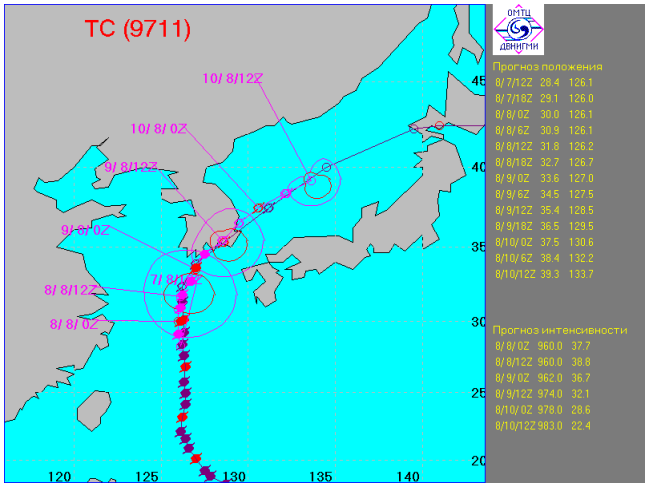


Fig. 2 An example of tropical a cyclone forecast.

Long-term weather forecasts and climate studies. Key activities in this field are aimed to develop and improve long-term forecast methods for hydrometeorological parameters, and to develop and improve techniques for the collection, storage and processing of hydrometeorological data. In addition, studies of global climate, interaction between ocean and atmosphere, El Niño phenomenon and blocking effects in atmosphere which influence human activities to a large extent are carried out.

Oceanography. FERHRI researchers carry out scientific studies on the following problems:

- physical properties of sea water;
- oceanographic data collection and processing;
- water circulation;
- oceanography of coastal areas;
- tides, tsunamies, waves and storm surges;
- ice properties; and
- development of forecasting methods and numerical modeling.

Geographically the main areas of investigation are: the subarctic Pacific Ocean, the Japan Sea, the Okhotsk Sea (including Sakhalin Island shelf), the Bering Sea, the South China Sea (including Vietnam shelf) and the Indian Ocean. Practical results of long-term oceanographic investigations are compiled in various books, manuals, atlases, catalogues, maps and reviews that include data on temperature, salinity, density, wind, wave height, currents, ice characteristics, etc. Electronic versions of most publications are also available. In addition, FERHRI specialists provide recommendations to fisheries, marine transportation and engineering organizations. In 1994, the Regional Oceanographic Data Center (RODC) was established in FERHRI. RODC is a branch of the World Data Center B (Obninsk).

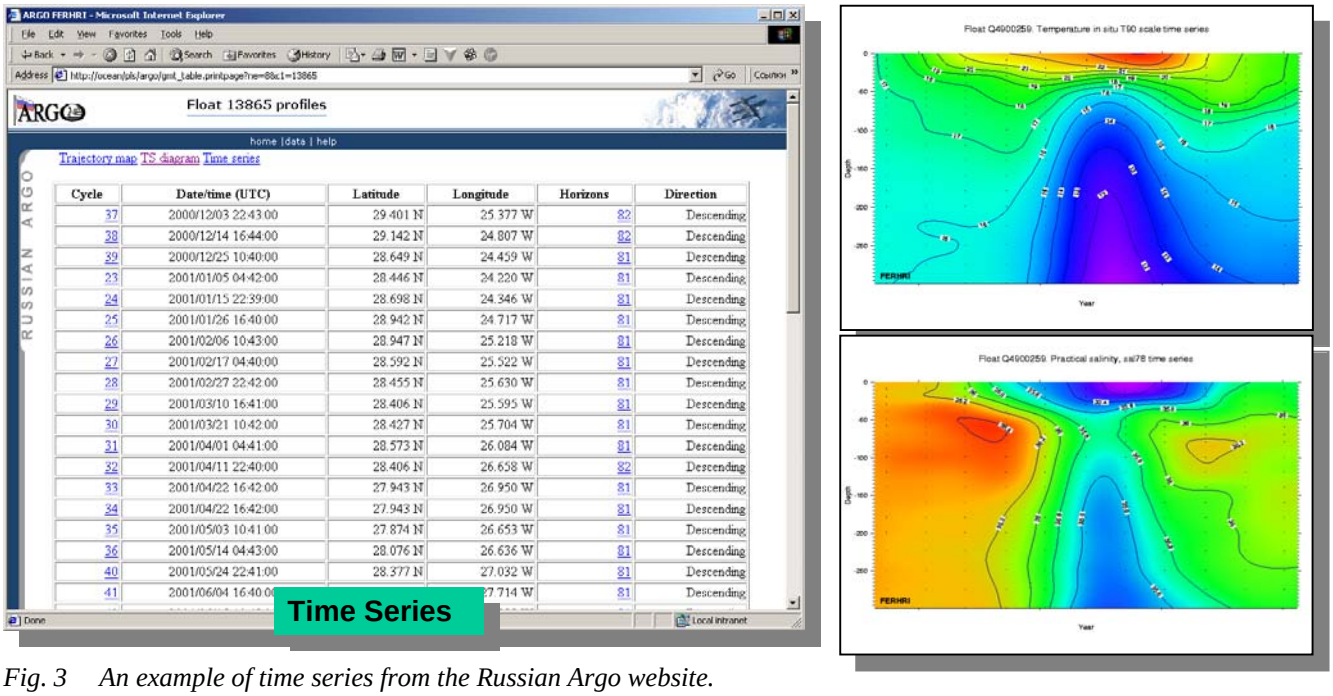
FERHRI specialists are involved in several multi- and bilateral research projects in the North Pacific Ocean. To name a few, Circulation Research of the East Asian Marginal Seas (CREAMS) has been implemented in collaboration with Japanese, Korean and US researchers since 1994, and resulted in a few international symposia and numerous publications. In 1998-2000, three Japanese-Russian expeditions in the Sea of Okhotsk had been carried out. New data on circulation and water exchange between the Sea of Okhotsk and the Pacific Ocean were obtained.

Since 2002, the Institute has been involved in the Argo project. FERHRI has bought and deployed a few PALACE floats already. 14 floats are planned to be deployed by the Russian Federation by 2005. The Russian Argo web page developed by FERHRI presents general information on the project, informs on the results of Russian activities under this project, and provides data obtained from the floats (Fig. 3). Access to the database is allowed through the national Argo web server (http://rus.hydromet.com/~argo/). The national Argo Center is under development now. The Institute is also maintaining the Russian NEAR-GOOS Real Time Data Base. This database contains data obtained aboard the voluntary observing ships and at coastal observation stations (http://www.hydromet.com/project/near-goos/).

In recent years, FERHRI specialists have been involved in large-scale national program entitled "*Integrated Information System of World Ocean Conditions*" (Fig. 4). The system will combine databases of various Russian ministries and maritime organizations. The information included in the system will cover hydrography, meteorology, biology, geology and other related data. The data products, diagnosis and forecasts will be available via Internet for users (Russian version is available at: http://rus.hydromet. com/~esimo/). Access to some data (*e.g.*, for military use) might be restricted. Now the program is at the second stage of implementation (2003-2007).

Marine ecology. FERHRI specialists are actively involved in marine pollution studies in the Northwest Pacific Ocean including its marginal seas and coastal zone. During the last years, for example, bottom sediment pollution by trace metals, chlorinated hydrocarbons and other anthropogenic pollutants in the Chukchi and Bering seas, in some coastal areas of Russia and D.P.R. Korea, in Lianyungang Harbour and Hainan Island (People's Republic of China) and along Vietnam shelf have been investigated.

Joint Japanese-Korean-Russian investigations of radioactive waste dumping areas in the NW Pacific were carried out aboard FERHRI research vessels in 1994-1995. No effects of radioactive waste dumping were found so far. Nevertheless, in 1999-2002, joint Japanese-Russian expeditions were continued. As a result, new data on radionuclide distribution and transport were collected. In addition, the formation of new bottom waters in the Sea of Japan was detected.



Cycle	Date/time (UTC)	Latitude	Longitude	Horizons	Direction
37	2000/12/03 22:43:00	29.401 N	25.377 W	82	Descending
38	2000/12/14 16:44:00	29.142 N	24.807 W	82	Descending
39	2000/12/25 10:40:00	28.649 N	24.459 W	81	Descending
23	2001/01/05 04:42:00	28.446 N	24.220 W	81	Descending
24	2001/01/15 22:39:00	28.698 N	24.346 W	81	Descending
25	2001/01/26 16:40:00	28.942 N	24.717 W	81	Descending
26	2001/02/06 10:43:00	28.947 N	25.218 W	81	Descending
27	2001/02/17 04:40:00	28.592 N	25.522 W	81	Descending
28	2001/02/27 22:42:00	28.455 N	25.630 W	81	Descending
29	2001/03/10 16:41:00	28.406 N	25.595 W	81	Descending
30	2001/03/21 10:42:00	28.427 N	25.704 W	81	Descending
31	2001/04/01 04:41:00	28.573 N	26.084 W	81	Descending
32	2001/04/11 22:40:00	28.406 N	26.658 W	82	Descending
33	2001/04/22 16:42:00	27.943 N	26.950 W	81	Descending
34	2001/04/22 16:42:00	27.943 N	26.950 W	81	Descending
35	2001/05/03 10:41:00	27.874 N	26.653 W	81	Descending
36	2001/05/14 04:43:00	28.076 N	26.636 W	81	Descending
40	2001/05/24 22:41:00	28.377 N	27.032 W	81	Descending
41	2001/06/04 16:40:0		7.714 W	81	Descending

Fig. 3 An example of time series from the Russian Argo website.

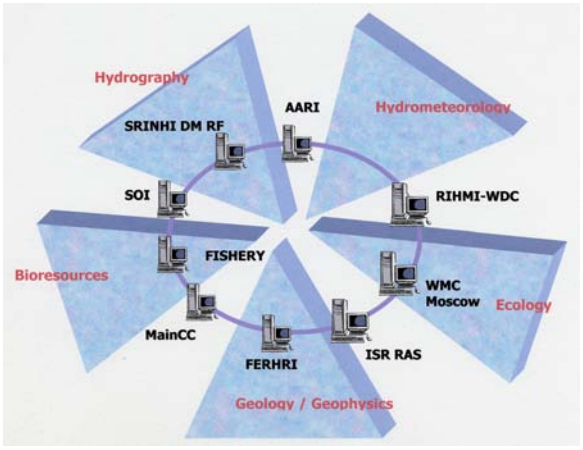


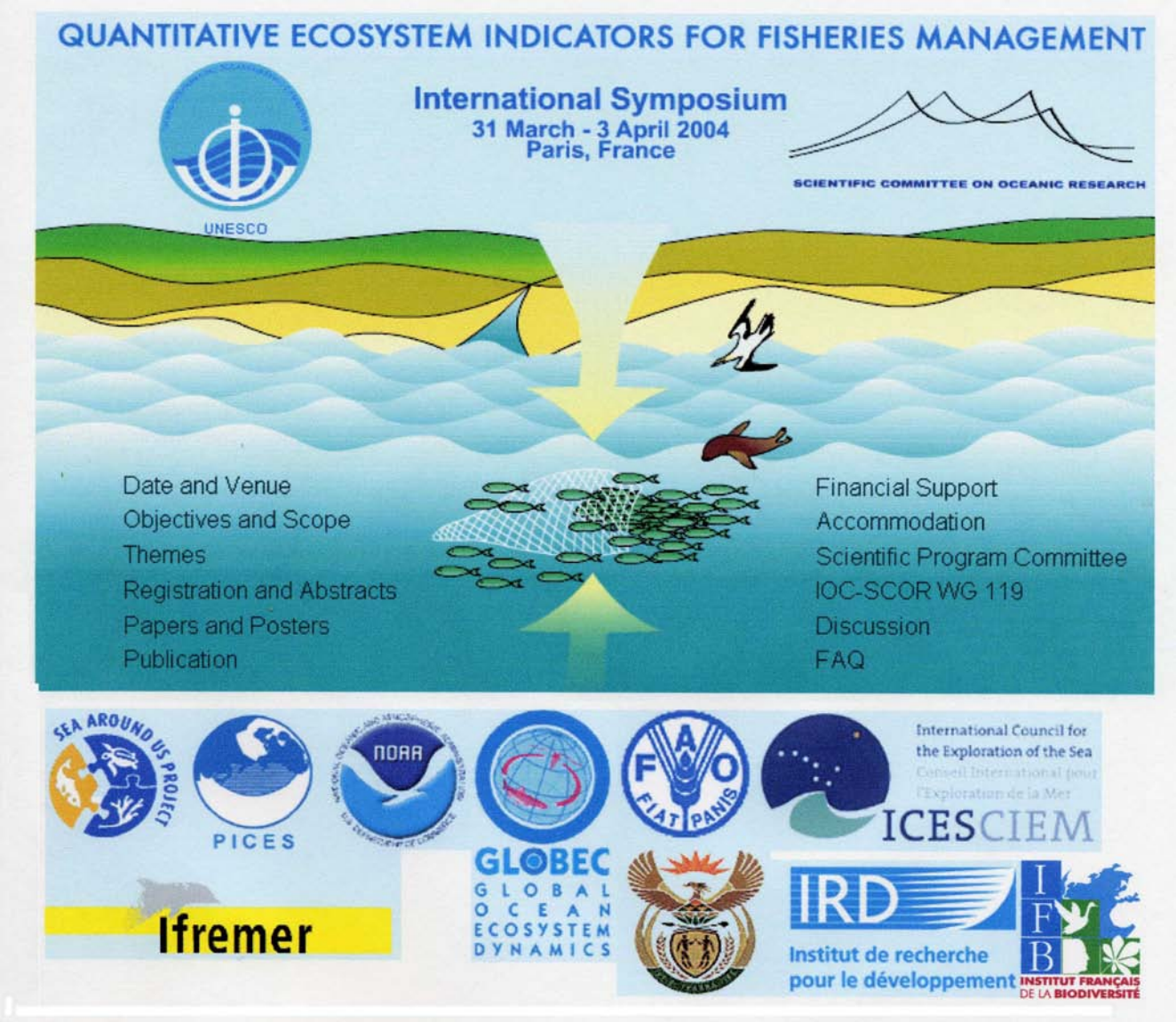
Fig. 4 The structure of the Integrated Information System of World Ocean Conditions.

Fig. 5 Installation of the "Moliqpak" oil production platform.

Background ecological surveys (including measurements of pollutant content in seawater and bottom sediments, plankton and benthos characteristics, etc.) have been carried out at oil and gas fields along Sakhalin Island shelf since 1990. From 1998, FERHRI has started regular (annual) monitoring at the Piltun-Astokh field (contracted by the Sakhalin Energy Investment Company). So far, changes in the marine environmental parameters were registered only within very limited areas around the drilling rigs or production platforms (about 250 m), and these changes were temporary.

FERHRI specialists are also working for other Sakhalin Island shelf projects in developing new methods, models and techniques that allow assessments necessary for Environmental Impact Assessment (EIA). From 1995 to 2000, the Institute prepared several volumes of documents as the general EIA contractor for the drilling/production platform "Molikpaq" (Fig. 5) and for the appraisal drilling programs under Sakhalin-2 and Sakhalin-4 projects. Since 2002, the Institute has been developing technical documentation for the Sakhalin-1 project (contracted by Exxon-Mobil). FERHRI specialists also have experience in the modeling of oil spills and drilling discharge transport as well as calculating the Maximum Permissible Discharges and Emissions (MPD and MPE).

Symposium Announcement



The effects of fishing on marine ecosystems have been widely recognized, as has the need to move toward an ecosystem approach to fisheries (EAF). Such an evolution is being sought by society for all exploited natural resources. Fisheries are no exception. To meet this new challenge, we need a strategy that will elaborate operational frameworks. This will require the development of quantitative indicators at the ecosystem level, and the definition of innovative reference points to provide bridges between scientific results, society's needs, and an effective EAF. The Symposium is planned to support scientific aspects of using indicators for an EAF, and aims to review existing indicators as well as to develop new indicators reflecting the exploitation and state of marine ecosystems. It is also aimed at evaluating the utility of indicators relative to specific objectives. The Symposium will deal with two major themes: the first theme will provide an overview of the vast range of indicators of exploitation and state of ecosystems that are being developed for fisheries management from an ecosystem perspective; the second theme will cover the scientific basis for integrating indicators into an effective EAF. This comprises the evaluation of indicators, the definition of operational frameworks and the communication to stakeholders of inferences based on indicators. A session on the Symposium's last day will be devoted to summarizing the major themes and conclusions of the Symposium. Further information can be found on the **Symposium website: http://www.ecosystemindicators.org.**

A reminder: **the abstract submission deadline is November 14, 2003.**

PICES Interns

PICES offers special thanks to Ms. Natalya Bessmertnaya, the 2002 PICES Intern, who completed her term at the Secretariat and has returned to Russia.

We are pleased to announce that **Mr. Chuan-Lin Huo** from the National Marine Environmental Monitoring Centre (NEMEC of SOA), Dalian, People's Republic of China, joined the Secretariat in late-May as the Fourth PICES Intern. You will have an opportunity to meet him for the first time, at PICES XII in Seoul or at the PICES Secretariat office.

Upcoming PICES Publications in 2003

PICES Scientific Reports:

- No. 24: *CO_2 in the North Pacific* (final report of PICES WG 13)
- No. 25: *Ecosystem models for the subarctic Pacific gyres* (joint report of BASS and MODEL Task Teams)
- No. 26: Report on MODEL Task Team Workshop to *develop a marine ecosystem model of the North Pacific Ocean including pelagic fishes*
- No. 27: Proceedings of the 2002 MONITOR Workshops on *Requirements and methods for "early detection of ocean changes"* and *Monitoring from moored and drifting buoys*
- No. 28: *Marine life in the North Pacific Ocean: The known, unknown and unknowable* (report for the Census of Marine Life)
- Special issue on *North Pacific transitional areas* - *Journal of Oceanography*, Vol. 59, No. 4
- Special issue on *Environmental assessment of Vancouver Harbour: Results from the 1999 PICES Practical Workshop* - *Marine Environmental Research*
- Special issue on *Plankton size classes, functional groups, and ecosystem dynamics* - *Progress in Oceanography*, summer 2003

PICES Twelfth Annual Meeting

October 10-18, 2003
Seoul, Republic of Korea

Human dimensions of ecosystem variability (Science Board Symposium)
Natural and anthropogenic influences on pelagic-benthic coupling in coastal systems (BIO/MEQ Topic Session)
Latitudinal differences in response of productivity and recruitment of marine organisms to physical variability, from Subarctic to subtropical waters, along the eastern and western sides of the Pacific (BIO/POC/CCCC Topic Session)
Influence of fishing and/or invasive species on ecosystem structure in coastal regions around the Pacific Rim (CCCC Topic Session)
Comparison of modeling approaches to describe ecological food webs, marine ecosystem processes, and ecosystem response to climate variability (CCCC Topic Session)
The role of sharks in marine ecosystems of the North Pacific Ocean (FIS Topic Session/S5)
Management of eel resources (FIS Topic Session/S9; jointly with EASEC)
Aquaculture within an ocean ecosystem (MEQ/BIO Topic Session)
Ecosystem-based management science in the context of the North Pacific (MEQ/BIO/FIS Topic Session)
Physical process impacts on biological and fish populations with variability in freshwater inputs to the ocean (POC/BIO Topic Session)
GIS/Geographic-based applications to marine sciences (TCODE Electronic Poster Session)
Linkages between open and coastal systems (BASS Workshop)
Examine and critique a North Pacific Ecosystem Status Report (MONITOR Workshop)
Combining data sets on distributions and diets of marine birds and mammals (MBM-AP Workshop)
Harmful algal blooms - harmonization of data (WG 15/ TCODE Workshop)
Planning a micronekton sampling gear intercalibration experiment (MIE-AP Workshop)

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