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The 2006 inter-sessional Science Board and Governing Council meeting: A note from the Chairman

By Vera Alexander

At the invitation of the U.S. Delegate, Dr. Samuel Pooley, the 4th inter-sessional joint meeting of the PICES Science Board and Governing Council was convened at the Ala Moana Hotel, Honolulu, U.S.A., on April 17–18, 2006. It was followed, on the afternoon of April 18, by a short meeting of the Governing Council. The dates and location of the meetings were chosen to allow participants the option to attend the PICES/GLOBEC Symposium on "*Climate variability and ecosystem impacts on the North Pacific*", also held at the Ala Moana Hotel on April 19–21. The tradition of holding inter-sessional meetings is fairly new, but now has become an integral part of PICES management. Today, PICES is involved in a daunting array of activities, such that it is usually not practical for the governing entities to meet only once each year at the Annual Meeting. The plan is to continue these inter-sessional meetings as needed.

The first order of business for the joint meeting was a systematic update on the activities of the various scientific entities. Chairmen of the Committees and the CCCC Program presented reports; each Committee had also been asked to provide an Action Plan, pursuant to the adoption of a Strategic Plan by the Governing Council at the 2004 Annual Meeting. The primary issue for the meeting, however, was the development of the Future Integrative Scientific Program for the Organization. The CCCC Program has been a centerpiece of PICES activities over the past decade. Its close juxtaposition with GLOBEC has enhanced its effectiveness. The challenge now is to develop a follow-up program that, while building on the CCCC's accomplishments to date, will further advance PICES scientific contributions, as well as the applicability of the information.

The development of the Future Integrative Scientific Program (FISP) for PICES was first discussed at the 2003 inter-sessional meeting in Victoria, Canada. Subsequently, the Governing Council established a Study Group on FISP at the 2005 inter-sessional meeting. This group was to develop ideas for one or more new integrative scientific programs to be undertaken by the Organization. Six proposals for study areas resulted from their activities, and these were discussed and presented at PICES XIV in Vladivostok. The intent at the 2006 inter-sessional meeting was to further refine the topic areas, possibly by combining or reorganizing them. In this regard, a lot of work was done while in Honolulu by members of Science Board collectively and individually, and input has been received by the Study Group from Governing Council members, as well as the broader PICES community. The Study Group will continue to work on refining the topics. Progress has been made, and we expect to address a proposed central theme for the new program at the next Annual Meeting.

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Much of the remainder of the joint meeting was devoted to reviewing upcoming PICES-sponsored activities, proposed publications and symposia, and discussing arrangements for PICES XV in Yokohama. The Governing Council also took up these issues, but the main order of its business was the adoption of the updated Rules of Procedure and Financial Regulations (RPFR). A Study Group on RPFR was established by the Governing Council at PICES XIII. The intent was to ensure that the rules and regulations agreed with the current practice of the Organization, and to eliminate problematic areas of ambiguity. Discussion of the revisions began at the 2005 inter-sessional meeting, continued at PICES XIV, and the revised documents were finally adopted at this inter-sessional meeting.

The other matter discussed by the Governing Council involved the guidelines for operating the Trust Fund. This fund, established in 1994 and supported primarily by voluntary contributions from the Contracting Parties, has been a useful mechanism for facilitating involvement in PICES activities by young scientists, and for providing funds for the PICES Intern Program as needed. Since the guidelines had not been updated in more than a decade, at PICES XIV the Finance and Administration Committee determined that a review was warranted. Again, our aim was to bring the current practice and the guidelines into accord, and to improve transparency of the decisions. Canadian Delegate, Mr. Serge Labonté, worked with the Secretariat in updating the procedures, which were then adopted at this inter-sessional meeting.

A bonus following a very fruitful meeting was provided by our host, Dr. Samuel Pooley, who arranged for an enjoyable and instructive very early morning outing to the fish auction operated by the United Fishing Agency, Ltd. The manager, Brooks H. Takenaka, presented us a wealth of information about the operation of the market and the fish for sale. The visit was followed by a breakfast reception *al fresco* near the dock.

PICES has achieved a substantial reputation over its early years, and has recently reached important new milestones. The completion of the first report on marine ecosystems of the North Pacific, the successful execution of the first large integrative research activity (the CCCC Program), and the first formal response to a request for advice by a Contracting Party (the Report of the Study Group on the Fisheries and Ecosystem Responses to Recent Regime Shifts, PICES Scientific Report No. 28) all point to the direction in which PICES must forge. Coordinating and synthesizing marine research in the North Pacific region is, in and of itself, a very worthy and defendable ambition. But PICES, in developing the new integrative research activity, must also continue to enhance its ability to provide knowledge applicable to the important management and policy decisions faced by the Contracting Parties. This means that PICES must walk the fine line between supplying information and recommending policy. PICES will not advocate policy, but must provide the critical understanding needed by the Contracting Parties to do so. This is especially important, as we face a changing oceanic environment.

Governing Council and Science Board representatives. Front row: Skip McKinnell, Igor Shevchenko, Tokio Wada, John Stein, Laura Richards, Vera Alexander, Suam Kim, Patricia Livingston, Fengkui Liang and Yukimasa Ishida; middle row: George Boehlert, Harold Batchelder, Michael Foreman, Samuel Pooley and, Ig-Chan Pang; back row: Michael Dagg, Kuh Kim, Alex Bychkov, Serge Labonté, Gordon Kruse and Sei-Ichi Saitoh. Absent: Lev Bocharov.

Science Board and Governing Council representatives at the United Fishing Agency, Ltd. fish auction in Honolulu.

Dr. Vera Alexander is currently serving the last year of her second term as PICES Chairman. She has been involved in PICES since the first planning activities in the early 1980s, and served as one of the two national U.S. delegates during the first PICES decade. Her scientific background is in biological oceanography. Recently stepping down as Dean and Professor at the University of Alaska Fairbanks, she is now devoting her time to national and international marine science affairs. In addition to her work with PICES, she is serving as President of the Arctic Research Consortium of the United States and is on the Scientific Steering Committee and the U.S, National Committee for the Census of Marine Life.

Future Integrative Science Program – Progress report

By John E. Stein

The Climate Change and Carrying Capacity (CCCC) Program was our first – and so far only – major science initiative in PICES. Over the years, our colleagues have come together well in the CCCC Program to develop a science that stretches across the North Pacific. They are now in the challenging phase of synthesizing the results of their research (see the summary of the CCCC Synthesis Symposium by Harold Batchelder and Suam Kim in this issue). As the CCCC Program enters the synthesis phase, it is time to start thinking about the next future integrative science program (FISP) of PICES. FISP was discussed initially in 2003, at the first inter-sessional Science Board/Governing Council meeting. At that meeting, Science Board and Governing Council asked Dr. Makoto Kashiwai, a former Chairman of PICES Science Board and co-convenor of the 1994 PICES/GLOBEC Workshop on Climate Change and Carrying Capacity Program, to prepare guidelines for developing a new scientific program in PICES (PICES Press Vol. 11, No. 2). This insightful article has proven to be very useful to ensure that we take into account the lessons learned in developing the CCCC Program. The process gained momentum in 2005, when the Governing Council established a Study Group on FISP. The major function of the Study Group was to develop ideas for one or more new integrative science programs to be undertaken by scientists in PICES member countries. It was also emphasized that the next integrative science program has to be well aligned with the PICES Strategic Plan approved in 2004 (http://www.pices.int/about/PICES_strategy.pdf).

This article describes the progress we have made, especially between PICES XIV in Vladivostok and the just-completed inter-sessional Science Board/Governing Council meeting, held from April 17–18, 2006, in Honolulu. I represent the Study Group on FISP whose members are: Harold P. Batchelder, Michael G. Foreman, Yukimasa Ishida, Kuh Kim, Suam Kim, David L. Mackas, Jeffrey M. Napp, Fangli Qiao, Hiroaki Saito, and myself.

We were asked by Governing Council to address the following Terms of Reference:

1. Solicit ideas (short 1-page descriptions) from PICES Committees, the CCCC Program, and more broadly as appropriate, concerning future major scientific endeavors for PICES;
2. Compile, review and assess the responses; develop themes of potential interest to all member countries, and present the results to Governing Council at PICES XIV, indicating preferences of the Study Group if more than one theme is recommended;
3. Disseminate findings and recommendations after meeting with Governing Council, and seek feedback from the PICES scientific community;
4. Present revised themes and recommendations for proceeding with the implementation of the selected theme(s) to Governing Council at its inter-sessional meeting in spring 2006;
5. Provide the final report to Governing Council and make an open forum presentation on the preferred theme(s) at PICES XV.

Following our inter-sessional Science Board/Governing Council meeting in April 2005, the Study Group developed short descriptions of candidate themes. We received six descriptions, which we reviewed and discussed at a special meeting of the Study Group at PICES XIV:

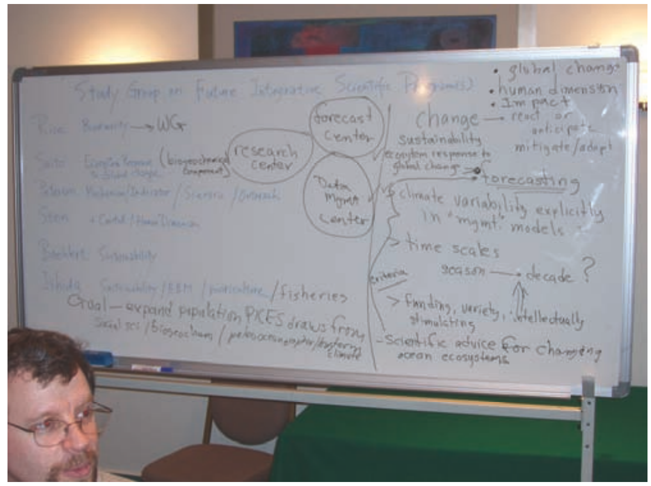
- Ecosystem-based fisheries management and sustainable use;
- North Pacific marine ecosystem response to global change;
- A new integrative scientific program built upon the foundation of the CCCC Program;
- North Pacific ocean sustainability;
- Coastal Ocean ecosystems – The human dimension and climate;
- Status and trends in marine biodiversity.

Discussing FISP proposals at the inter-sessional Science Board/Governing Council meeting, April 2006, Honolulu.

We had a lively and productive discussion in Vladivostok. Rather than having widely divergent views, there were common elements arising from nearly all of the candidate themes and the views of the Study Group members. Those of you who attended the meeting in Vladivostok, may recall that I gave a presentation at the Closing Session summarizing the progress of the Study Group; the presentation can be found on the PICES website at http://www.pices.int/members/study_groups/SGFISP/FISP_theme_proposals.aspx (click on the "Report on Future Integrative Scientific Program(s)" link located at the bottom of the table). In brief, the common elements or key words in the candidate themes were – *climate, forecasting, scenarios and uncertainty, human dimension and outreach, ecosystem response to change, sustainability, biodiversity, indicators* and *mechanisms*. It also became evident that the candidate themes represented an evolution of the science in the CCCC Program and a recognition of topics covered in recent Science Board Symposia, like the human dimension. While we saw the value of building on the progress and success of the PICES' first integrative science program, the Study Group was encouraged to look broadly to make sure that we are addressing those scientific questions that will be the key questions over the next decade.

The discussions in Vladivostok led to consensus that the next major science program should: (1) build upon the successful CCCC Program; (2) move from climate variability to global change; and (3) bring climate into management models. We also proposed that the program should have the following key elements – development forecasts, more explicit inclusion of the human dimension, a focus on mechanisms, development of scenarios for the range of effects of climate change on ecosystem structure and function, and the delivery of ecosystem goods and services that are important for human societies. The following was suggested as a possible name for the new program: FUTURE – **F**orecasting and **U**nderstanding **T**rends, **U**ncertainty and **R**esponse of **E**cosystems. After Dr. Kuh Kim, Science Board Chairman, and I gave an

Members of the FISP Study Group and invitees participate enthusiastically in the group's meeting at PICES XIV.



Whiteboard of the FISP Study Group meeting in Vladivostok.

overview of the progress to Governing Council, the Study Group was asked to move ahead 'smartly' to narrow the number of candidate themes, to request comments from the PICES community, and to be prepared to have a full discussion at the next inter-sessional Science Board/Governing Council meeting. As we say in the western Pacific – we had our marching orders.

Following our Annual Meeting in Vladivostok, the Study Group sought comments from the broader PICES community – we really wanted to hear from our fellow 'PICESians'. This is an extremely important step that we are just starting. It is very important to hear from as many of you as possible since this is *your* next major science program and it will only be as successful as is the acceptance and energy that you bring to the program. The Study Group also feels that it is crucial for the theme to be scientifically compelling and interesting to as wide a range of our members as possible. While this may be an obvious goal, it is one that requires special attention because it is so important to the success of the new integrative science program.

We received comments from PICES colleagues and additional feedback from Study Group members. This served to stimulate an in-depth discussion of FISP at the recent inter-sessional Science Board/Governing Council meeting in Honolulu. Having Governing Council members present added to the breadth of the discussion as we worked to refine our vision of the next integrative science program. It is hard to summarize all of the comments we received, plus an entire day's discussion, but here is my attempt. The next science program should build off the 'PICES trademark' of understanding climate–ecosystem linkages. It must be integrative and involve all PICES countries and all scientific committees, have a duration of about 10 years, contain the key elements outlined above, and accept that a need exists for translating complex ecosystem-scale data for use by management agencies and the general public. PICES should tackle the need to be 'translators' who derive indices of ecosystem patterns, trends, variability, and uncertainty that will be useful to, and understood by, individuals outside the scientific community. There was a great deal of discussion around the latter point, with strong consensus that we must do this. Nevertheless, it is not clear yet how to do it, to what extent, who should be involved, and if we should partner with other organizations. Noting as well, these activities have elements that broach the social sciences considered desirable for FISP. The Study Group was challenged to be bold and to think broadly, but to have clear objectives, and to be aware of major initiatives and geopolitical momentum around issues such as biodiversity. Over the last decade or so, we have learned a great deal about climate and ecosystem linkages, but this knowledge is not necessarily incorporated in the development of policy and management of our oceans and coasts.

Here is a 'sneak preview' of a description of FUTURE that is a result of the progress to date, and will be part of a short document to go Study Group, Science Board and Governing Council members for further review, and then out to you to seek your very important comments:

FUTURE will build on the success of the CCCC Program and is motivated by three universal societal issues:

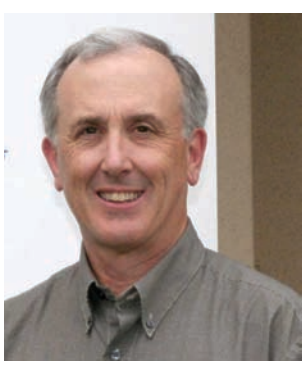
1. the loss of natural environmental capital, such as renewable resources, non-renewable resources, and habitat;
2. the loss of socioeconomic opportunities within PICES member countries due to natural and anthropogenic change; and
3. increased uncertainty and risk faced by managers and policy makers.

These issues drive the need for improved scientific information and for better communication of that information to all facets of society.

The implementation of FUTURE will be to build on the improved understanding of marine ecosystems gained through programs like CCCC and GLOBEC; through the availability of the next generation of Intergovernmental Panel on Climate Change (IPCC) models; improved biological, physical, and geochemical time series in many PICES member countries; and substantial progress made in building models to synthesize existing data and test key hypotheses on the responses of North Pacific ecosystems to climate and human forcing. FUTURE will extend these past programs by focusing on better understanding of the mechanisms underlying ecosystem response, by developing a forecasting capability, and by providing estimates of the uncertainty associated with these forecasts. The challenge is not only to improve our scientific understanding of interactions between the North Pacific Ocean, climate, and biological communities, but also to communicate this information effectively to societies and governments so they can set policy and management directions for our oceans and coasts and the biological communities, including humans, that are in these ecosystems. In short, we need to clarify, anticipate, and communicate the linkages between climate, ecosystems and societies.

We are at an important juncture in the growth of PICES as an international organization as we develop our next major integrative science program. It is my view that we are building off the successes in PICES and the identity that PICES has established as a leader in improving our understanding of how marine ecosystems respond to climate variability. As I mentioned above, our challenges are to make the next major science program more integrative across the breadth of PICES scientific committees, move to forecasting what may be the consequences of changes in the ecosystems of the North Pacific, and be much more deliberate and active in informing those outside of PICES about what we do know and how it should be considered as our societies make decisions that affect the North Pacific ecosystem – from the basin to marginal seas and coasts.

Our next integrative science program will only be as good as the level of involvement from you, the PICES community. So I encourage all of you to come to the Open Science Forum on FISP planned for Thursday, October 19, at our next Annual Meeting in Yokohama. I encourage all of you to attend the meetings of your committees and groups to discuss FISP as well, because we want FUTURE to be truly multidisciplinary and involve all of the PICES Scientific and Technical Committees and meet the needs of our member countries. Make your voice heard by contacting any of the members of the FISP Study Group with ideas or comments on FUTURE.



Dr. John Stein (John.E.Stein@noaa.gov) is currently the Deputy Science Director of the Northwest Fisheries Science Center, National Marine Fisheries Service (Seattle, U.S.A.) and Co-Director for NOAA's West Coast Center for Oceans and Human and Health. In 2005, John was appointed Affiliate Professor at the University of Washington in the Department of Environmental and Occupational Health Sciences. In PICES, John serves as the Vice-Chairman of the Science Board and the Chairman of the Marine Environmental Quality Committee. His science and scientific leadership have focused primarily on the impacts of anthropogenic and natural toxic compounds on fishery resources and protected marine species, and bringing science to the support efforts on recovery of endangered and threatened Pacific salmon. His relevant scientific expertise includes the development and application of biological markers to delineate relationships between exposure and biological effects in fishes and marine mammals. Recently, John has become more involved in the emerging area of scientific investigation on the connections between state of the ocean ecosystem and risk and benefits to human health, an area that is often referred to as oceans and human health.

Big-picture synthesis requires understanding the small and "in-between" stuff – A summary of the CCCC Synthesis Symposium

By Harold P. Batchelder and Suam Kim

On April 19–21, 2006, 90 scientists from 12 countries met in Honolulu, U.S.A., at the PICES/GLOBEC *Climate Change and Carrying Capacity (CCCC) Synthesis Symposium* to discuss patterns of ocean ecosystem and productivity responses across the North Pacific to historical and recent climate variability. This symposium was organized to culminate the CCCC Scientific Program. The intent of the meeting was two-fold: (1) to establish process-based generalizations about how ecosystems have responded to climate variability through cross-regional comparisons of processes and responses, and (2) to identify issues of climate–ecosystem connectivity that remain unclear, and may be topics of future scientific efforts and programs in the North Pacific. This latter goal may be viewed as assessing what we do not yet know, and how we might incorporate those needs into the design of a future integrative scientific program of PICES. The entire symposium was held in plenary to facilitate the goals of synthesis. There were three invited overview presentations and 35 contributed presentations distributed among three theme sessions:

Theme 1: *Examination of ocean and ecosystem responses to known strong, infrequent changes in the North Pacific (regime shifts), such as those that occurred in 1977, 1989, and 1998*;

Theme 2: *Ecosystem productivity and structural responses to physical forcing, with an emphasis on shorter than interdecadal time scales, especially examining variability at interannual (El Niño–La Niña), seasonal and event time scales*;

Theme 3: *Pan-Pacific comparisons, with an emphasis on comparisons of similar species or processes from multiple coastal ecosystems and of open ocean-coastal linkages and climate connections*.

A remarkable accomplishment was that, with only one or two exceptions, all of the speakers concluded their presentations with sufficient time remaining for multiple questions from the audience. This was important for providing feedback on the work, and for stimulating broader discussion. There were contributed posters, with several dedicated discussion periods – often accompanied by copious quantities of "vittles and grog" – to allow poster presenters to interact with other scientists. Finally, Makoto Kashiwai (Japan) and John Davis (Canada) provided retrospective "Perspectives" talks, and a panel discussion was held that touched upon the successes of the CCCC Program and the synthesis symposium, and provided guidance for future research on climate and ecosystem connections. We thank Kuh Kim (Korea), David Mackas (Canada), Brenda Norcross (U.S.A.) and Manuel Barange (GLOBEC IPO) for offering their thoughts and insights during the panel discussion, and the audience for the ensuing lively exchange of ideas. This newsletter article cannot possibly do justice to all of the synthesis presentations, so proceedings of the symposium will be published as a special issue of *Progress in Oceanography*. In the meantime, we share some thoughts about the symposium, highlight a few points made, and offer a report card for the CCCC Program – based upon whether or not we have made significant progress in addressing the central scientific issues of the CCCC Program outlined a decade ago.

The mission statement of the CCCC Program describes two roles:

- To provide a strategy for determining the carrying capacity for higher trophics in the subarctic North Pacific (salmon, pollock, birds, mammals, *etc.*); and
- To develop a plan for a cooperative study of how changes in ocean conditions affect the productivity of key fish species in the subarctic North Pacific and coastal zones of the Pacific rim.

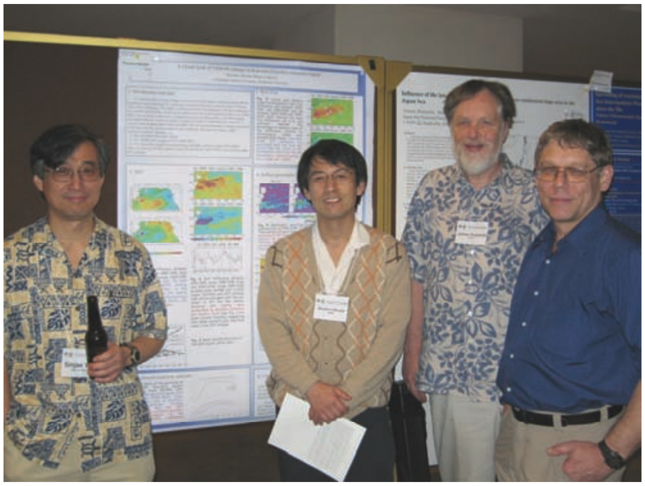
An ultimate goal of the CCCC Program is "to forecast the consequences of climate variability on the ecosystems of the subarctic Pacific." To forecast, we must understand. So a first step is to answer the following question: "How do interannual and decadal variations in ocean conditions affect the species dominance, biomass, and productivity of the key zooplankton and fish species in the ecosystems of the PICES area?" Specifically, the issues being addressed by the CCCC Program are:

Physical Forcing – What are the characteristics of climate variability? Can interdecadal patterns be identified? How and when do they arise?

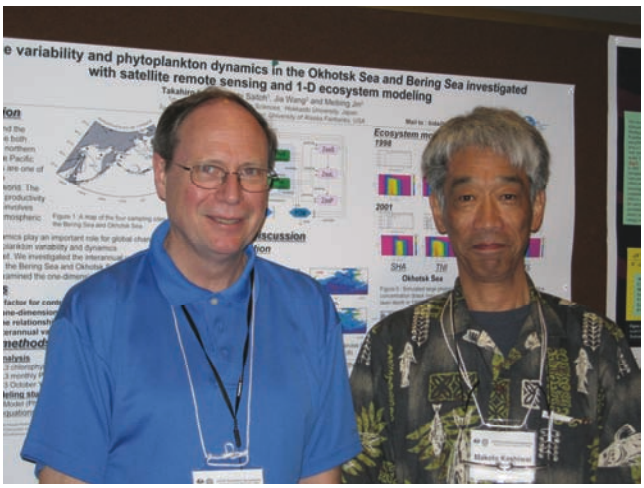
Lower Trophic Level Response – How do primary and secondary producers respond in productivity and in species and size composition, to climate variability in different ecosystems of the subarctic Pacific?

Higher Trophic Level Response – How do life history patterns, distribution, vital rates, and population dynamics of higher trophic level species respond directly and indirectly to climate variability?

Ecosystem Interactions – How are subarctic Pacific ecosystems structured? Is it solely through bottom-up forcing, or are there significant intra-trophic level and top-down effects?



Invited speakers Drs. Sinjae Yoo (Korea), Shoshiro Minobe (Japan), James Overland (U.S.A.) and David Mackas (Canada).



"Perspectives" speakers Drs. John Davis (Canada) and Makoto Kashiwai (Japan).

Panel discussion with Drs. Manuel Barange (GLOBEC IPO), Brenda Norcross (U.S.A.), David Mackas (Canada) and Kuh Kim (PICES).

One lesson learned during the symposium is that synthesis is hard to accomplish because it requires general conclusions from specific information, demands multi-disciplinary thinking and interaction, and it takes a lot of time (and money). Synthesis can be defined as the combination of separate elements of thought or process into a whole, as of simple into complex conceptions. This is in contrast to analysis, which can be defined as an examination of the component parts, each separately, of a subject. As scientists, we do the latter as a matter of routine – *e.g.*, we examine the physical ocean processes of a small piece of ocean, or the population dynamics of a single seabird colony. Conversely, it is only relatively recently, largely due to societal needs and funding agency mandates, that we have undertaken synthesis – where the physics of the ocean, the seabird population dynamics, and all of the intervening trophic patterns and processes are examined to achieve a mechanistic understanding of how climate variability is impacting seabirds or other components of marine ecosystems.

Given the difficulty of synthesis, it was not surprising that many presentations were not successful in achieving synthesis and integration. There were exceptions, where presentations were integrative and accomplished an actual synthesis – *e.g.*, to think interdisciplinary or multi-regionally. To quote Manuel Barange of the GLOBEC International Program Office, who in his panel remarks paraphrased Robert Francis' talk, "*One could say that if a painter paints what otherwise is not there, integration and synthesis tries to extract from the observations what otherwise is not there*." Barange felt that few of the papers demonstrated integration and synthesis. We suppose, to some degree, judging the symposium's success in achieving synthesis is dependent on an individual's *a priori* expectations. One of the conveners (Batchelder) felt that most of the scientific presentations attempted to achieve synthesis, either by considering other aspects of the environment or comparing results to other regions to seek generality. In that respect, many of the presentations were "synthetic" – *e.g.*, very few were, in this convener's opinion, "reports of work in progress."

A number of recurrent themes emerged from the presentations. An emergent theme from the symposium was that "*sometimes the big picture requires that we notice and deal with the small and in-between stuff*", which is paraphrased as the title of this article. This was not a subject of a specific talk, but was mentioned by a number of presenters in the form of statements like, "think like the fish", "need to consider the life cycle specifics", "sockeye salmon life cycles are important", "time and location of spawning are important", *etc*. To paraphrase Marc Mangel (Mangel, 1993), "*Know your Organism*", you need to know the details of the biology in order to understand mechanisms that link the populations and ecosystems to climate change and variability. Brenda Norcross, in her panel remarks, listed a few themes that emerged from the 10 years of the CCCC Program. These include an increased research emphasis on: (1) larger spatial scales (ecosystem, region and basin); (2) comparisons of multiple geographic areas or multiple stocks; and (3) less examined species groups, like jellyfish. Moreover, the CCCC Program was successful in (4) stimulating interdisciplinary work; (5) providing mechanisms and venues for coordination of scientists from different nations; and (6) supporting the establishment or continuation of sustained time series observations.

A separate assessment of themes emerging from the symposium included: (1) do not use "regime shift" as a blanket cause of something; reality is much more complicated than what can be achieved with a simple index; (2) be open-minded and seek alternative explanations to observed phenomena; (3) local forcing and conditions, which might not necessarily be described by or related to ENSO or PDO, may be more important in structuring local ecosystems than basin-scale indicators; (4) do not forget the upward trend of global warming – even the "anomalously" cool years are warm now; (5) species biology and life history are important; and (6) it is not just climate, it is also habitat. One topic that deserves more attention than it received at the symposium, if not by the CCCC Program, then by the next integrative scientific program of PICES, is that climate changes that perturb fisheries have socio-economic and cultural impacts. This is widely recognized and assumed, but there were few presentations at the symposium that focused on quantifying economic impacts. The notable exception was a presentation by Jodie Little (U.S.A.) which examined projections of biomass and revenue derived from harvested marine resources under different scenarios of climate (*e.g.*, bottom-up and top-down forcing) (**Fig. 1**). Of course, human systems are adaptive – fishers retool as needed to utilize different resources – and projections of ecosystem and economic conditions cannot be forced as if the ecological–economic interactions are static. Fluctuations in fisheries resources lead to shifting harvesting priorities and use.

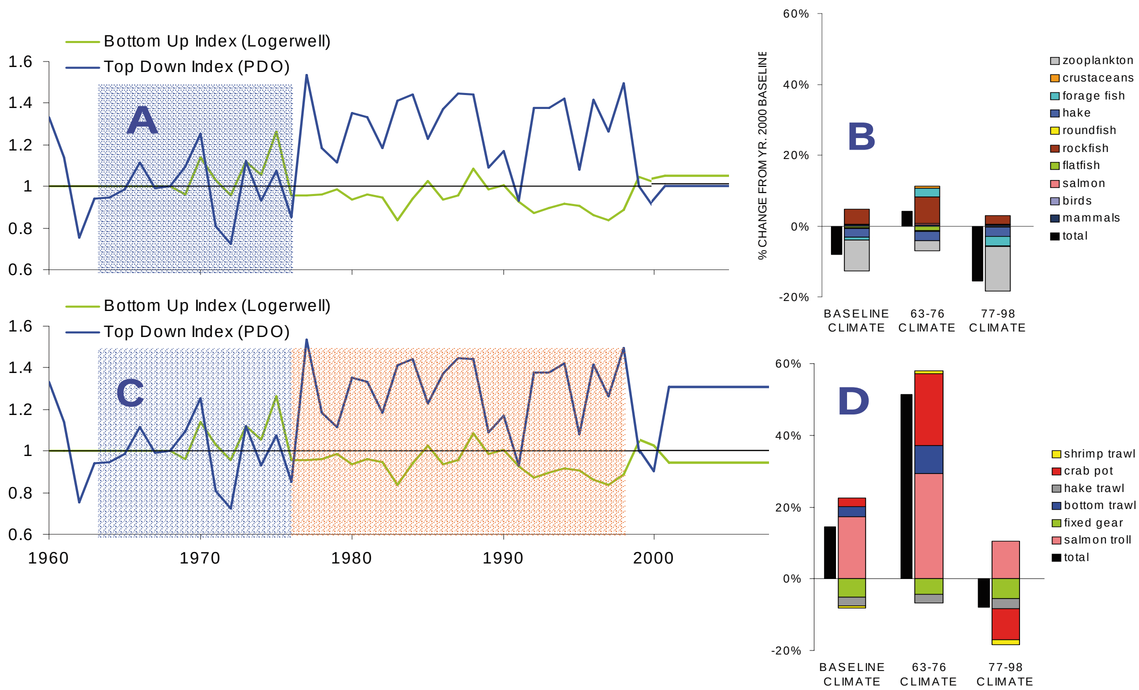


Fig. 1 Projections of California Current biomass and living marine resource-derived revenue by major fish categories for two different climate projections. Bottom-up forcing used a time series of early salmon survival (Logerwell et al., *2003). Top-down forcing used the PDO. Panel A is the projection scenario when forced by cold period (1963–76) conditions. Panel C is the projection scenario when forced by warm period (1977–98) conditions. Panels B and D show the percentage change of biomass and revenue, respectively, over the long-term (projections extended to 2100) under the baseline climate (1960–2000), and cold and warm scenarios, when fishing is assumed constant at 2000 levels through time. Figures are from the presentation by Jodie Little (with permission).*

James Overland (U.S.A.), in the invited talk (co-authored by Shoshiro Minobe (Japan) and Sergei Rodionov (U.S.A.)), described how regimes and regime shifts are ill- or inconsistently-defined, sometimes by statistically significant displacements in a time series, or by non-linear processes, or by external forcing. The FERRRS report (King, 2005) defined regimes as "a period of several sequential years (often a decade or more) in which the state, or characteristic behavior of the climate, the ocean conditions or an ecosystem is steady." Similarly, regime shift was defined as "a relatively rapid change (occurring within a year or two) from one decadal-scale period of a persistent state (regime) to another." This definition is of the displacement type described by Overland. Statistical displacement analysis (Rodionov, 2004) identification of regime shifts is sensitive to the parameterization of the detector, as illustrated by **Figure 2**. Two conclusions are: (1) most time series of ocean ecosystem conditions are still too short to determine the underlying model of regimes; and (2) it is important to understand the physical–biological links, and especially biological lags, in responding to physical forcing and long-term trends.

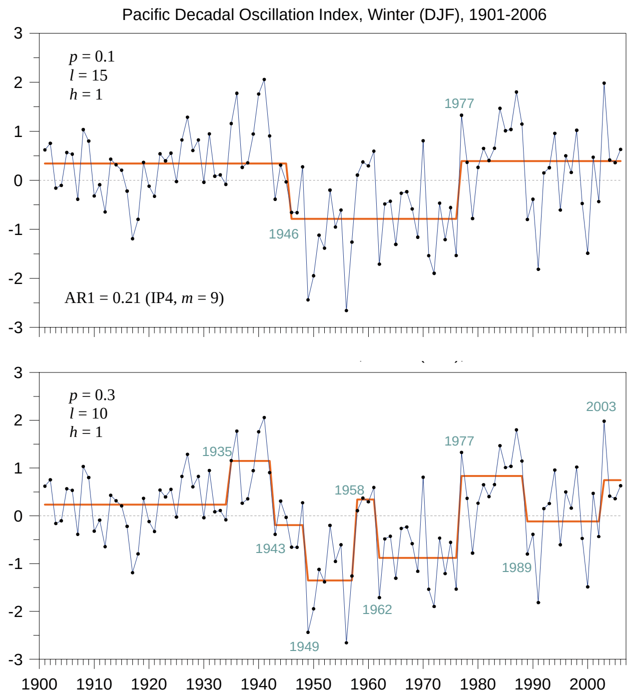


Fig. 2 Detecting regime shifts in the PDO using the displacement sequential regime detection method of Rodionov (2004). The algorithm has user-specified criteria, e.g.*, cutoff time-scale (l) that determines the minimum duration to qualify as a regime. The key concept is that there must be significant shifts in mean value relative to the within-regime variance in order to "detect" a new regime. Figure from presentation by James Overland (with permission).*

Sinjae Yoo (Korea) provided an overview invited talk for Theme 2 (co-authored by Harold Batchelder (U.S.A.)) on seasonal, interannual and event-scale changes in North Pacific ecosystems. The importance of temporal environmental variability is life-cycle scale dependent. The seasonal annual cycle is the largest amplitude signal in most regions and for most trophic levels (below fish). Spatial variations in seasonal climatology (magnitude and timing) of surface chlorophyll concentration, based on SeaWiFS data, for which comprehensive spatial data are available since 1998, indicate maximum amplitude fluctuations in continental shelf systems and high latitudes, and generally lower amplitude fluctuations in oceanic regions of the North Pacific. Fewer places have full seasonal descriptions of zooplankton biomass, but several that are described have seasonal peak biomasses corresponding with, or shortly after, peak chlorophyll concentrations (Japan/East Sea, East China Sea, Oyashio region, Alaska Coastal Current). Conversely, peak seasonal zooplankton biomass in some regions (Station P in the Gulf of Alaska, CalCOFI region) does not correspond well with peak seasonal chlorophyll concentration. For Station P, the explanation is likely related to the seasonal phenology of the large grazing copepods which peak in biomass in June, but depart surface waters to diapause at depth, enabling a slight accumulation of phytoplankton biomass in autumn.

Yoo described the interannual variability of phytoplankton biomass (surface chlorophyll) across the North Pacific for the period from 1998–2004. Several patterns of interannual variability were discerned: (1) an anti-El Niño pattern with highest chl-*a* in 1999–2002, and anomalously low chlorophyll in the other years (Southern Japan/East Sea, Alaska Coastal Current, Northern California Current); (2) an El Niño pattern opposite to that of (1), common in subarctic marginal seas (Okhotsk Sea and Bering Sea); and (3) a trend of increasing surface chlorophyll through time (Pacific subarctic regions of the Northern Japan/East Sea, Western Subarctic Gyre, Gulf of Alaska and the Pacific Subarctic Front region). Specific event-scale phenomena described were: (1) the anomalously enhanced southward flow of subarctic water into the California Current in 2001–2002, which stimulated very high phytoplankton production and had significant impacts, at multiple trophic levels, on the Oregon continental shelf ecosystems; and (2) the delayed spring transition in 2005 and its ecological impacts on zooplankton and the fish and seabirds that rely on abundant spring zooplankton prey for reproduction and/or survival.

Symposium in session.

David Witherell and Gordon Kruse discussing interesting presentations during coffee break.

David Mackas (Canada) provided an overview presentation for Theme 3 (co-authored by Kazuaki Tadokoro (Japan)) on Pan-Pacific comparisons, focusing on the ecology of subarctic zooplankton. He described what was known about zooplankton ecology prior to the CCCC Program and then summarized what was learned about zooplankton ecology of the North Pacific during the Program. Briefly, the pre-CCCC knowns were: (1) average zooplankton conditions (basin-scale distributions of biomass, dominant species and their distribution, seasonal life history (phenology), prey items and predators of a few species at a few locations); (2) average environmental conditions (mean water properties, circulation, seasonal cycles and east–west contrasts); and (3) increasing awareness of the importance of (a) iron to plankton dynamics in the subarctic, (b) climate variability (regimes and ENSOs) and (c) climate trends and CO_2. Large body-sized, inter-zonal migrant copepods, especially *Neocalanus* spp., dominate the spring–summer biomass at all deep water locations in the subarctic Pacific. In addition there are a few other groups of smaller copepods, euphausiids and some "jelly" plankton that contribute to the zooplankton biomass. Despite the rather uniform east–west composition of the zooplankton fauna, there are substantial east–west contrasts in the environment (temperature, circulation, phytoplankton biomass). New zooplankton insights during the CCCC Program include: (1) quantification of how much low-frequency (regime shift and ENSO) variability of zooplankton biomass occurs; (2) knowledge of the natural history of many more zooplankton taxa (thanks largely to Japanese studies); (3) new information about within-species variability of body size and phenology, through both time and space; (4) improved knowledge about the composition of zooplankton assemblages and their variation in space and time; and (5) development of a geographically more comprehensive set of zooplankton time series across the North Pacific, and comparison of these zooplankton time series.

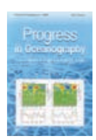
It was clear from the presentations made at the symposium and from recent publications that great progress has been made on coupling biological models of lower trophic levels of varying complexity (NEMURO, Individual Based Models) to physical dynamics (hydrographic structure and circulation) and to other components of the biological system, as exemplified by the coupling of NEMURO with models of growth and population dynamics of herring and Pacific saury. Recently, these coupled models are being forced by climate projections derived from IPCC (International Panel on Climate Change) assessment models to examine potential impacts of continued global warming on the ecosystems of the North Pacific.

Physical Forcing

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

Progress and Products

- 2000 Progress in Oceanography (North Pacific Climate Regime Shifts)
- 2005 Fisheries Ecosystem Responses Recent Regime Shifts (FERRRS) Report



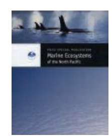
- Many scientific papers on regime shifts, climate variability and posters and presentations at this symposium (*e.g.*, Overland, Schwing)

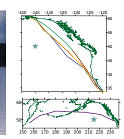
Lower Trophic Level Response

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

Progress and Products

- Forthcoming Ecological Modelling special issue on NEMURO model
- Contributions to North Pacific Ecosystem Status Report





- Development of NEMURO through many workshops. Great progress on LTL and linkage to climate, including papers at this symposium (*e.g.*, Aita, Hashioki presentations)
- Activities leading to SCOR WG 125 (Global Comparisons of Zooplankton)—Mackas presentation
- New CPR program in North Pacific

Higher Trophic Level Response

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

Progress and Products

- Linkage of NEMURO to higher trophics, esp. fish, NEMURO.FISH (e.g., Rose, Ito presentations)
- Cross-regional comparisons of species responses to climate — *e.g.*, herring, sardine, pollock (presentations by Hay, Perry, Peterman, Sydeman, Beamish poster, Takasuka, *etc.*)
- ECOSIM/ECOPATH efforts of BASS Task Team to examine differences in higher trophic food webs of eastern and western subarctic gyres.

Ecosystem Interactions

How are subarctic Pacific ecosystems structured? Is it solely through bottom-up forcing, or are there significant intra-trophic level and top-down effects?

Progress and Products

- Forthcoming Prog. Ocean. special issue on "Mechanisms that regulate North Pacific ecosystems: Bottom-up, top-down, or something else?"
- ECOSIM/ECOPATH efforts of BASS Task Team to examine differences in higher trophic food webs of eastern and western subarctic gyres.
- Iron Fertilization Experiments in Western and Eastern Subarctic Pacific that were coordinated through IFEP advisory panel.

Fig. 3 Summary of progress and products resulting from CCCC investigations directed at each of the major CCCC scientific issues described in the text. An overall conclusion is that the CCCC-stimulated studies have improved understanding of climate–ecosystem interactions in the North Pacific, but that not all questions and issues have been resolved.

Overall, the Symposium on "*Climate variability and ecosystem impacts on the North Pacific: A basin-scale synthesis*" was a success. Some of the progress and products of the PICES CCCC Program are summarized in **Figure 3**. Of course, we have not accomplished all that we set out to do at the inception of the Program, and there is room for improvement in achieving a synthesis. The co-conveners of the symposium (and co-authors of this article) hope that many of the presentations from the symposium will be prepared as manuscripts and submitted for consideration in the symposium proceedings in *Progress in Oceanography*.

References

King, J. R. (Ed.) 2005. Report of the Study Group on Fisheries and Ecosystem Responses to Recent Regime Shifts. PICES Scientific Report No. 28, 162 pp. (Online at: http://www.pices.int/publications/scientific_reports/Report28/Rep_28_default.aspx)

Logerwell, E., Mantua, N., Lawson, P., Francis, R. and Agostini, V. 2003. Tracking environmental processes in the coastal zone for understanding and predicting Oregon coho (*Oncorhynchus kisutch*) marine survival. *Fish. Oceanogr.* 12, 554–568.

Mangel, M. 1993. Models, physics and predictive biological oceanography: know your organism. U.S. GLOBEC News, 4, 1–2. (August 1993; Available online at ADDRESS)

Rodionov, S.N. 2004. A sequential algorithm for testing climate regime shifts. *Geophys. Res. Lett.* 31, L09204, doi:10.1029/2004GL019448.

Dr. Harold (Hal) Batchelder (hbatchelder@coas.oregonstate.edu) is a professor (senior researcher) at Oregon State University, and the Executive Director of the U.S. GLOBEC Northeast Pacific Regional Coordinating Office. Previously he served for 6 years as the Scientific Director of the National U.S. GLOBEC Steering Committee Office. Hal is Co-Chairman of the Climate Change and Carrying Capacity Program of PICES. His research uses models to examine the interactions of plankton populations and physical flow fields, using in particular Lagrangian–Eulerian approaches that allow coupling of complex biological states and behaviors with lower trophic levels.

Dr. Suam Kim (suamkim@pknu.ac.kr) received his B.Sc. (1976) and M.Sc. (1979) in Oceanography from the Seoul National University and his Ph.D. in Fisheries Oceanography from the University of Washington in 1987. Currently he is a professor of the Pukyong National University, Busan, Korea. He served as the Director of the Polar Research Center of the Korea Ocean Research and Development Institute (KORDI) and Chairman of Korea GLOBEC. His areas of interest include fisheries ecology (especially recruitment variability focusing on early life histories of fish in relation to oceanic/climate changes) and fish stock assessment using the egg production method. Suam has represented Korea on several international organizations such as PICES (Co-Chairman for the CCCC Program and member of the Fishery Science Committee), GLOBEC (SSC member), and CCAMLR (Vice-Chairman of the Scientific Committee).

PICES Calendar

- Workshop on "*Model-data inter-comparison for the Japan/East Sea*" and Summer school on "*Ocean circulation and ecosystem modeling*" (co-sponsored by PICES, SNU and KORDI), August 21–25, 2006, Busan, Korea;
- ICES/PICES theme sessions on "*Large-scale changes in the migration of small pelagic fish and the factors modulating such changes*" and on *operational oceanography* (title TBD) at the ICES Annual Science Conference, September 2006, Maastricht, Netherlands;
- PICES Fifteenth Annual Meeting, October 13–21, 2006, Yokohama, Japan;
- International Conference on "*The Humboldt Current system: Climate, ocean dynamics, ecosystem processes and fisheries*" (co-sponsored by IMARPE, IRD, NASA, FAO, GLOBEC, ICES, PICES and IMBER), November 27–December 1, 2006, Lima, Peru;
- 5th International Conference on "*Marine bioinvasions*", (co-sponsored by ICES, PICES and the U.S. National Sea Grant College Program), May 21–24, 2007, Cambridge, U.S.A.;
- 4th International Zooplankton Production Symposium on "*Human and climate forcing of zooplankton populations*" (co-sponsored by PICES, ICES and GLOBEC), May 28–June 1, 2007, Hiroshima, Japan;
- PICES/ICES Young Scientists Conference, June 26–29, 2007, Baltimore, U.S.A.;
- PICES Sixteenth Annual Meeting, October 26–November 4, 2007, Victoria, Canada;
- International Symposium on "*Effects of climate change on the world's oceans*" (co-sponsored by ICES, PICES, IOC, GLOBEC, SCOR and WCRP), May 19–23, 2008, Gijón, Spain;
- PICES Seventeenth Annual Meeting, October 16–26, 2008 (tentative), Dalian, China.

Integration of ecological indicators for the North Pacific with emphasis on the Bering Sea

By Gordon H. Kruse, Diana Evans and James E. Overland

PICES scientists responded to a North Pacific Research Board (NPRB) call for proposals to evaluate the utility of ecosystem indicators to explain processes underlying biological production in the ocean. The principal investigators (Glen Jamieson, Gordon Kruse, Patricia Livingston, James Overland and Ian Perry) have interests in processes associated with physical (*e.g*., atmospheric forcing, ocean temperature, salinity, sea level, freshwater discharges, transport of planktonic life history stages, sea ice extent and duration, turbulence, and cold pool extent), chemical (*e.g*., nutrient/micronutrient availability to phytoplankton), and biological (*e.g*., predation, timing of plankton/zooplankton production, commercial catch composition, and biomass/abundance trends) phenomena and their potential utility as indicators of ecosystem status. The goals of the project were to:

- report on the current understanding of ecosystem indicators in the Bering Sea and Aleutian Islands;
- evaluate the pros and cons of existing indicators; and
- identify the next steps toward developing and/or validating indicators and evaluating their performance (*e.g*., using hind-casts of indicators and various marine populations).

A final report of the project will be published as a PICES Scientific Report.

The overall approach included:

1. involving the Bering Sea and international communities in developing of a set of operational objectives for the southeast Bering Sea ecosystem;
2. evaluating two existing status reports with a goal of integrating results and streamlining their presentation:
    a. NPFMC. 2005. Appendix C: Ecosystem Considerations for 2006. North Pacific Fishery Management Council, Anchorage, Alaska. (available at: http://access.afsc.noaa.gov/reem/ecoweb/index.cfm)
    b. PICES. 2004. Marine Ecosystems of the North Pacific, PICES Special Publication 1, 280 p. (available at http://www.pices.int/publications/special_publications/NPESR/2005/npesr_2005.aspx);
3. investigating methodologies to monitor system-wide structural changes within the marine ecosystem; and
4. identifying steps to validate indicator performance, improve the monitoring network, and integrate indicators into predictive models.

There was a focus on the southeastern Bering Sea because it represents the center of the Bering Sea/Aleutian Islands large marine ecosystem (LME), one of three LMEs (the other two are the Gulf of Alaska and Arctic Ocean) encompassed by the NPRB research region. Nevertheless, the intent was to provide insights, findings, and recommendations that might be more broadly applicable to the northern North Pacific and adjacent marginal seas, including waters bordering China, Japan, Korea, Russia, Canada, and the United States.

While the main activity involved a workshop of experts (Seattle, June 1–3, 2006) who addressed the challenge of developing indicators and interpreting their utility, the pre-workshop activities included outreach to engage the Bering Sea/Aleutian Island communities in the project. One such meeting was organized in Anchorage on January 25, 2006, at the annual Marine Science in Alaska Symposium, and the other was held on February 8, 2006, in Seattle during a North Pacific Fishery Management Council meeting.

PICES/NPRB workshop convenors and breakout group facilitators (clockwise from left): Glen Jamieson, George Hunt Jr., Sarah Kruse, Gordon Kruse (no relation), Patricia Livingston, James Overland, Nathan Mantua, Franz Mueter, Ian Perry, Anne Hollowed, and Robert O'Boyle.

Beth Fulton was invited to present the Australian experience on the use of ecological indicators.

Ian Perry describing the development of the first PICES Ecosystem Status Report.

Jake Rice was invited to critique ecosystem status reports.

White (working) papers related to the first three elements of the overall approach were written by Gordon Kruse and Diana Evans (*Operational objectives for the Bering Sea*), Patricia Livingston and Andrea Belgrano (*Ecosystem-based management of the oceans*), and Sergei Rodionov (*Analysis of ecological indicators*). These papers can be found on the PICES website at http://www.pices.int/projects/Bering_Indicators/bering.aspx.

The main product of this project will be a PICES Scientific Report, which will include the three working papers, and a summary of workshop discussions and recommendations. As the outcomes of the workshop will be used by NPRB in developing an integrated ecosystem research plan for the Bering Sea, an interim report will be prepared shortly after the workshop so that key findings are available for planning.

Although the issue of dealing with large numbers of potential indicators was not discussed in depth, the workshop had initiated a process for developing a list of indicators for the Bering Sea and the broader Pacific region. The purposes and objectives of indicators in management were discussed, and it was concluded that considerable work on establishing critical issues has been completed. There were excellent presentations by scientists who have used indicators in other regions, including the east coasts of the United States (Jason Link) and Canada (Robert O'Boyle), and the Australian experience (Beth Fulton). Exploration of these topics provided a basis for the credible use of indicators in the North Pacific.

A major theme of the Seattle workshop was to consider how to communicate information about the ecosystem and fisheries. Although it is important to document and interpret a large number of indicators as background material, it is also important to consider the audience and the core information to be presented. For example, it is crucial to focus on a reduced set of key indicators so that the main patterns of change can be elucidated from a myriad of variables. Given the complexity and uncertainty about ecosystem change, a continuing dialog about potential ecosystem/management issues is needed. Discussion around the appropriate use of indictors is a good start, as they provide semi-quantitative information that enhances communication between scientists, managers and the larger community.

Breakout group discussion at the PICES/NPRB workshop.

It was noted that there was already a good match between the operational objectives developed by the North Pacific Fishery Management Council and the indicators reported in the NMFS Ecosystem Considerations Appendix. These include, for instance, onboard observations of discards that are used as a performance measure for an objective to reduce bycatch and waste, and a prohibition of fishing on forage fishes to, in part, address an objective to avoid fishing impacts on seabirds and marine mammals. Unlike most other LME regions where fishing is the main driver of the ecosystem and recovery plans are paramount, issues for the Bering Sea appear to deal more with climate change and resultant ecosystem dynamics and structural responses rather than mitigation of adverse anthropogenic effects. In this region it is important to monitor the state of the system and its response to ongoing climate change. Thus, there is a need to have broad ecosystem indicators that provide the context for the ecosystem state, in addition to management (*e.g.*, fisheries) indicators that have specific reference points and management actions if the thresholds are crossed.

Time series of the Northeast Pacific: A symposium to mark the 50th anniversary of Line-P

By Angelica Peña

As one of the longest running ocean time series in the world, Ocean Station Papa (OSP; 50°N and 145°W) represents a unique dataset that has improved our understanding of ocean processes. Meteorological and surface ocean sampling from a weather ship at OSP began in 1949. In 1956, observations were initiated at stations along the 1425 km-long line between the coast of British Columbia and OSP. Since then, surveys along this line, now called Line-P, have been undertaken many times each year. However, Line-P is only one of the ocean time series of the Northeast Pacific, and previous research has benefited from comparisons among the various time series. To facilitate interaction and exchange of information among investigators working in the Northeast Pacific, a symposium, sponsored by Fisheries and Oceans Canada and the North Pacific Marine Science Organization (PICES), with additional support from CLIVAR, was held July 5–8, 2006, at the Victoria Conference Centre in Victoria, British Columbia, Canada. Convenors of the symposium were Howard J. Freeland and Angelica Peña. The symposium, which celebrated 50 years of oceanography along Line-P and at OSP, explored the scientific value of both Line-P and the time series of the Northeast Pacific in general. More than 80 scientists from PICES member countries attended the symposium.

The symposium consisted of plenary talks by invited speakers interspersed with contributed posters. It included: (i) overviews of specific time series of the Northeast Pacific such as CalCOFI (California Cooperative Oceanic Fisheries Investigations), the NH (Newport Hydrographic) Line, the GAK (Gulf of Alaska) Line and HOT (Hawaii Ocean Time-Series); (ii) a review of main findings from the Line-P program, including presentations of the physical variability, plankton and biogeochemical cycles, and ecosystem modelling; (iii) presentations on process studies in the Northeast Pacific, including discussion of the factors influencing gas exchange, the large-scale iron fertilization experiment (Subarctic Ecosystem Response to Iron Enrichment Study – SERIES), and the influence of eddies and mesoscale variability in the region; (iv) a panel discussion on the strengths and weaknesses of the Line-P program as it has been executed to date; and (v) a workshop to discuss the future of Line-P by those who plan on carrying out research in the Line-P program.

Coastal waters of the Northeast Pacific are highly productive, supporting important commercial fisheries. This is reflected in the motivation and design of the coastal time series programs such as CalCOFI, and NH and GAK Lines. For example, the goal of CalCOFI, the longest time series of the region, was to achieve an understanding of the dynamics of fish resources off California to enable their management to be improved. After 57 years, they are able to infer confidently about phenomena of time scales ~0.25–15 years, and spatial scales ~60–500 km horizontally and ~5–500 m vertically, as well as large-scale trends. CalCOFI has become one of a few programs with data to understand processes over this range of scales, now including climate change.

Sampling of the NH Line, which extends along 44.65°N from the central Oregon coast to 160 km offshore, began in 1961. Observations show that the seasonal cycle is very strong, with rapid transitions in spring and fall. Comparison of summer regimes between two epochs: 1961–1971 and 1997–2003, indicates that the near-surface

Line-P symposium turnout.

Attendance at the poster session.

Line-P panel discussion with (left to right) Ricardo Letelier, William Crawford, Timothy Parsons, Douglas Bancroft, Diana Varela and Ed Harrison.

layer at most locations is significantly warmer and fresher during the latter period.

The GAK Line has been sampled intermittently for 35 years, with more intensive sampling taking place during the GLOBEC Coastal Gulf of Alaska program (1997–2004). The marine ecosystem in this region shows large seasonal variations and is influenced by a seasonally-varying Aleutian Low which induces large annual cycles in heat fluxes, runoff, and winds, and by a complex bathymetry and coastal orography. Cross-shelf variability in phytoplankton and zooplankton appear linked to freshwater dispersal processes and along- and cross-shelf transports. Observations in recent decades show a marked reduction in ocean cooling by the atmosphere and increasing runoff.

The subarctic and mid-latitude North Pacific and its marginal seas include several of the world's longest and richest marine zooplankton time series (**Fig. 1**), displaying large amplitude interannual to decadal changes in total zooplankton biomass, community composition, and body size and life cycle timing within individual species.

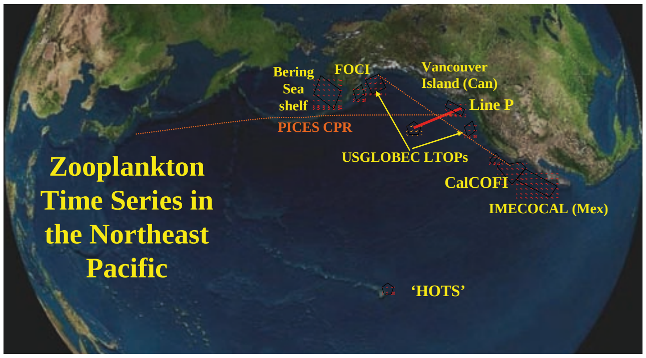


Fig. 1 Location of zooplankton time series in the Northeast Pacific.

Open oceans experience variable productivity due to mesoscale processes and interannual and decadal oscillations. Open ocean time-series sites are very valuable for monitoring biogeochemical cycles and climate change. For example, the HOT long-term records of water soluble reactive phosphorus (SRP) concentration in the North Pacific Subtropical Gyre indicate that during warm phases of the Pacific Decadal Oscillation (PDO), microbial assemblages are able to deplete SRP well below the concentrations observed during cold PDO phases. These observations, when combined with other physical and biological time-series data, suggest an increase in nitrogen fixation and the relative contribution of prokaryotic photoautotrophs to this ecosystem during warm PDO phases. As another example, the Line-P records reveal surface warming, increasing stratification (**Fig. 2**), shallowing trend in the mid-winter mixed layer, earlier maturation of spring zooplankton and decreased ventilation of the interior of the ocean during the past 50 years. There is now compelling evidence that the large-scale upper ocean variability in the Northeast Pacific is a direct response to atmospheric forcing.

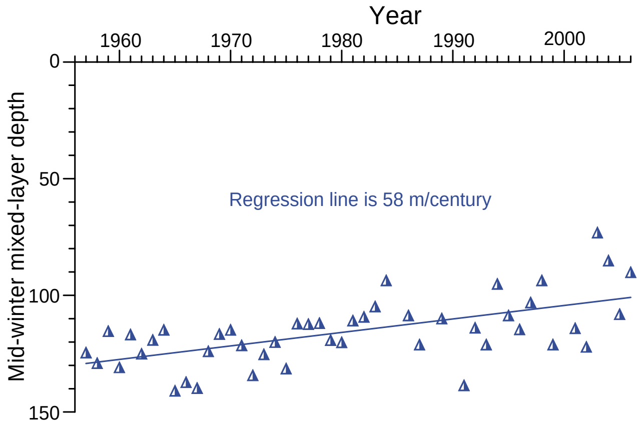


Fig. 2 Depth of the mid-winter mixed layer depth plotted against year at OSP during the period of 1956 to 2005.

Early work at OSP was critical to our present understanding of HNLC (high nutrient low chlorophyll) regions, and to the formulation of the iron limitation hypothesis where the availability of iron was proposed to be the main control on primary production and nitrogen uptake. Results from the SERIES iron fertilization experiment, conducted in the Northeast Pacific in July 2002, as part of the Canadian SOLAS program, showed an important increase in phytoplankton biomass, a moderate increase in carbon sequestration, and a decrease in DMS (dimethylsulfide) concentrations, leading to conditions that would not mitigate greenhouse warming. Modelling studies at OSP have been integral to the major cooperative ecological programs. Studies along Line-P have greatly improved our understanding of the interactions between trace metals, microbes and ocean biogeochemical cycles. Variability of nutrients and other biogeochemical parameters is much larger than first expected, and points to the importance of events as opposed to stable processes.

Satellite and ship-based observations have defined the impacts of mesoscale eddies on properties of Line-P and the Gulf of Alaska. These studies have revealed that Haida and Sitka Eddies dominate the surface chlorophyll distribution, as seen from the satellite-based SeaWiFS sensor, around the entire rim of the gulf. Several physical processes allow mesoscale eddies to carry coastal chlorophyll, macro- and micro-nutrients, and low oxygen water several hundreds of kilometres into near-surface, mid-gulf waters. Ten years of sediment trap data along Line-P show a summer seasonal peak in sediment transport, a decrease in the flux of particles with distance from the coast, and a different composition of sediments compared to the western Pacific. In the last decade, studies at the air–sea interface, including multi-year moorings and sampling of the sea-surface microlayer, have been carried out at OSP. These studies have found differences in the thickness of the microlayer between OSP and coastal waters, and that increasing gas transfer rates are coincident with increasing winds and deepening bubble penetration depth.

(*cont. on page 18*)

PICES hosts an ESSAS workshop in St. Petersburg, Russia

By Kenneth Drinkwater and George Hunt

The first ESSAS (Ecosystem Studies of Sub-Arctic Seas) workshop was held from June 12 to 14, 2006, in St. Petersburg, Russia, to lay the ground work for developing comparative studies of the subarctic seas. To this end, 27 scientists from 6 nations (Canada, Greenland, Japan, Norway, Russia and U.S.A.) were in attendance. Four subarctic ecosystems were selected for the first comparison: two from the Pacific (the Sea of Okhotsk/Oyashio region and the Bering Sea) and two from the Atlantic (the Newfoundland/Labrador region and the Barents Sea). The workshop was co-sponsored by GLOBEC International and PICES, both of whom contributed travel funds, while the latter, with assistance from the Pacific Scientific Fisheries Research Center (TINRO-Center), also arranged and provided logistical support at the meeting. Our local host was the State Scientific and Projecting Institute "Giprorybflot".

Participants of the first ESSAS workshop in the main hall of the State Scientific and Projecting Institute "Giprorybflot", June 2006, St. Petesburg, Russia.

The primary objective of ESSAS, a GLOBEC regional programme, is to understand how climate variability affects the productivity of subarctic ecosystems and their ability to support sustainable commercial and subsistence fisheries. The ESSAS Science Plan outlined a 5-stage implementation strategy (Hunt and Drinkwater, 2005) consisting of (1) ecosystem summaries, (2) regional programmes, (3) comparative analyses, (4) prediction, and (5) synthesis. The first major ESSAS activity was the symposium on "*Climate variability and subarctic marine ecosystems*" held in Victoria, Canada, in May 2005, which brought together over 220 scientists from different subarctic regions to present their recent work and understanding of their particular seas (see the report by Hunt and Drinkwater in the GLOBEC Newsletter Vol. 11, No. 2 and in PICES Press Vol. 13, No. 1). The symposium largely addressed item (1). Newly funded ESSAS research programmes in Japan, Iceland, Norway and U.S.A, with some activities also initiated in Canada, Russia and West Greenland, provide a strong start to the development of regional programmes (item 2). Comparative studies between different subarctic ecosystems (item 3) are a major focus of ESSAS. Therefore, building on the Victoria symposium and other recent research, an ESSAS workshop was convened in St. Petersburg to explore how fruitful comparative studies should be developed.

Many excellent compendia of information about particular subarctic ocean basins are available, although few have explicitly compared mechanisms and responses to climate forcing across basins or between Atlantic and Pacific systems. For the comparative method to be used successfully, it is necessary to identify important underlying structuring features of the ecosystems, and then to determine how climate forcing, acting on those mechanisms, will result in ecosystem change. It is also necessary to develop datasets that can be used to parameterize, test and validate models. Although each system is unique, ESSAS seeks to search for those basic elements common to many, if not all, subarctic seas.

The workshop began with a presentation by James Overland on atmospheric forcing over the four subarctic regions. He showed that all regions have decreasing trends in sea level pressure (more wind forcing), but with no link in the phasing between the basins. Of particular note was the different decadal forcing between the Barents Sea and the Newfoundland/Labrador region in the Atlantic, with surface air temperature associated with variability in the North Atlantic Oscillation out of phase between the two sides of the Atlantic until recently, when both regions showed enhanced warming. In the Pacific, the Bering Sea and the Sea of Okhotsk have experienced enhanced heating in winter and spring since 1970. Next, Wieslaw Maslawski gave a talk on a physical model for the Arctic and subarctic regions. He stressed the importance of the circulation and sea ice on ecosystem structures, and showed that many of these features are well represented in existing models. However, he noted that other important processes, such as baroclinic coastal currents and eddies, need increased horizontal and vertical resolution before they can be adequately simulated.

These two talks were followed by several presentations covering the ecosystems of each of the four regions. Several interesting comparisons were made. In the Labrador region, with the collapse of the Atlantic cod stocks in the early 1990s, no cod-like species appeared to fill the niche left vacant by the disappearance of cod, unlike in some more southern systems such as Georges Bank. There was an increase in invertebrates, in particular, snow crab and northern shrimp, but their biomass was much lower than that of the cod that was formerly present. A similar change occurred off West Greenland in the late 1960s, where northern shrimp increased when the cod disappeared. These responses appear to be the flip side of what happened in the eastern Bering Sea where, when the climate changed in the late 1970s and early 1980s, populations of crabs decreased and pollock increased.

Recently, all regions except the Sea of Okhotsk, have experienced warmer than normal sea temperatures and reductions in sea ice coverage. In the Barents Sea, there have been distributional shifts in the fauna, with the appearance of large numbers of blue whiting, traditionally a more southern species. Also, the spawning grounds of cod off the coast of Norway have shifted more northward.

In the southeastern Bering Sea, years with cold temperatures and extensive sea ice have led to earlier phytoplankton blooms and more benthic production, while years with warm temperatures and less ice have resulted in later blooms, higher abundance of copepods and less benthic production. These responses were not observed in the Barents Sea, however, and the question arose as to why not? Is it related to the more northern location and the fact that the seasonal cycle in temperature is delayed in the Barents Sea by about a month relative to the Bering Sea? The warm conditions in the northern Bering Sea in recent years have led to a significant reduction in benthic production and an increase in the pelagic production, but information is lacking for the southeastern Bering Sea.

The workshop participants recognized the importance of understanding the roles of mesopelagic organisms and forage species. For example, we found that there were interesting parallels between the roles played by squid in the Oyashio Current system, and their roles in waters offshore of the continental shelves of eastern Canada.

In addition to the regional presentations and discussions, the workshop developed tables listing the dominant species in the food web (both as prey and predators) for some of the major commercial fish species (or their prey), from nanoplankton up through to their marine mammal predators, as a means of focusing the comparisons. Another table listed the major climate processes that affect each of these species. This led to discussions centered on the mechanisms linking climate to the ecosystems, followed by evaluation of modelling strategies that could be employed to elucidate how climate variability may impact these marine ecosystems.

The workshop then developed possible ways forward for ESSAS. The idea of focused working groups was adopted. Three working groups were suggested: modelling, climate change predictions, and biophysical coupling. The Modelling Working Group would deal with the various modelling strategies (conceptual, mechanistic and statistical) as part of the comparisons. Questions arose as to whether to integrate the various methods or to pursue them separately. The Predictions Working Group would guide ESSAS through developing likely ecosystem responses to future climate change as taken from the most recent IPCC (International Panel on Climate Change) climate scenarios, and thereby also addressing part of item 4 in the ESSAS Implementation Plan. The Biophysical Coupling Working Group would compare different subarctic ecosystems through annual workshops. Each workshop would focus on a particular climate variable, for example sea ice, to see how the ecosystems were affected by this variable. Emphasis would be on developing papers that compared all or as many of the ESSAS regions as possible. Further implementation of the Working Groups was left to the ESSAS Scientific Steering Committee.

A presentation captures audience attention.

Enjoying fine food and wine during a cruise on rivers and canals of St. Petersburg with Vasilevskiyisland in the background.

In addition to plotting the future of ESSAS, workshop participants were asked to assess how the next edition of the PICES North Pacific Ecosystem Status Report might be modified to increase its utility to scientists developing comparative studies of the PICES regions in the North Pacific. The general feeling was that the present format and content were valuable, and that increased standardization of the content of regional reports would facilitate comparisons. In addition, the development of some tabular comparisons in the Synthesis Chapter could be of value. Although difficult to develop, such tables help to sharpen the focus on the important elements, as was found in the ESSAS workshop when we attempted to develop tables for the four regions comparing trophic linkages and biophysical coupling mechanisms vulnerable to climate variability.

Participants at the meeting also took advantage of the wonderful surroundings, warm weather and delicious food in the many restaurants of St. Petersburg. Most of the participants and several accompanying spouses enjoyed a scenic evening cruise on rivers and canals, complete with food and beverages. St. Petersburg offered lots of nightly entertainment with several workshop participants attending one or more of the many ballet, opera and concert performances. The Hermitage Museum, which houses the largest art collection in the world and is located in the former palace of the Russian Czars, was probably the number one attraction, although some of us also had a pleasant time wandering around the gardens and fountains at Petergof, the royal summer residence of Peter the Great.

We, the conveners, would like to thank all of the participants for making our first ESSAS workshop a great success. Special thanks go to Alex Bychkov, Executive Secretary of PICES, for his support and efforts in arranging the venue and logistics for the meeting, and to those at the "Giprorybflot" who also helped, especially Ludmila Zaslavskaya, who did an excellent job of seeing that we were well taken care of throughout our stay in St. Petersburg.

Dr. Kenneth Drinkwater (right) (ken.drinkwater@imr.no) is a fisheries oceanographer conducting research on climate variability and its effects on the marine ecosystem, with a special interest in fish populations. Having worked many years at the Bedford Institute of Oceanography in Canada, he is now working at the Institute of Marine Research in Bergen, Norway. Ken is a member of the GLOBEC Focus 1 Working Group on Retrospective Analysis, and Co-Chairman of the Scientific Steering Committee (SSC) of a new GLOBEC regional program on Ecosystem Studies of Sub-Arctic Seas (ESSAS).

Dr. George Hunt (left) (geohunt2@u.washington.edu) joined the School of Aquatic and Fishery Sciences at the University of Washington as a Research Professor after retiring from the University of California, Irvine. For many years, George studied the reproductive and foraging ecology of seabirds in various regions. More recently, he has participated in ecosystem-level studies of the southeastern Bering Sea and the Aleutian Archipelago. He chairs the BEST (Bering Sea Study) SSC and co-chairs the SSC of ESSAS. He is also a member of the PICES CFAME (Climate Forcing and Marine Ecosystems) Task Team.

(*cont. from page 15*)

Some of our most important knowledge of the ocean has come from long-term measurements at particular sites or from repeated measurements along sections. Knowing accurately the time variability in even a few locations around the world is important, as very long records are needed to determine the difference between multi-decadal cycles and climate trends. Line-P is a program highly regarded by the scientific community, and has itself benefited from numerous collaborations and partnerships with the national and international research communities. Since its initiation, it has been a multi-disciplinary program including oceanic and atmospheric research, and physical, chemical and biological studies of the upper mixed layer dynamics. Another strength has been its flexibility to allow the integration of many process studies. During the panel discussion, concerns were raised regarding the continuation of Line-P given the limitation of ship time and personnel. Several challenges were identified, including continuity, innovation, funding, and the need to provide results useful for management and policy. Both academics and government scientists are needed in the Line-P program. The Canadian and international scientists at this symposium agreed on the need to continue the Line-P series indefinitely, as it is the only series of observations that allows scientists to determine climate change events and processes in the northeastern subarctic Pacific.

Dr. Angelica Peña (penaa@pac.dfo-mpo.gc.ca) is a biological oceanographer conducting research on phytoplankton ecology and biogeochemical cycles. She uses field observations and models to study the dynamic relationships that exist between the planktonic ecosystem and its environment, and its response to climate change. Angelica works as a research scientist for Fisheries and Oceans Canada at the Institute of Ocean Sciences (IOS). She received her B.Sc. from the University of Concepcion, Chile, and her M.Sc. and Ph.D. degrees in Oceanography from Dalhousie University, Canada. Angelica has been involved in several international programs including JGOFS, GLOBEC and ECOHAB. She is a member of the PICES Biological Oceanography Committee.

Professor Mikhail N. Koshlyakov

Professor Mikhail Koshlyakov in his office at the P.P. Shirshov Institute of Oceanology (Moscow, Russia, 2005).

Misha Koshlyakov was destined for a career in science from his early childhood. Born November 29, 1930, in Leningrad (St. Petersburg), Russia, into a family with a long history of scientific tradition, Misha was immersed in an atmosphere of teaching and science. His father, Nikolai Koshlyakov, a well-known Russian mathematician and author of several textbooks on partial differential equations, brought him up to admire the power of mathematics to explore natural phenomena. His grandfather, a prominent Russian historian, gave him an understanding of the importance of intuitive methods in studying complex systems. The research atmosphere, the eternal variability of the Baltic Sea, the sounds and smells of the port of Leningrad, and the novels of Jules Verne combined favorably in Mikhail's decision to be an oceanographer.

Mikhail as a boy with his father (second from left) at the May Day celebration in Leningrad (1940).

His way to becoming a scientist was not straightforward. At the age of ten, Mikhail's childhood was interrupted by the war. A few months after the German invasion in December 1941, Leningrad was besieged by the Nazis who brought cold and starvation to its inhabitants. But an even stronger blow hit the family when they were evacuated to Siberia in 1942; Mikhail's father was falsely accused of "political terror" and sentenced to death. Luckily, the sentence was replaced by 10 years at a Gulag camp in the Ural mountains. Nikolai Koshlyakov barely survived the war years. In September of 1945, he was transferred to the Gulag science camp (the so-called *sharashka*) as a labor force for military projects. Despite the hardships that he and his family experienced in Leningrad, and later in Siberia, Mikhail kept studying eagerly and graduated from high school with honors (gold medal) in 1948. That same year he entered the School of Geography of the Leningrad State University. In 1951, luck was with Mikhail's family again when his father was released from the *sharashka* before the end of his term, given the highest government awards, and eventually declared innocent of whatever crime that had caused his incarceration.

In the courtyard of the Leningrad State University (1952).

Meanwhile, Mikhail was a student assistant on his first expedition to the Sea of Okhotsk on board the famous R/V *Vityaz*. Two months of hands-on probing the rough sea gave Mikhail confidence in his choice of profession and addicted him to experimental field work for the rest of his life. In 1953, Mikhail graduated with honors from the Leningrad State University with a Master's degree in oceanography. His research was awarded first prize at the university competition of graduating diploma works. That same year the Koshlyakovs moved to Moscow, where Mikhail got a Ph.D. student position with Professor Vladimir Shtokman, a prominent Soviet geophysicist, who was a co-founder of the Shirshov Institute of Oceanology (SIO) of the USSR Academy of Sciences – the leading Soviet oceanographic institution. Mikhail was lucky to start his career under the leadership of Professor Shtokman, whose way of thinking, exceptional human qualities, and delicate style of scientific guidance provided Mikhail with high standards that he tried to keep through his whole life in science.

The 1950s and 1960s were the golden years of field oceanography, when new discoveries were awaiting scientists at virtually any point of the World Ocean, and governments were just starting to pour money into oceanographic research. During these years Mikhail was deeply involved in the SIO expeditions aboard the R/V *Vityaz*. Among the most challenging of his experiments were studies of the large-scale circulation of the equatorial Pacific, the investigation of the New Guinea coastal current, and tasting kava[1] with a tribal leader on the Fiji Islands. Mikhail's Ph.D. thesis dealt with a diagnostic analysis of the wind-driven and geostrophic currents of the Pacific Ocean. By the end of the 1950s and in the beginning of the 1960s, observational oceanographers started to accumulate evidence to contradict the general view of the World Ocean as a system of deterministic large-scale currents. Moored observations, repeat sections and floats revealed open-ocean variability at scales of several tens of kilometers and periods of 3–10 days, but the three-dimensional (3-D) structure of these features was largely unknown. As an observational oceanographer, Mikhail Koshlyakov became a proponent of the idea that mesoscale eddies were the dominant component of the open ocean currents. He was one of the most active organizers and participants of the SIO expeditions to the Arabian Sea (1967) and Tropical Atlantic (POLYGON-70). These unique projects conducted synchronous multi-ship hydrographic surveys and *in situ* moored velocity measurements that enabled scientists to directly map mesoscale eddies and estimate their dynamical parameters. Soon after that, as a lead expert in the mesoscale eddy survey, Mikhail participated in the Mid-Ocean Dynamic Experiment (MODE) on board of the U.S. research vessels *Chain* and *Researcher* (1973). A few years later, he was on the organizing and scientific steering committees of the joint U.S.–Soviet POLYMODE experiment, and headed one of the flagship expeditions of the Soviet component of the POLYMODE in the Sargasso Sea (1978).

Field studies of mesoscale eddies became the major focus of Mikhail's research in the next decade. He was one of the organizers and participants of massive multi-ship expeditions to the Tropical Atlantic (Mesopolygon-85) and mid-latitude Pacific (Megapolygon-87). Operating in accord with each other, the research vessels deployed large mooring arrays (70–120 moorings) and conducted a series of coordinated hydrographic surveys of the regions that documented the complex 3-D structure and evolution of the mesoscale eddy fields, revealing details of their dynamics and interactions with jets, fronts and other eddies. Polygon's observations of mesoscale eddies provided the first observational evidence of open-ocean Rossby waves, their statistics and the peculiarities of their behavior in highly non-linear regimes. With a team of co-workers that he assembled in his group, which later transformed into the Laboratory of Marine Currents, Mikhail Koshlyakov obtained a significant number of fundamental scientific results, related to the formation and dynamics of the eddies, their interaction with the large-scale oceanic circulation, and their properties in the light of the theory of quasi-geostrophic turbulence. Mikhail Koshlyakov is a co-author of the book "*Mesoscale Eddies in the Ocean*", whose several editions were published in the USSR and abroad. He is a contributor to the fundamental encyclopedia "*Oceanology*", whose ten sizable volumes provided the most complete overview of achievements in all branches of oceanology by 1978. Mikhail is also the author and co-author of more than 100 scientific papers.

Frisbee tossing during a break in the POLYMODE planning committee meeting (Moscow, 1975). From left to right: A. Sarkisyan, V. Kamenkovich, V. Kuksa, M. Koshlyakov, unidentified person, W. Simmons, F. Webster.

Koshlyakov discussing red-hot POLYMODE data with (left to right) Curt Collins, unidentified person, and Allan Robinson (Philadelphia, 1978).

In the 1980s and in the beginning of the 1990s, Mikhail's scientific interests shifted to the Southern Ocean – a large body of water that even nowadays, in the era of satellite oceanography, is relatively unexplored. In 1982, he organized and headed the expedition that supplied hydrographic and current meter data proving the complex multi-jet structure and strong temporal variability of the Antarctic Circumpolar Current in the segment between Africa and Antarctica. In 1991–92, Mikhail headed a large World Circulation Experiment Expedition (WOCE S4) to the Pacific sector of the Antarctic. The expedition faced many logistic problems since it was held at the time of collapse of the Soviet Union. Despite these difficulties and severe weather conditions on the late return from Antarctica, the observational part of the cruise was successful. However, bad luck came again in the form of a heavy storm on the way to New Zealand, where Mikhail

[1] *kava – a soporific drink made from the root of a plant related to the pepper tree. Kava root is chewed into a pulp by women, spat into a container and then drunk.*

severely broke his hip after a monster wave hit the side of the ship. Fortunately, the urgent and sophisticated surgery he experienced at a Wellington hospital was successful.

Heading the 1983 New Year party in the expedition to the Southern Ocean, 52.30°S, 25.00°E.

Perestroika brought a lot of problems to fundamental research in Russia, and many of Mikhail's co-workers either moved abroad or quit oceanographic research. As a true patriot of Russian science, Mikhail is working to maintain the high standards of scientific research at the Shirshov Institute of Oceanology. Being a Professor at the Department of Ocean Thermohydromechanics of the Moscow Institute of Physics and Technology, he lectures in general oceanography and supervises a new generation of students. Over the decades his brilliant courses lured hundreds of young people, many who were seeking subjects for their life's work, into becoming dedicated oceanographers. After the collapse of the Soviet Union, he organized a new team of young researchers with a passion for observational work in the rough waters of the Southern Ocean. In recent years they have obtained a number of important results on hydrology, dynamics and climate of the Southern Ocean, that include discovery and quantification of the transport in the Pacific–Antarctic cell of the global conveyor belt and the mechanism of formation of the Antarctic Intermediate Water.

Despite a total of four and a half years spent at sea, Mikhail enjoys the rare good fortune of true family happiness. Natalia Evgenievna, his spouse and closest friend for 47 years, is proud of Mikhail's mission in science and is doing her best to fence him from routine problems of everyday life. She is known and loved by all students, friends and colleagues of Mikhail. Her open mind and sincere compassion combined with the simple pragmatism of a former construction superintendent, and fringed with her outstanding culinary art, make visits to their home unforgettable. Mikhail and Natalia are very proud of their son Evgeniy, and look forward to every meeting with their beloved grandson.

Mikhail Koshlyakov and his wife Natalia (St. Petersburg, 2004).

Mikhail Nikolaevich Koshlyakov gave 53 years of his life to the Shirshov Institute of Oceanology, its development and its activities. He was especially active in promoting international collaboration and served as a member of many working groups in the Scientific Committee of Oceanic Research (SCOR), within the World Climate Research Program (WCRP), WOCE, CLIVAR, POLYMODE, and others. For his contributions to the understanding of the ocean, Mikhail Koshlyakov was awarded the Makarov Prize (the highest Russian oceanographic award), the State award "Honored Scientist of Russian Federation", Academy award for outstanding publications, and others. Results of Mikhail's work on mesoscale eddies in 1967–1970 were qualified as a discovery by the USSR State Committee for Discoveries and Inventions.

Mikhail never used political tools to build his career; among his colleagues he is known as an honest, friendly, open-minded and helpful person who never rejected fulfilling routine work, be it the edition of the POLYMODE Atlas, providing assistance in a culinary contest with Allan Robinson, taking responsibility for logistics of a large expedition, or helping Henry Stommel to get rid of an old stump from the back yard. As a true altruist, Mikhail has a passion for working with students: dozens of Master and seven Ph.D. theses were defended under his guidance. Many of his former students are now working in the oceanographic laboratories around the world but keep in touch with their teacher, remembering him as an extremely warm, generous, tactful and responsive person. At the age of 75, Mikhail Koshlyakov keeps active in science. His curiosity, original way of thinking, and delicate manner of scientific guidance are among his best qualities highly appreciated by colleagues. There is no doubt that Mikhail Nikolaevich Koshlyakov will continue to make important contributions to the research at SIO and the oceanography community in general.

This article was the result of a collaboration by the following contributors: A. Groto (Shirshov Institute of Oceanology), N. Maximenko (University of Hawaii), D. Nechaev (University of Southern Mississippi), G. Panteleev (University of Alaska), T. Sazhina (Newspaper "Vedomosti", Moscow), A. Shcherbina (Woods Hole Oceanographic Institution) and M. Yaremchuk (University of Hawaii).

The state of the western North Pacific in the second half of 2005

By Shiro Ishizaki

Sea surface temperature

Figure 1 shows the monthly mean sea surface temperature (SST) anomalies in the western North Pacific from July to December 2005, computed with respect to JMS's (Japan Meteorological Agency) 1971–2000 climatology. Monthly SSTs are calculated from JMA's MGDSST (Merged satellite and *in-situ* data Global Daily SST), which is based on AVHRR/NOAA data, microwave sensor (AMSR-E/AQUA) data, and *in-situ* observations. Time series of 10-day mean SST anomalies are presented in **Figure 2** for 9 regions indicated in the bottom panel.

SSTs were generally above normal in the seas adjacent to Japan from July to November except east of Honshu in July. Positive SST anomalies exceeding +2°C prevailed around Hokkaido from October to November. These anomalies were significant over the past 9 years in Regions 1 and 2. Negative SST anomalies were found in a broad area except around Hokkaido in December. In the region of the Philippines, positive SST anomalies dominated in July and from October to November, while negative SST anomalies appeared from August to September and in December.

Kuroshio path

Figure 3 shows a time series of the location of the Kuroshio for this period. A large meander path of the Kuroshio, which was formed off Tokai in July 2004, was maintained throughout August 2005. This meander moved away to east of the Izu Islands (along 140°E) from September to October. The Kuroshio then flowed eastward off Shikoku Island and off Tokai.

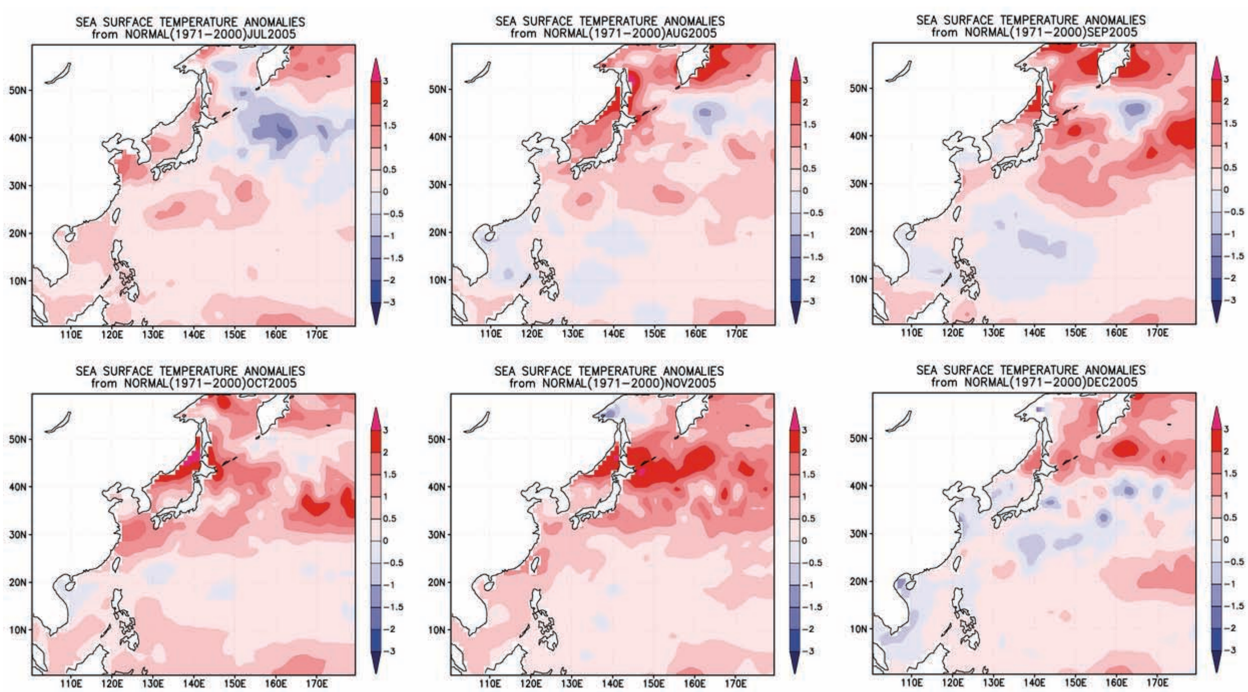
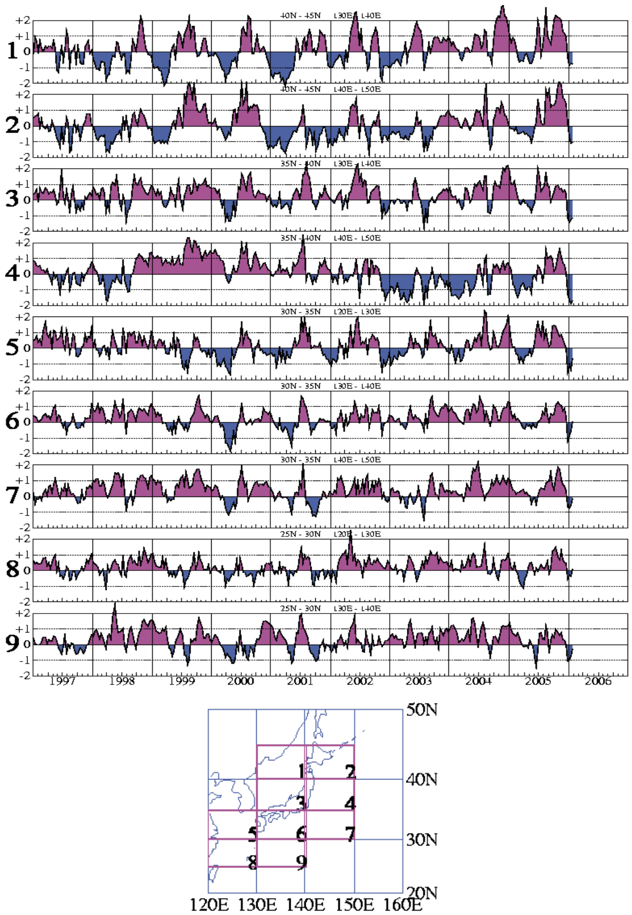
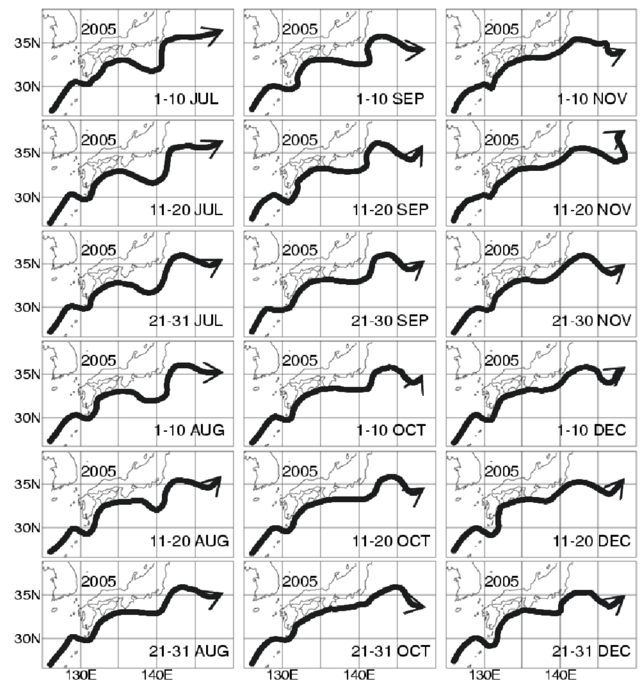


Fig. 1 Monthly mean sea surface temperature anomalies (°C) from July to December 2005. Anomalies are deviations from JMA's 1971–2000 climatology.

Carbon dioxide

JMA has been conducting observations of carbon dioxide (CO_2) in the surface seawater and overlying air in the western North Pacific, on board the R/V *Ryofu Maru* and the R/V *Keifu Maru*. **Figure 4** illustrates the distribution of the difference in CO_2 partial pressure (pCO_2) between the surface seawater and the overlying air (denoted as ΔpCO_2) observed in the western North Pacific in each season of 2005. The ΔpCO_2 value represents the direction of CO_2 gas exchange across the air–sea interface, indicating the ocean to be a potential source (or sink) for atmospheric CO_2 in the case of a positive (or negative) value of ΔpCO_2. In the subtropical region, oceanic pCO_2 was lower than atmospheric pCO_2 in winter, spring and autumn 2005, implying that the ocean was a sink for atmospheric CO_2, whereas the ocean turned into a source in the summer. Oceanic pCO_2 in the equatorial region has been at low levels since 2002, and was much lower than atmospheric pCO_2 in winter and summer 2005.





Left column:

Fig. 2 Time series of the 10-day mean SST anomalies (°C) averaged for the sub-areas shown in the bottom panel. Anomalies are deviations from JMA's 1971–2000 climatology.

Right column:

Fig. 3 Location of the Kuroshio path from July to December 2005.

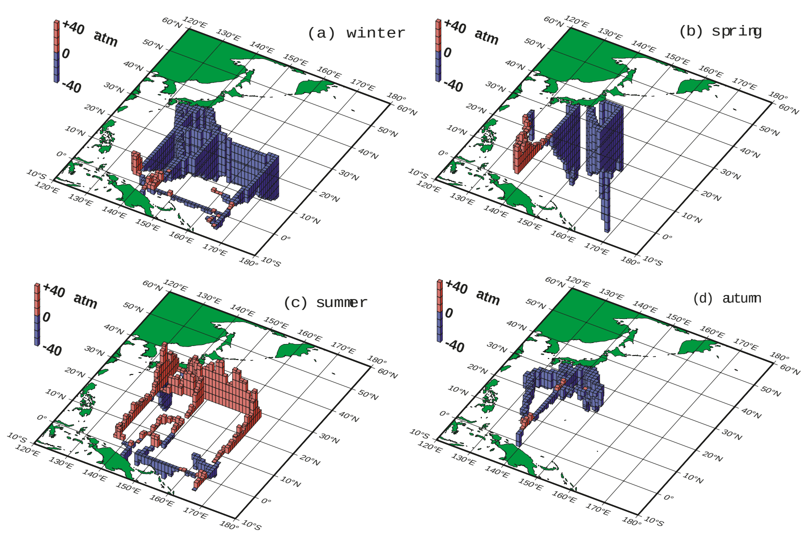


Fig. 4 Difference in CO_2 partial pressure between the ocean and the atmosphere in the western North Pacific in 2005. Red/blue pillars show that oceanic pCO_2 is higher/lower than atmospheric pCO_2.

Shiro Ishizaki (s_ishizaki@met.kishou.go.jp) 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 the data assimilation system named "Ocean Comprehensive Analysis System", this group provides an operational surface current prognosis (for the upcoming month) as well as seawater temperature and an analysis of currents with a 0.25 × 0.25 degree resolution for waters adjacent to Japan. He is now involved in developing a new analysis system for temperature, salinity, and currents that will be altered with the Ocean Comprehensive Analysis System.

Recent trends in waters of the subarctic NE Pacific

By William Crawford

Surface waters of the Gulf of Alaska returned to nearly-normal temperatures in late 2005 and early 2006, following several years of warming that included record high temperatures in the summer of 2004. **Figure 1** reveals this return to normal through a sequence of plots of temperature anomalies for the winters of 2005 and 2006, plus the summer of 2005.

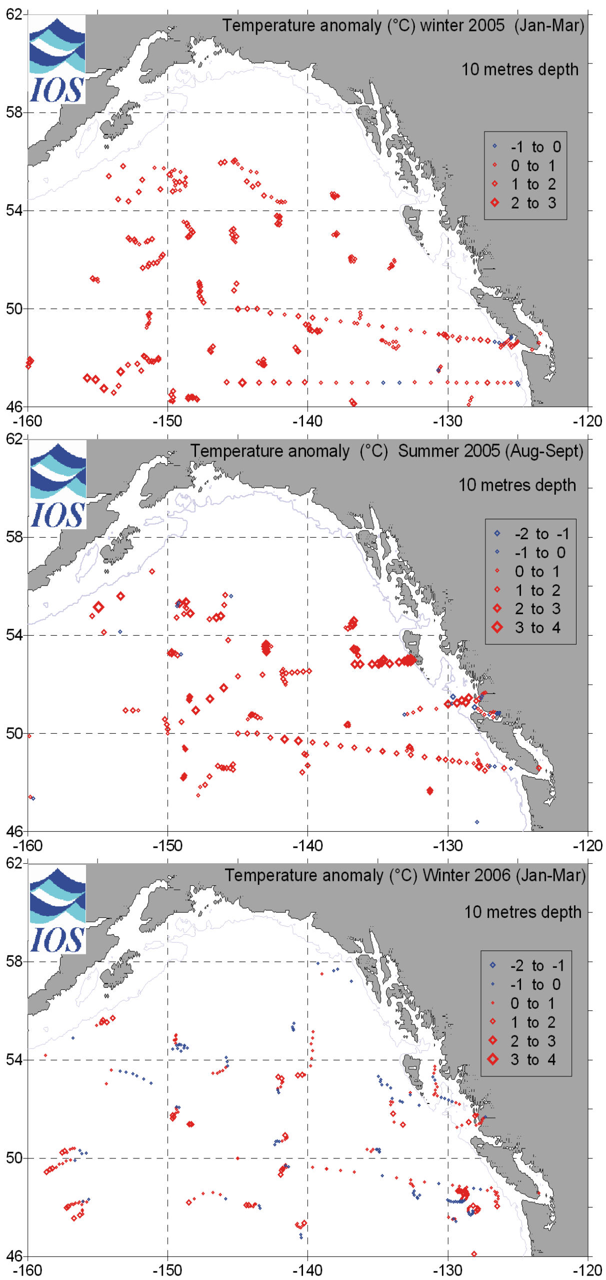


Fig. 1 Anomalies of temperature in the Gulf of Alaska from winter 2005 to winter of 2006. Symbols denote cold (blue) or warm (red) anomalies, with magnitude of anomaly denoted by symbol size. Each symbol represents a single profile from a Canadian research vessel, or by an Argo profiler.

Anomalies are computed relative to climatology of all observations in the U.S. and Canadian data archives. This climatology covers shelf, inshore and deep-sea regions. Summer includes the two-month interval from August 1 to September 30, avoiding the month of July when surface temperatures are still warming through most of these regions. Winter extends through the three months from January 1 to March 31. Anomalies are computed from observations by Canadian research vessels, and by Agro profilers operating in these waters. Temperatures at 10-m depth were selected to enable better comparison between ship-based and Argo measurements, and to avoid waters stirred at depths above 10 m by vessels while on station.

This decline in the warm anomalies began after the record high temperatures observed in the Gulf of Alaska in the summer of 2004. For example, temperatures measured between 10 and 50 m below surface along Line-P, which extends from the mouth of Juan de Fuca Strait to Ocean Station Papa at 50°N, 145°W (position shown in **Figure 2**), in August 2004 were the warmest ever observed in almost 50 years of sampling along this line.

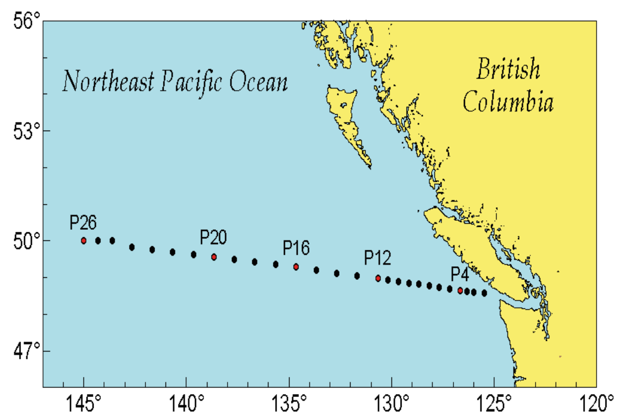


Fig. 2 Stations along Line-P. Ocean Station Papa lies at P26.

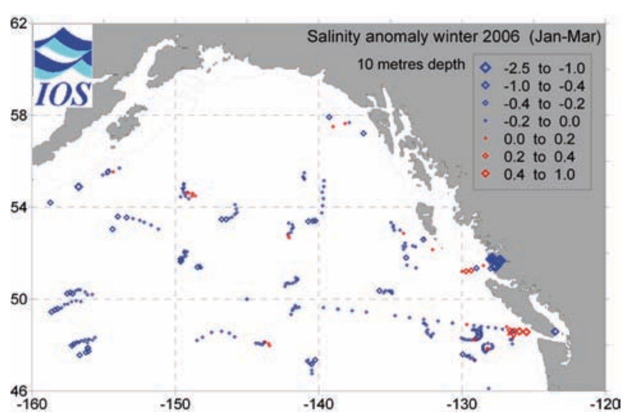


Fig. 3 Anomalies of salinity in the Gulf of Alaska for the winter of 2006. Symbols denote fresher (blue) or saltier (red) anomalies, with magnitude of anomaly denoted by symbol size.

Figure 3 displays salinity anomalies for the Gulf of Alaska for early 2006, revealing a continuation of fresher conditions that began several years earlier. Only a few profiles of salinity show saltier waters in the mid-gulf, and the great majority report fresher waters at 10 m depth.

The warm era from late 2002 through 2005 can be observed in several climate indices, including the Pacific Decadal Oscillation (PDO) and another index recently developed by Patrick Cummins of Fisheries and Oceans Canada at the Institute of Ocean Sciences. His index is based on sea surface height (SSH) reported by altimetry satellites at 1° resolution over a region extending from the west coast of North America to the dateline and from 25°N to 60°N, excluding the Bering Sea. His SSH index is focussed more on the eastern North Pacific than is the PDO, and is less subject to short-term variability than the PDO because SSH observations represent a deeper water layer than do measurements of surface temperature. His plot of indices is presented in **Figure 4**.

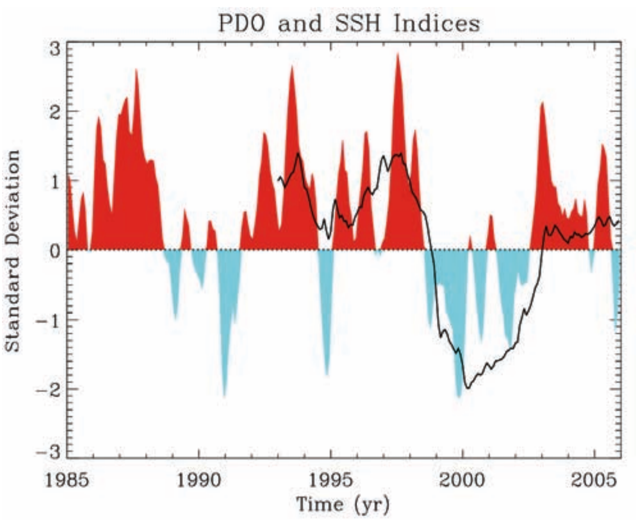


Fig. 4 The PDO index is shown in solid blue and red. Blue indicates the PDO cold phase and red the warm phase. The solid black curve gives the sea level index with positive values indicating elevated sea level off the west coast of North America and sea level anomalies of opposite sign in the central Pacific.

Both the PDO and SSH indices show that persistent changes in the state of the Northeast Pacific occurred in winter 1998/99 that were marked by colder sea surface temperatures and lower SSH over the Gulf of Alaska. These changes were characteristic of the cold phase of the PDO and occurred in association with a significant La Niña event in the tropical Pacific in the winter of 1998/99. The effects of the 1998/99 regime shift persisted for about four years, ending in 2003.

During the last three years (2003–2005) the indices shown in **Figure 4** indicate a return to the warm phase of the PDO, characterized by above-average sea surface temperatures and sea levels in the Gulf of Alaska. In late 2005, the PDO shifted to the cold phase, apparently in response to the recurrence of La Niña conditions in the tropical Pacific. However, the SSH index did not change sign in 2005, suggesting that a persistent cold phase in the Gulf of Alaska has yet to develop.

In summary, we observe a return toward normal surface temperatures in the Gulf of Alaska in late 2005 and early 2006, following several warm years, and possibly associated with a weak El Niña in early 2006. This cooling was not accompanied by a drop in the SSH index in the gulf in late 2005.

During the warm years of 2002 to mid-2005, the Pacific coastal waters of Canada experienced an increase in numbers of warm-water visitors. For example, sardines returned to Canadian waters in 1992 after a 45-year absence. With warmer waters of 2004 and 2005, their numbers increased again.

Humboldt squid (*Dosidicus gigas*), a tropical squid normally ranging from central California to southern Chile, was captured incidentally in the summer and fall of 2004–2005, by commercial fishermen and in research surveys throughout British Columbia (for details see the article on "*Unusual invertebrates and fish observed in the Gulf of Alaska, 2004–2005*" by Bruce Wing in this issue). Until 1997, none had been reported in coastal waters north of Oregon.

Pacific hake expanded their range northward through Canadian waters in 2004 and 2005.

Finally, returns of west coast Vancouver Island sockeye salmon are expected to drop in the next few years, due to prey and predator changes associated with warm ocean waters.

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Unusual invertebrates and fish observed in the Gulf of Alaska, 2004–2005

By Bruce L. Wing

During the past two years, unusual fish and invertebrates have been reported by fishermen and biologists working in the coastal waters of the eastern and central Gulf of Alaska. These observations are associated with the anomalously warm water found in the eastern North Pacific for at least the past three years. This is not the result of an El Niño event, but rather an overall warming of the whole North Pacific. The long-term implications of this ocean warming on the distribution and abundance to Alaskan fisheries are not clear. Here, I report on the continued presence of jumbo squid (*Dosidicus gigas*) in Southeast Alaska waters, as well as selected or noteworthy occurrences of pelagic animals. I also comment on the natural history and importance of some of these animals.

The records of occurrences were compiled from personal communication with Alaska Department of Fish and Game biologists and port samplers who receive their information from commercial fishermen, charter boat operators, sports fishermen, *etc*. Some observations are from National Marine Fisheries Service (NMFS) personnel conducting surveys of juvenile salmon, sablefish, and inshore fish habitats. Individual fishers and biologists also brought to our attention unusual species encountered during their work. Where possible, the identifications were confirmed through photographs or actual specimens submitted to the Auke Bay Laboratory reference collections.

Zooplankton are seldom noticed by fishermen or others working on the water unless the species is very abundant or very large. Otherwise, it is usually the specialist doing detailed analysis of plankton net tows who spots an unusual occurrence of zooplankton species. In 2004 and 2005, specialists and non-specialists noted unusual zooplankton in the Gulf of Alaska. *Limacina helicina* is the most common pteropod there. Typically, this small purple snail is an abundant but not dominant zooplankton in our plankton net tows. In the spring of 2005, *Limacina* was reported as a dominant zooplankton in net tows from Chatham Strait, Peril Strait, and Icy Strait. *Limacina helicina* and the pyramid clio, *Clio pyramidata*, are most frequently encountered in abundance in offshore waters, where they feed on small microflagellate phytoplankton. Their abundance in inshore waters may be the result of strong onshore transport of surface waters from the central Gulf of Alaska. When very abundant, they are fed on extensively by chum and pink salmon, herring, and whales. When Southeast Alaska had herring reduction fisheries prior to 1965, this was the principal component of "black feed" evident in both herring and pink salmon diets. It was not considered as desirable as "red feed" (euphausiids and copepods) because of the low oil content resulting in a "wet" and difficult-to-dry fish meal and a strong tendency for fish to "belly burn" in the hold of seiners.

In addition to the pteropods, a heteropod, *Atlanta* sp., and several copepods, *Mesocalanus tenuicornis*, *Paracalanus parvus*, *Clausocalanus* sp., *Aegisthus mucronatus*, and a *Sapphirina* sp., were reported from northern Gulf of Alaska zooplankton samples in 2004. These zooplankton are usually associated with the California Current system and are rarely encountered north of British Columbia. *Paracalanus parvus* was also seen in the southeastern Bering Sea in 2004.

Squid attracted considerable interest among fishermen and biologists in 2004 when jumbo squid were first taken off northern Southeast Alaska (Cosgrove, 2005). Their continued presence in Alaska was confirmed by a brief Auke Bay Laboratory survey in August 2005 (**Photo 1**). This large squid forms an important fishery in the Gulf of California. It is taken sporadically in sport fisheries off Southern California and more recently off Oregon and Washington. Considered a tropical species, its range and abundance have increased in Peru and Chile where it is thought to be a serious predator of hake. The Alaskan specimens collected last summer were feeding on euphausiids and squid.

Photo 1 Wade Loofborough, Captain of FRV Media*, with a jumbo squid, August 2005. (NMFS photo)*

Several specimens of the boreal clubhook squid, *Onychoteuthis borealijaponicus*, were collected off the northern coast of Southeast Alaska in 2005, along with the jumbo squid during surface night trawling by the Auke Bay Laboratory survey. This medium-sized squid was of minor importance in the former North Pacific high seas driftnet fishery. Its northern distribution is typically along the southern edge of the Gulf of Alaska (~55ºN). We have earlier specimens from Cape Ommaney from the late 1970s. Like the neon flying squid, *Ommastrephes bartrami*, little is known of this squid's biology in the eastern Pacific and Gulf of Alaska.

Opalescent inshore squid, *Loligo opalescens,* is a small squid that at times has been abundant in southern Southeast Alaska. During periods of abundance, they are important forage for salmon in this region (Reid, 1961). Previously reported in northern Southeast Alaska in the early 1980s (Wing and Mercer, 1990), no additional occurrences were noted north of Prince of Wales Island until the spring of 2005, when they were abundant in the Sitka area and in northern Clarence Strait. This is the market squid of California, and it is important in commercial and sport fisheries from California to southern British Columbia. Its abundance in Southeast Alaska fluctuates radically, thus it has never become a commercial species and is rarely harvested in subsistence or sport fisheries.

Two specimens of the eight-armed luminescent squid, *Octopoteuthis deletron,* were photographed December 2004, from a research trawl catch in northern Southeast Alaska (**Photo 2**). Unfortunately the specimens were not saved. It has previously been reported only as far north as central Vancouver Island (~50ºN) (Jefferts, 1983). Little is known about the biology of this unusual squid.

Photo 2 Luminescent eight-armed squid, Lynn Canal, December 2004. (ADF&G photo)

Although white sharks, *Carcharadon carcharias,* occur in Alaska waters, they are not abundant. Their presence usually generates considerable interest by the fishing community and the public. In 2004, white sharks were reported from southern Southeast Alaska north to Yakutat, Alaska. Karinen (2004, personal comm.) reported that at least five were seen off Noyes Island in 2004. Most notable was one photographed off Yakutat after taking a bite out of a sport-caught halibut. The photographs were widely circulated by news media and the Internet. Although not restricted to warm waters, white shark occurrences in Alaska are often associated with El Niño conditions (Karinen *et al.*, 1985; Mecklenberg *et al*., 2002).

At least three thresher sharks, *Alopias vulpinus*, were reported in Alaska in summer 2004 (**Photo 3**). These confirm an earlier landing in 1990 that had no location data (Mecklenberg *et al*., 2002). The 2004 observation from west of Yakobi Island (55º57′N) is the farthest north record for thresher sharks.

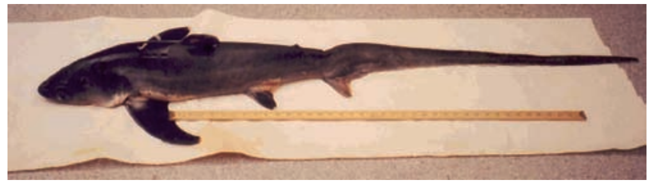

Photo 3 Thresher shark from Yakobi Island, Alaska, August 2004. (NMFS photo)

The blue shark, *Prionace glauca*, was reportedly common along the outer coast of Alaska in 2005. Although typically associated with the warmer southern waters, they may be more closely associated with waters from the central Gulf of Alaska. Blue sharks are frequently reported during the strong El Niño years. Most of the blue sharks observed in Alaska are small, less than 150 cm, and appear to move northward with warming water during the summer.

Two opahs, *Lampris guttatus*, were landed in Sitka in 2005 (**Photo 4**). Reported weights were 6.8 and 15.9 kg, respectively. They have been reported to 68 kg from the western Gulf of Alaska with a maximum weight of 273 kg (Mecklenberg *et al*., 2002). Six Alaskan specimens have been reported to the Auke Bay Laboratory since 1962. Two large opahs caught south of Kodiak Island in 1998 were feeding on squid. Opah appear to be more abundant south of the North Pacific transition zone. They occasionally are seen in fish markets in Hawaii and California.

Photo 4 Opah landed at Sitka, Alaska, August 2005. (NMFS photo)

Pacific sardines, *Sardinops sagax,* were reported in unusual abundance in southern Southeast Alaska and were captured as far north as Cross Sound. Previously reported in 1998 following a 67-year absence (Wing *et al.,* 2000), the 2005 reports represent the highest abundance and most northerly presence of sardines in Alaska. Recent reports indicate that some sardines have remained in Alaska through February 2006. The Alaskan occurrences follow a trend of increasing abundance in British Columbia.

Anchovy, *Engraulis mordax*, is an important forage species in British Columbia and south. Previously accounted for only in 1997 from Alaska (Mecklenberg *et al*., 2002), they were reported as abundant in 2005 from southern Southeast Alaska.

In 2005, shiner surfperch, *Cymatogaster aggregata*, was found to be very abundant in Yakutat Bay. This is a 210-nautical mile northwest range extension from their previous (1998) northern limit of Sitka. This range extension appears limited to the outer coast. Shiner surfperch have not been reported north of Petersburg in the inside passages of Southeast Alaska.

Four species of marine turtles were reported from Alaska. (Hodge and Wing, 2000; Wing, 2004). A skeleton of a Pacific Ridley turtle, *Lepidochlys olivacea*, was found in August 2004 south of Yakutat, but may have been the remains of a 2003 stranding. The Pacific Ridley is the smallest and rarest of turtles found in Alaska. Hard-shelled turtles, although arriving with warm waters in summer and early fall, lack cold tolerance and typically die from hypothermia before being able to return to more southern areas.

Monthly average sea surface temperatures (SST) at the Auke Bay Laboratory have been about 0.75ºC above average for most of the past two years (**Fig. 1**). Peak anomalies were +2.48ºC and +2.83ºC in May 2004 and 2005, respectively. Similar anomalies were observed throughout most of the eastern North Pacific and Gulf of Alaska (see details at www.fnmoc.navy.mil/PUBLIC). The temperature patterns differ from El Niño conditions in that the warming was initially observed in the Central Pacific and gradually extended east, then north and west to include the Gulf of Alaska and Bering Sea. A typical El Niño event begins in the equatorial western Pacific, moves east to the coast of South America, and then north and south along the coasts of the eastern Pacific Ocean.

If warm oceanic conditions remain stable and continue to support sizable populations of *Loligo*, *Onychoteuthis*, *Ommastrephes*, *Dosidicus*, and *Sardinops*, fisheries may develop for them. There are currently markets for these species as food and bait. Alaskan fisheries for these species may be a desirable diversification for the seine and jig (troll) fleets. However, before management and the fishing industry invest a great effort in new fisheries, we need to have a better understanding of these species and their dynamics at the northern limits of their distribution. Shifts in the food webs in

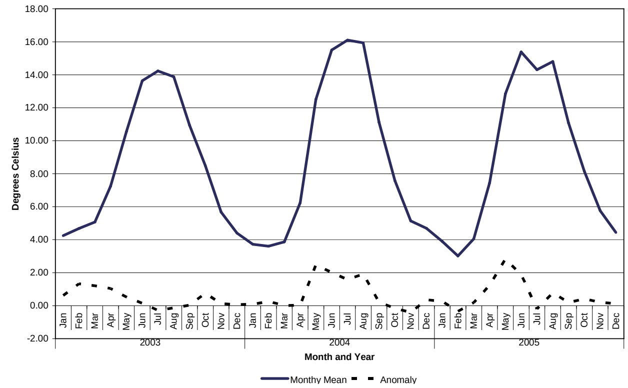

Fig. 1 Monthly mean SST and anomalies (2003–2005) from the long-term mean at Auke Bay, Alaska.

the eastern Gulf of Alaska could be either detrimental or beneficial to current fisheries. Some of the unusual catches these past few summers will probably always be rare and noteworthy.

References

Cosgrove, J.A. 2005. The first specimens of Humboldt squid in British Columbia. *PICES Press* 13(2), 30–31.

Hodge, R.P. and Wing, B.L. 2000. Sea turtle occurrences in Alaska, 1960–1998. *Herp. Rev.* 31(3), 148–151.

Jefferts, K. 1983. Zoogeography and systematics of cephalopods of the northeastern Pacific Ocean. Ph.D. thesis, Oregon State Univ. Corvallis, OR. 291 p.

Karinen, J.F., Wing, B.L. and Straty, R.R. 1985. Records and sightings of fish and invertebrates in the eastern Gulf of Alaska and oceanic phenomena related to the 1983 El Niño event. pp. 253–267. In: Wooster, W.S., and Fluharty, D.L., Eds. El Niño North: Niño effects in the eastern subarctic Pacific Ocean. Washington Sea Grant Program Publication WSG-WO 85-3. Univ. Washington, Seattle, WA.

Mecklenburg, C.W., Mecklenburg, T.A. and Thorsteinson, L.K. 2002. *Fishes of Alaska*. American Fisheries Society, Bethesda, MD.

Reid, G.M. 1961. Stomach content analysis of troll-caught king and coho salmon, southeastern Alaska, 1957–1958. *U.S. Fish Wildl. Serv. Spec. Sci. Rep. Fish.* 379, 8 p.

Wing, B.L. 2004. Alaskan marine turtles: An update. Proceedings of the First Statewide Conference on Amphibians of Alaska, March 31–April 1, 2004, Juneau, AK.

Wing, B.L. and Mercer, R.W. 1990. Temporary northern range extension of the squid *Loligo opalescens* in Southeast Alaska. *Veliger* 33(3), 238–240.

Wing, B.L., Murphy, J.M. and Rutecki, T. 2000. Occurrence of Pacific sardine, *Sardinops sagax*, in southeastern *Alaska. Fish. Bull.* 98, 881–883.

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The Bering Sea: Current status and recent events

By Jeffrey M. Napp

Current status of the Bering Sea ecosystem

What a difference a year makes! Before the early 2000s, the dominant mode of variability in the physics of the eastern Bering Sea was interannual variability. From 2000 to 2005, however, the interannual signal was much reduced, and we experienced 5 consecutive “warm” years without significant intrusion of seasonal sea ice into the southeastern region (**Fig. 1**). In fact, many thought it would be “a cold day in *hades*” before we would see another frigid (or a least average) winter in the eastern Bering Sea. This year, though, a familiar atmospheric pattern associated with cold winters emerged: a negative Arctic Oscillation combined with La Niña conditions on the equator. Ice that had penetrated the southeast during winter, did not immediately recede as expected. Instead, it continued its southwesterly journey as the spring winds remained out of the northeast.

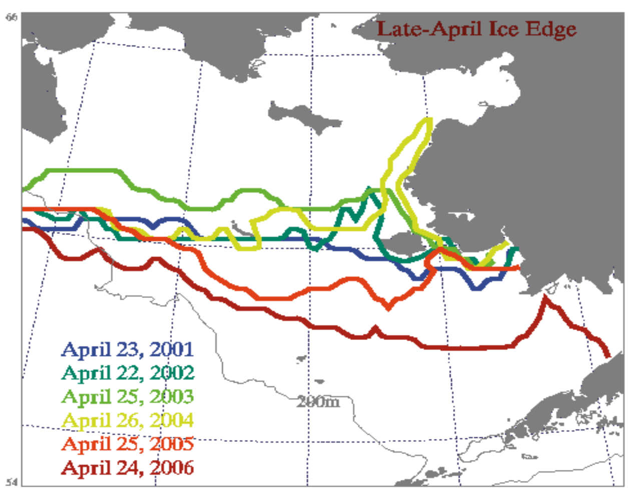

Fig. 1 Estimated position of the leading ice edge in April 2006. Source: P.J. Stabeno, NOAA – PMEL.

The energetic spring winds and atmospheric cooling of the surface layer continued mixing of the water column well into May, and helped to form a large pool of cold water (< 2°C) over the southeastern shelf. At the time of this writing (late June), the NOAA Groundfish Assessment Group from the Alaska Fisheries Science Center had completed the southern third of their annual survey. Bottom temperatures measured during this survey show the cold pool extending well into Bristol Bay (**Fig. 2**). Temperatures in Bristol Bay were much colder than the previous year, but warmer than recorded in 1999, the last “cold” year.

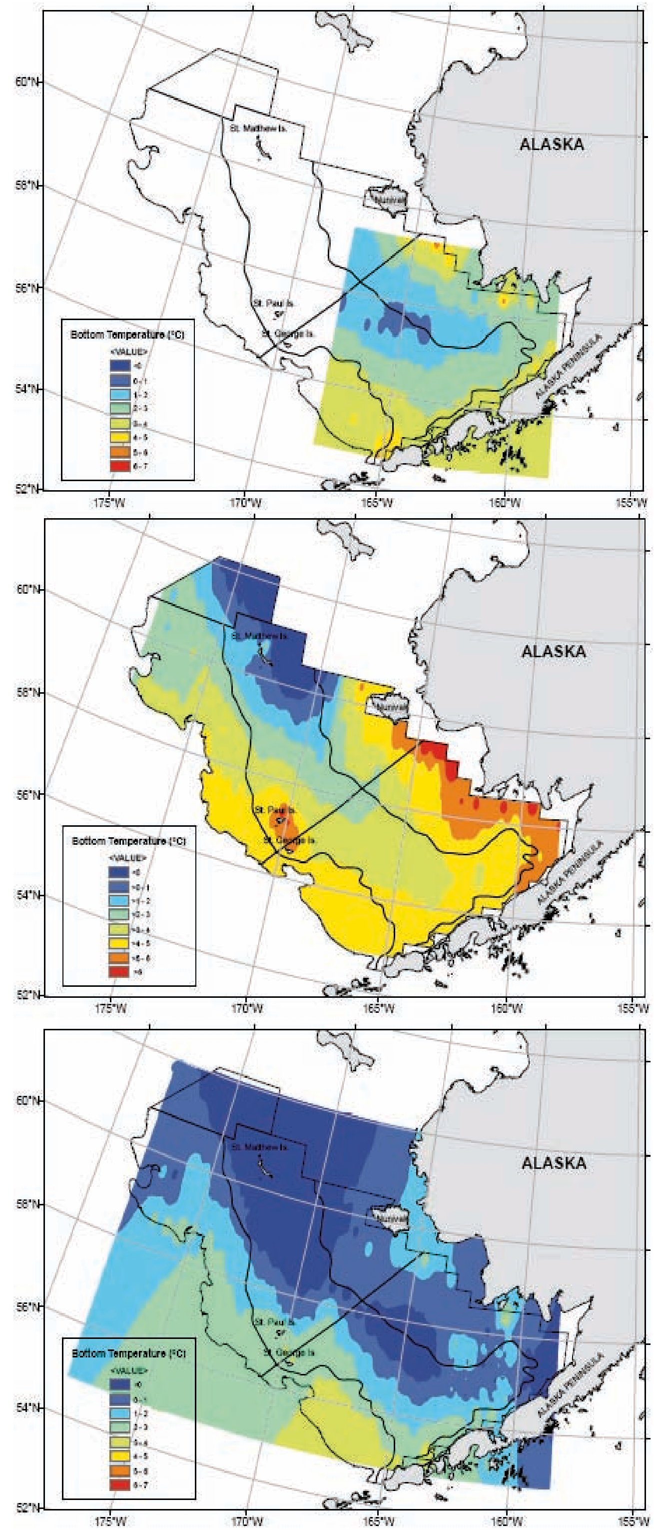

Fig. 2 Bottom water temperatures measured on the AFSC-RACE bottom trawl survey. Top: 2006 survey as of late June; middle: 2005; bottom: 1999. Source: R. Lauth, NOAA – AFSC.

Spring ice edge survey

This past spring, a group of researchers from NOAA and the University of Washington (UW) conducted a multi-disciplinary cruise along the leading edge of the ice in the eastern Bering Sea. The group was comprised of physical, biological, and fisheries oceanographers, marine mammalogists and seabird ecologists, plus a photographer and reporter from the *Seattle Times* and an independent cinematographer. They worked for about 20 days aboard UW's vessel, the *Thomas G. Thompson*. Midway through the cruise, the R/V *Thompson* was joined by the NOAA Ship *Miller Freeman* for several days to use hydroacoustics to document the distribution of fish in and around the ice. The cruise was both a NOAA investigation into effects of climate on ecosystems (North Pacific Climate Regimes and Ecosystem Productivity – NPCREP) and an unofficial pilot cruise for the NSF-sponsored Bering Ecosystem Study (BEST).

Water column sampling (hydrography, nutrients, chlorophyll, phytoplankton species and primary productivity, and zooplankton species and distribution) was conducted throughout the cruise and sampled during the transition from a well-mixed water column to a stratified water column. A minor component of the water column research was to examine light penetration through the sea ice and the contribution of ice-bound phytoplankton species to the spring bloom (**Photos 1 and 2**). On one occasion divers from the NOAA Ship *Miller Freeman* sampled the undersides of pancake ice floes for phyto- and zooplankton.

The tagging of ice-dependent seals was the focus of scientists from NOAA's National Marine Mammal Laboratory (NMML). Bering Sea populations of ringed, spotted, ribbon, and bearded seals are not routinely assessed and very little is known about where they go once the ice melts. During the cruise, the NMML scientists successfully equipped a total of 18 seals (4 adults, 1 juvenile, and 13 pups) with satellite-tracked tags (**Photo 3**). Seals were equipped with two types of instruments: SPLASH tags which telemeter position, depth, and the timing of haulout, and SPOT tags that telemeter only position and the timing of haulout. SPLASH tags are glued to the seal's fur, and fall off with their annual molt. SPOT tags are mounted on semi-permanent flipper tags.

Fisheries acoustics observations were collected by the NOAA AFSC Midwater Assessment and Conservation Engineering (MACE) group during the time when the *Freeman* and *Thompson* worked together. Previous to this expedition, there was anecdotal information suggesting that some fishes may aggregate at the ice edge. During this cruise, however, all of the acoustic signatures (scatter) in and around the ice edge were (was) associated with euphausiids or jellyfish.

Photo 1 Members of the science team prepare to obtain ice cores. Source: M. Cameron, NOAA/AFSC – NMML.

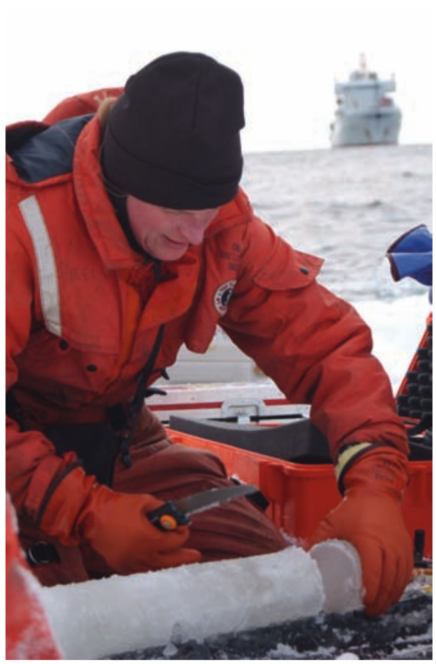

Photo 2 Dr. Carol Ladd of the science team saws the core into sections. Source: M. Cameron, NOAA/AFSC – NMML.

Photo 3 Ice-dependent seals. Pup (top) and tagged female ribbon seal (bottom) on ice. Mother has newly installed SPLASH tag attached to her back. Source: M. Cameron, NOAA/AFSC – NMML.

Observations for seabird abundance and distribution were taken on dedicated strip transects near and away from the ice edge, as well as during most of the daylight transits between sampling regions. The expectation of finding high concentrations of seabirds at or around the ice edge was not met. In general, it seemed as if the northward migration of species may have been somewhat delayed, with the virtual absence of summer visitors from the southern hemisphere. Overall, there were very low densities of planktivorous seabirds across the study area (< 2% of the sightings), although there appeared to be good agreement between their distributions and the concentrations of zooplankton prey.

Acknowledgements: Many thanks to the following people who helped create this report: Drs. Phyllis Stabeno and James Overland (NOAA – PMEL), Drs. John Bengtson, Michael Cameron, Robert Lauth and Chris Wilson (NOAA – AFSC), and Dr. David Hyrenbach (University of Washington).

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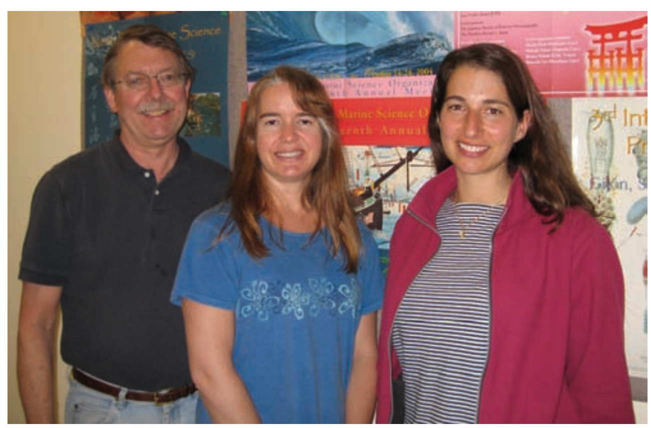
The Year of the Euphausiid

By William Peterson, Tracy Shaw and Leah Feinberg

At PICES XIII (Honolulu, 2004), it was resolved that PICES scientists would work jointly, under the Biological Oceanography Committee, to implement a research project entitled "*The Year of the Euphausiid*". The proposed idea was that, during a given year, scientists from all member countries would focus on an ecological study of *Euphausia pacifica*. This animal was selected for the project because of its important role in food chain processes in both oceanic and coastal waters around the Pacific. *Euphausia pacifica* are found throughout the North Pacific, thus this species is ideal for a pan-Pacific life history comparison, one of the goals of the CFAME (Climate Forcing and Marine Ecosystem Response) Task Team. One step toward achieving this goal is to develop standardized techniques for laboratory measurements of egg production and molting rates of living animals. To facilitate comparative studies, we distributed a handbook entitled "*Protocols for measuring molting rate and egg production of live euphausiids*" at PICES XIV (Vladivostok, 2005). A revised version of this document has been published on the PICES website under the "Projects" menu: http://www.pices.int/projects/Euphasiid/PICES%20Protocols%20COMPLETE.pdf. We are especially interested in receiving comments, particularly from those of you who have used these protocols on cruises in your waters.

Another recommendation at PICES XIV was that a synthesis paper be prepared and delivered at the PICES/GLOBEC Symposium on "*Climate variability and ecosystem impacts on the North Pacific: A basin scale synthesis*", in Honolulu, in April 2006. Such a paper entitled "A Pan-Pacific comparison of the biology of *Euphausia pacifica*", was presented by Tracy Shaw with co-authors Leah Feinberg, William Peterson, Alexei Pinchuk (U.S.A.), Kenji Taki (Japan) and Jaime Gómez-Gutiérrez (Mexico).

What are the next steps for "*The Year of the Euphausiid*"? We suggest meeting in Yokohama to determine if we are ready to form a PICES working group. We hope to see many modelers and zooplankton ecologists at such a planning meeting.



William (Bill) Peterson, Tracy Shaw and Leah Feinberg of the Hatfield Marine Science Center in Newport, Oregon, posing on a carefully selected background of PICES posters. Bill works for NOAA Fisheries, Tracy and Leah work at Oregon State University. Their research focuses on climate effects on zooplankton, particularly euphausiids and copepods. They are currently in their eleventh year of year-round sampling on the Newport Hydrographic line off Newport, Oregon.

Michio J. Kishi awarded 2005 Uda Prize by the Japan Society of Fisheries Oceanography

By Shin-ichi Ito

In 1995, the Japan Society of Fisheries Oceanography (JSFO) established an award named in honour of Dr. Michitaka Uda, the principal founder and first president of JSFO and a pioneer of fisheries oceanography in Japan. The Uda Prize is given annually to an individual who has made significant scientific contributions to fisheries oceanography. Many scientists who have been active in PICES are among the recipients of the Uda Prize, and Professor Michio J. Kishi (Hokkaido University) is the first modeling scientist to be awarded the Prize.

Uda Prize Recipients

1995	Hideo Tameishi	2001	Yoh Yamashita
1996	Sigeo Funakoshi	2002	Kaoru Nakata
1997	Tokio Wada	2003	Yoshiro Watanabe
1998	Yasunori Sakurai	2004	Teruaki Suzuki
1999	Hideaki Nakata	2005	Michio J. Kishi
2000	Akira Nihira		

Professor Kishi's modeling work has contributed significantly to the efforts of the North Pacific Marine Science Organization (PICES), and much of his recent scientific research was done in collaboration with PICES' CCCC MODEL Task Team members. The MODEL Task Team and PICES itself are pleased to be acknowledged in this honour.

The Uda Prize presentation ceremony took place on April 8, 2006, during the spring symposium of JSFO in Tokyo, Japan. Dr. Yoshiro Watanabe, President of JSFO, and Dr. Yoh Yamashita, Chairman of the JSFO Award Committee, conducted the ceremony. Dr. Yamashita announced that Dr. Michio J. Kishi was the recipient of the Uda Prize for 2005, and read the following JSFO award committee citation:

"Dr. Michio J. Kishi has been a pioneer in developing physical–biological coupled models since the late 1970s. His doctoral thesis on modeling the lower trophic level ecosystem in Mikawa Bay is recognized as a primary example of environmental assessment in Japan. He successfully developed an ecosystem model NEMURO (**N**orth Pacific **E**cosystem **M**odel for **U**nderstanding **R**egional **O**ceanography) as the Co-Chairman of the PICES' CCCC MODEL Task Team. NEMURO has been widely distributed within the PICES scientific community, and it is expected to bring numerous scientific contributions. Moreover, he developed a coupled lower trophic level – fish model NEMURO.FISH (NEMURO **F**or **I**ncluding **S**aury and **H**erring), and the application of NEMURO.FISH is attracting the interest of scientists around the world. Besides these modeling activities, he has been engaged in the education of young scientists and promoting fisheries oceanography to the public. He also has provided a great service to JSFO as an editor of *Fisheries Oceanography*, an editor of "*Suisan Kaiyo Kenkyu*", and served on many committees. These combined contributions to fisheries oceanography make him a deserving recipient of the Uda Prize."

Professor Michio Kishi wearing the Uda Prize medal.

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