



Major Outcomes from the 2009 PICES Annual Meeting: A Note from the Chairman

The PICES Eighteenth Annual Meeting took place from October 23 to November 1, 2009, at the International Convention Center in Jeju, a scenic volcanic island of the Republic of Korea. The Ministry of Land, Transport and Maritime Affairs was our host organization, with local arrangements made by the Jeju Special Self-Governing Province, the Korea Ocean Research and Development Institute (KORDI), and the National Fisheries Research and Development Institute (NFRDI). About 500 scientists and administrators from 18 countries and several organizations attended the meeting held under the theme “*Understanding ecosystem dynamics and pursuing ecosystem approaches to management*”. A highlight of this Annual Meeting was the start of the new integrative scientific program of PICES called FUTURE, an acronym for “*Forecasting and Understanding Trends, Uncertainty and Responses of North Pacific Marine Ecosystems*”.

Start of FUTURE

During the previous decade, much progress was achieved on the understanding of linkages between periodic climate changes on various scales and ecosystem responses in the North Pacific. The PICES-GLOBEC Climate Change and Carrying Capacity (CCCC) Program, the first integrative scientific program of the Organization, greatly contributed to deepen our knowledge in this regard. Ecological consequences of the recent global warming and our

socioeconomic activities are also essential for making ocean management policies in PICES’ Contracting Parties. However, there are many unknowns here as global warming and the rapid increase of anthropogenic impacts are phenomena not experienced in the history of humankind. The aim of FUTURE is to understand and forecast how marine ecosystems in the North Pacific respond to climate change and human activities, and to communicate new insights to policy makers, stakeholders and the public of the Contracting Parties. The FUTURE Science Plan was approved in February 2008, and the Implementation Plan was adopted in June 2009.



Venue for PICES-2009: Jeju International Convention Center.

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The CCCC Program was a regional program of the International GLOBEC (Global Ocean Ecosystem Dynamics) Project, and its implementation was separated from the standing scientific structure of PICES. FUTURE is the scientific program of the Organization, both in name and in reality, as the PICES Science Board serves as the Scientific Steering Committee (SSC), and is responsible for initiating activities of the program by working through the Scientific and Technical Committees and their expert groups, and for evaluating progress toward the FUTURE goal, which is expected to be accomplished in the next decade.

Following the adoption of the Implementation Plan, three Advisory Panels named AICE (*Anthropogenic Influences on Coastal Ecosystems*), COVE (*Climate, Oceanographic Variability and Ecosystems*) and SOFE (*Status, Outlooks, Forecasts, and Engagement*), were established to provide continuing direction, leadership, coordination, and synthesis within PICES, and to assist SSC toward attaining the FUTURE goal. During PICES-2009, the Advisory Panels met both separately and jointly to discuss the immediate course of actions. Based on this discussion, Council formally decided to form a Study Group on *Human Dimensions* under the direction of Science Board. The Study Group will review the roles of social science tools and examine practical ways to involve socioeconomic studies into activities of FUTURE. Council also recognized that new developments within the Organization, and especially the launching of FUTURE, call for revisions in the PICES Strategic Plan approved in May 2004, and not reviewed since its adoption. Therefore, a Study Group on *Updating the PICES Strategic Plan* was also established, under the direction of Council, to develop recommendations on required amendments for consideration at the 2010 PICES Annual Meeting.

Cooperation with non-member countries and organizations

As many scientific issues in the North Pacific are common to the Northern hemisphere or the globe, cooperation with non-member countries and other international and regional organizations sharing common interests has been an

important issue for PICES. The creation of joint working groups and the holding of co-sponsored symposia and workshops with other organizations, such as ICES (International Council for the Exploration of the Sea) and FAO (Food and Agriculture Organization of the United Nations), will be a future direction of actual collaboration.

Involving external experts to PICES activities is not only beneficial for promoting cooperation, but is also essential for activating PICES science. At the 2009 inter-sessional meeting in Qingdao, People's Republic of China, Council unanimously agreed to amend the PICES Rules of Procedure to allow experts from non-member countries and other international and regional organizations to serve as *ex-officio* members on PICES Technical Committees and subsidiary bodies of PICES Scientific Committees. In Jeju, the Technical Committees and temporary expert groups discussed the potential implications of these changes in the Rules of Procedure on their membership. Taking the lead in applying these changes, the Technical Committee on Data Exchange (TCODE), the Sections on *Ecology of Harmful Algal Blooms in the North Pacific* (HAB-S) and the Section on *Carbon and Climate* (CC-S) recommended some potential *ex-officio* members. Simultaneously, two international organizations, NOWPAP (Northwest Pacific Action Plan) and IGBP (International Geosphere-Biosphere Programme) sent letters to the Executive Secretary expressing their interest in having *ex-officio* members in HAB-S and CC-S. The PICES Secretariat will take necessary steps in completing these arrangements.

Intergovernmental negotiations are in progress for establishing the new Regional Fisheries Management Organization (RFMO) for the North Pacific following the adoption of the Resolution 61/105 on *Sustainable Fisheries* by the General Assembly of the United Nations. PICES has no fisheries management function, but could provide comprehensive information on North Pacific marine ecosystems which is essential for the discussion in the new RFMO. Providing this broad scientific advice would also meet the expectations of the Contracting Parties for PICES scientific products to be useful for national policy making.



Participants of the Governing Council meeting at the entrance of the Jeju International Convention Center: (left to right) – Alexander Bychkov (Secretariat), Gongke Tan (China), Chul Park (Korea), Harumi Yamada (Japan), Yingren Li (China), Tokio Wada (Chairman), Stephen DeVincent (U.S.A.), Vera Alexander (past Chairman), Samuel Pooley (U.S.A.), Laura Richards (Canada), Jeonghwa Kim (Korea), Sylvain Paradis (Canada), Patricia Livingston (U.S.A.), Lev Bocharov (Russia), George Boehlert (U.S.A.), Yukimasa Ishida (Japan), Darlene Smith (Canada) and Igor Shevchenko (Russia).

Improving participation in PICES activities

The participation of scientists from Contracting Parties in the activities of Standing Committees and their subsidiary bodies, and in PICES Annual Meetings, is a key element for sustaining the scientific activities of the Organization. While the PICES Rules of Procedure explicitly state that each Contracting Party is responsible for covering the expenses of its own delegation to all meetings authorized by Council, the Contracting Parties often fail to support the attendance of their appointed members at these meetings. As the result, the work of Committees and expert groups is seriously impaired.

At PICES-2009, Council confirmed that Contracting Parties have to regularly review their national membership and make changes as appropriate, and to provide the updated national membership list as of the first day of each calendar year. These lists are required to maintain a historical record of PICES membership, and to assist in improving participation in the activities of the Organization.

Contracting Parties were also requested to follow up on the PICES Rules of Procedure and notify the Executive Secretary, three weeks in advance, of the names of delegates, alternate delegates, advisors and members, who will attend each meeting of the Organization. These national delegation lists are required to assist in better coordinating activities of the Standing Committees and their subsidiary bodies, and in better preparing for the Annual Meeting.

Council recognizes the importance of inter-agency coordination and communication within Contracting Parties for improving the participation of their scientists in the activities of PICES, but believes that this problem must be faced at the national level. PICES can only urge that it be recognized and solved at that level to ensure that the lead agency (an agency that has the principal responsibility for interaction with PICES) represents the interest of other agencies, or coordinate PICES interactions with them and promote activities within PICES that have high national interest and relevance.

Capacity building

PICES has been trying to encourage the involvement of early career scientists from Pacific Rim countries in marine scientific research and the activities of the Organization by holding special conferences, summer schools, training courses and methodological workshops for them, and by providing financial support for their participation in PICES Annual Meetings and other symposia organized or co-sponsored by PICES.

The Intern Program, initiated in 2000, is also an essential component of PICES' strategy for capacity building. This program aims at providing young marine researchers and administrators from Contracting Parties, for whom English

is not a native language, with an opportunity to get experience in the operations of an international scientific organization and in the coordination of multi-disciplinary international research programs. The Intern Program has proven to be successful and has performed well in supporting functions of the Secretariat. At PICES-2009, Ms. Tatiana Semenova (Pacific Research Fisheries Centre (TINRO-Centre), Russian Federation) was selected as the 2010 PICES intern. Canada, the Republic of Korea, the Russian Federation and the United States of America have kindly committed to make voluntary contributions to the Trust Fund for the program in 2010. On behalf of Council, I would like to express our deepest thanks for their generous and encouraging support of the program.



2008 PICES Intern and PICES-2009 local organizer, Mr. Keyseok Choe (KORDI), taking a well deserved break from duties with his former professor Ik-Kyo Chung.

Financial issues and restructuring of the Annual Meeting

With the expansion of PICES activities, the annual budget of the Organization has also increased, and now reaches nearly CDN\$1,400,000. However, the total annual contribution from Contracting Parties covers less than 50% of the budget. The remainder depends on voluntary contributions, grants and partnerships, and most of the funding offers have specific product and service requirements, which put an additional burden on the Secretariat, the permanent staff of which has been restricted to four people since 1995. This size seems not enough to provide sufficient service to all activities of PICES and, therefore, the Organization has a "carrying capacity" problem of financial and logistical capabilities, so we must strive for more efficient administration of PICES within our capacity.

The PICES Annual Meeting is a unique and irreplaceable forum where scientists from a wide spectrum of marine sciences get together for interdisciplinary discussions under an overall theme. To continue this valuable forum in the future, we should consider some changes in the structure of the Annual Meeting to harmonize scientific demands with financial and logistical limitations. As part of the restructuring, Council changed the format of the Opening Session by abolishing remarks by Contracting Parties,

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PICES Science – 2009

by John Stein

Highlights of scientific activities and publications

Since the 2008 Annual Meeting in Dalian, China, PICES has been a very active international scientific organization. We co-organized and participated in major international symposia, convened meetings of PICES expert groups and held joint theme sessions and workshops with key partners, such as GLOBEC (Global Ocean Ecosystem Dynamics), ICES (International Council for the Exploration of the Seas), IOC (Intergovernmental Oceanographic Commission of UNESCO), and ESSAS (Ecosystem Studies of Sub-Arctic Seas). Below I highlight key events after PICES-2008.

In 2009, PICES was involved in several major international symposia:

- In June, PICES co-sponsored and assisted in organizing the 3rd GLOBEC Open Science Meeting in Victoria, Canada;
- In August, the 6th International Conference on “*Marine bioinvasions*”, co-sponsored by PICES, ICES, the U.S. National Sea Grant College Program, the Pacific States Marine Fisheries Commission and Portland State University, was held in Portland, Oregon, U.S.A.;
- In September, the OceanObs’09 Conference, endorsed by PICES, took place in Venice, Italy;
- In September, the CIAC’09 Symposium on “*The effects of environmental variability on cephalopod populations*”, co-sponsored by ICES and PICES, was convened in Vigo, Spain;
- In November, an ICES/PICES/UNCOVER Symposium on “*Rebuilding depleted fish stocks: Biology, ecology,*

social science and management strategies” was held in Warnemünde, Germany.

Other joint events included:

- In November 2008, an ICES/PICES/GLOBEC-SPACC Workshop on “*Changes in distribution and abundance of clupeiform small pelagic fish in relation to climate variability and global change*” held in Kiel, Germany;
- In March, the 3rd Argo Science Workshop on “*The future of Argo*”, co-sponsored by PICES and several Chinese organizations, and convened in Hangzhou, China;
- In September, a joint ICES/PICES Theme Session on “*Climate impacts on marine fishes: Discovering centennial patterns and disentangling current processes*” held at the ICES Annual Science Conference in Berlin, Germany.

Several workshops were organized in preparation for the second North Pacific Ecosystem Status Report (NPESR):

- In April, the 11th Salmon Ecology Workshop related to the development of NPESR for the Alaska Current, California Current and Bering Sea, and co-sponsored by PICES, NOAA, Fisheries and Oceans Canada and Douglas Island Pink and Chum Inc., was convened in Juneau, U.S.A.;
- In April, the NPESR Workshop on “*Status and trends in East Asian Marginal Seas*”, co-sponsored by PICES, KORDI, NFRDI and MLTM, was held in Busan, Korea;
- In December, an invitation-only NPESR Synthesis Workshop was convened in Honolulu, U.S.A.



Participants at the 2009 Science Board meeting in Jeju: (left to right) – Skip McKinnell (Secretariat), Mikhail Stepanenko (FIS), Gongke Tan (China), Glen Jamieson (MEQ), Sinjae Yoo (Vice-Chairman), Harold Batchelder (CCCC), John Stein (Chairman), Michael Dagg (BIO), Hiroya Sugisaki (MONITOR), Michael Foreman (POC), Hiroaki Saito (FUTURE), Mitsutaku Makino (SG on Human Dimensions) and Bernard Megrey (TCODE).

Other PICES events included:

- In January, a PICES Harmful Algal Bloom training course organized in Manila, Philippines;
- In April, an invitation-only PICES workshop to develop an Implementation Plan for the new PICES integrative scientific program, FUTURE, held in Qingdao, China;
- In June, a meeting of the PICES/ICES Working Group on *Forecasting Climate Change Impacts on Fish and Shellfish* held in Victoria, Canada;
- In August, the 3rd PICES Summer School on “*Satellite oceanography for earth environments*” co-sponsored by several Korean agencies/organizations, SCOR and NOWPAP/CEARAC, and held in Seoul, Korea;
- In September, a PICES CPR Workshop on “*The Continuous Plankton Recorder survey and long-term observations of plankton ecosystems in the North Pacific*” convened in Yokohama, Japan;
- In October, a PICES Rapid Assessment Survey for non-indigenous aquatic species performed in several ports in Korea.

It was another good year for publishing PICES science stemming from our collaborative and coordinated research on the North Pacific and on key global issues. Selected papers were published from the:

- 2006 International Conference on “*The Humboldt Current system: Climate, ocean dynamics, ecosystem processes, and fisheries*” as a special issue of *Progress in Oceanography* in December 2008 (Vol. 79, Nos. 2–3; Guest Editors: A. Bertrand, R. Guevara-Carrasco, P. Soler, J. Csirke and F. Chavez);
- 2007 ICES/PICES Early Career Scientists Conference on “*New frontiers in marine science*” as a special section in a regular issue of *ICES Journal of Marine Science* in March (Vol. 66, No. 2; Guest Editors: E. North and F. Mueter);
- 2007 NAFO/PICES/ICES Symposium on “*Reproductive and recruitment processes of exploited marine fish stocks*” as a special issue of *Journal of Northwest Atlantic Fishery Science* in April (Vol. 41; Guest Editors: R. Brodeur, M. Dickey-Collas and E. Trippel);
- 2008 PICES/ICES/IOC International Symposium on “*Effects of climate change on the world’s oceans*” as a special issue of *ICES Journal of Marine Science* in August (Vol. 66, No. 7; Guest Editors: K. Brander, J. Church, M. Marcos, W. Peterson and L. Valdés);
- 2007 ICES/PICES Theme Session on “*Comparative marine ecosystem structure and function: Descriptors and characteristics*” as a special issue of *Progress in Oceanography* in August (Vol. 81, Is. 1–4; Guest Editors: B. Megrey, J. Link and E. Moksness);
- 2006 International PICES/CREAMS Workshop as a special issue of *Journal of Marine Systems* in September (Vol. 78, Is. 2; Guest Editors: K.-I. Chang, S.-I. Ito, C. Mooers and J.-H. Yoon);
- 2007 PICES Topic Session on “*Ecosystem approach to fisheries: Improvements on traditional management for declining and depleted stocks*” in a special issue of

Fisheries Research in September (Vol. 100, Is. 1; Guest Editors: G. Kruse, Y. Ishida, E. Perry, V. Radchenko and C.-I. Zhang);

- 2007 PICES Topic Session on “*Decadal changes in carbon biogeochemistry in the North Pacific*” as a special section in a regular issue of *Journal of Oceanography* in September (Vol. 65, No. 5; October 2009, Guest Editor: T. Saino);
- 2007 PICES Topic Session on “*Phenology and climate change in the North Pacific: Implications of variability in timing of zooplankton production to fish, seabirds, marine mammals and fisheries (humans)*” as a theme section in *Marine Ecology Progress Series* in October (Vol. 393; Coordinator: W. Sydeman).

One more volume was published in September in the PICES Scientific Report Series:

- Kashiwai, M. and Kantakov, G.A. (Eds.). 2009. Proceedings of the Fourth PICES Workshop on “*The Okhotsk Sea and adjacent areas*”. PICES Sci. Rep. No. 36, 305 pp.

Two special CD-ROMs were also produced:

- one dedicated to Dr. Warren Wooster, a principal founder and the first Chairman of PICES (“*Warren S. Wooster: The Measure of a Man, 1921–2008*”);
- one containing PICES scientific publications, 1993–2008.

PICES-2009

The PICES Eighteenth Annual Meeting was held from October 23 to November 1, 2009, at the International Convention Center in Jeju, Korea. The meeting was hosted by the Ministry of Land, Transport and Maritime Affairs (MLTM), in coordination with the PICES Secretariat. I am sure that all of you who had the opportunity to attend PICES-2009 would agree that it was an excellent venue, and local arrangements by the Korea Ocean Research and Development Institute (KORDI), the National Fisheries Research and Development Institute (NFRDI) and the government of the Jeju Special Self-Governing Province, made for a very successful meeting. It was truly an Annual Meeting to remember. What became evident to me is that our PICES scientific community is very vibrant, we have strong partnerships and collaborations among scientists from all member countries, and our science is dynamic, cutting-edge and well-recognized.

Nearly 500 scientists and managers from 18 countries attended 12 sessions, 10 workshops and 25 meetings of the committees and expert groups, and presented 280 talks and 135 posters. I also want to mention that the inaugural meetings of the three FUTURE Advisory Panels, AICE (*Anthropogenic Influences on Coastal Ecosystems*), COVE (*Climate, Oceanographic Variability and Ecosystems*), and SOFE (*Status, Outlooks, Forecasts and Engagement*), were held, marking the formal start of the next generation science program of PICES.

We had a number of Topic Sessions convened jointly with other organizations: “*Early life stages of marine resources as indicators of climate variability and ecosystem resilience*” with ICES (International Council for the Exploration of the Sea); “*Outlooks and forecasts of marine ecosystems from an earth system science perspective: Challenges and opportunities*” with IMBER (Integrated Marine Biochemistry and Ecosystem Research); “*State of the art of real-time monitoring and its implication for the FUTURE oceanographic study*” with the International Argo Program and GOOS (Global Ocean Observing System); and “*Marine spatial planning in support of integrated management – tools, methods, and approaches*” with NOWPAP (Northwest Pacific Action Plan). We also convened several joint workshops: “*Integrating marine mammal populations and rates of prey consumption in models and forecasts of climate change—ecosystem change in the North Pacific and North Atlantic Oceans*” with ICES; “*Exploring the predictability and mechanisms of Pacific low frequency variability beyond inter-annual time series*” with CLIVAR (Climate Variability and Predictability Program); “*Marine ecosystem model inter-comparisons*” with ESSAS (Ecosystem Studies in Sub-Arctic Seas); and “*Natural supplies of iron to the North Pacific and linkages between iron supply and ecosystem responses*” with SOLAS (Surface Ocean Lower Atmosphere Study).

Representatives from almost 30 international and regional organizations and programs were present as observers at PICES-2009. Strong collaboration and interaction with these organizations and programs is vital to maintaining a vibrant PICES. This year it was a pleasure to have Dr. Michael Sinclair, new President of ICES, attending the Science Board meeting. It was Dr. Sinclair’s first time at a PICES Annual Meeting, so we very much appreciated his participation and his excellent talk at the Science Board Symposium.



Dr. Michael Sinclair making his presentation at the Science Board Symposium.

The theme of PICES-2009 was “*Understanding ecosystem dynamics and pursuing ecosystem approaches to management*”, and the keynote lecture at the Science Board Symposium was given by Professor Chang-Ik Zhang (Pukyong National University, Korea) on “*Ecosystem-*

based fisheries assessment and management: A step towards the FUTURE implementation of ecosystem approaches to management”. His talk emphasized the progress he and his colleagues, both in Korea and from other PICES member countries, have made in developing a pragmatic ecosystem-based approach for assessing fisheries management. His approach examines fisheries management objectives from the perspective of maintaining sustainability, biodiversity, habitat quality and socioeconomic benefits. Professor Zhang’s presentation highlighted not only the progress to date but also work that lies ahead in taking a full ecosystem approach to management of marine and coastal ecosystems of the North Pacific.



Prof. Chang-Ik Zhang giving the keynote lecture at the Science Board Symposium.

Every year we acknowledge the excellent science and high quality of presentations at our Annual Meetings. The recipient of the award for the best oral presentation in the 2009 Science Board Symposium was Dr. Erlend Moksness from the Institute of Marine Science, Norway, for his talk on “*Major human activities affecting Norwegian coastal marine ecosystems: Present status and challenges*”, that illustrated how the use of models incorporating environmental, social and economic components, when coupled with ecosystem scale research and improved mapping, can be very useful for engaging stakeholders in decision making for marine spatial planning. Clearly, his presentation addressed the theme of PICES-2009, but was also relevant to FUTURE because the model he presented is one of the tools used for communicating our science to key stakeholders.

Congratulations are also in order for the recipients of the best presentation awards given by the Standing Committees. The awards for best oral presentations are given to scientists early in their career, and the recipients were: BIO – Bryan A. Black (U.S.A.), FIS – Hyunjung Kang (Korea), MEQ – I. Nyoman Radiarta (Japan), MONITOR – Kelly J. Benoit-Bird (U.S.A.), and POC – Xiaohui Tang (China). Each Committee also gives a best poster award, which is open to all presenters, and the recipients were: BIO – Tetsuichi Fujiki (Japan), FIS – Tatiana Tunon (Canada), MEQ – Sang Rul Park (Korea), MONITOR – Shin-ichi Ito (Japan), POC – Satoshi Osafune (Japan).



Start of an evening get together at the Poster Session.

For details on the recipients of the Wooster Award and PICES Ocean Monitoring Service Award (POMA), please refer to the 2009 PICES Awards article in this issue.

It is also important to acknowledge service to PICES and changes in leadership. At this Annual Meeting we thanked Dr. Glen Jamieson (Canada) for his leadership of the Marine Environmental Quality Committee (MEQ) since 2006, and welcomed Dr. Steven Rumrill (U.S.A.) as the next Chairman of MEQ. As I enter my last year as Science Board Chairman, we also took a step to ensure continuity in scientific leadership by unanimously electing Dr. Sinjae Yoo (Korea) for this position. His term as Science Board Chairman will start after PICES-2010. I have enjoyed working with Sinjae for several years and am very confident that he will serve PICES well in this capacity.



Dr. Glen Jamieson receiving a PICES certificate of appreciation at the Closing Session.

At the inaugural meetings of FUTURE Advisory Panels, Drs. Thomas Therriault (Canada), Hiroaki Saito (Japan) and Robin Brown (Canada) were recommended and then appointed as Chairmen of AICE, COVE and SOFE, respectively. Science Board is very confident that these three scientists will be excellent Chairmen of the Advisory Panels, and will get FUTURE off to a quick and productive start. It is proposed that the Chairmen serve for 3 years, however, for continuity, two of the Advisory Panel Chairmen will serve for 3 years



An example of PICES/ICES similarities: (left) Hal Bauchelder (PICES) and (right) Jürgen Alheit (ICES).

and one will serve for 4 years, so that we can stagger the transition to new Chairmen. An important initial task for Advisory Panel Chairmen will be to work with their members developing a work plan for review and approval at the next inter-sessional Science Board meeting to be held in Sendai, Japan, in April. I would like to acknowledge and thank Tom, Hiroaki, and Robin for being willing to step up and take the responsibility to lead these FUTURE Advisory Panels, and to note that it is important for all of us, and especially younger members of PICES, to seriously consider opportunities for leadership roles in our Organization. Without individuals willing to actively assume strong leadership roles, PICES will not grow as a valued and integral component of the international science community.

Finally, I would like to point out that through the excellent leadership of Drs. Skip McKinnell and Michael Dagg, good progress is being made on the second PICES North Pacific Ecosystem Status Report (NPESR). At this Annual Meeting, the editorial board met to review the status of the report and the plan for a NPESR Synthesis Workshop to be held in December in Honolulu, U.S.A. The objectives of the Workshop were to review the Regional Chapters, compare regional variability and begin writing the Synthesis Chapter. This report is a major product of PICES, and will be an important contribution and update of our understanding of the status of ecosystems in the North Pacific.

Looking ahead

This next year is looking to be busy, as we will be actively working on developing work plans and starting the initial science activities for FUTURE, completing and publishing NPESR, and continuing collaborative work with ICES and other organizations. I would like to highlight several upcoming joint activities. An initial step was taken in planning for the ICES/PICES Early Career Scientist Conference to be held in Europe in 2012, by nominating 3 young scientists, Bryan Black (U.S.A.), Hanna Na (Korea) and Naoki Yoshie (Japan), as PICES members to the Steering Committee. We also will be initiating a joint

PICES/ICES Study Group on *Developing a Framework for Scientific Cooperation in Northern Hemisphere Marine Science*. Dr. Sinjae Yoo was approved to be an associate member of the new SCOR Working Group on *Patterns of Phytoplankton Dynamics in Coastal Ecosystems*, and Dr. Hiroaki Saito was selected as a PICES co-convenor of the 2nd PICES/ICES/IOC Symposium on “*Effects of Climate Change on the World’s Oceans*” to be held in Yeosu, Korea, in 2012. Last but not least, I must mention that PICES, jointly with ICES and the Food and Agriculture Organization (FAO), is convening a major symposium on “*Climate Change Effects on Fish and Fisheries*” from April 25–29, 2010, in Sendai, Japan. The local host is the Fisheries Research Agency of Japan, and Drs. Anne Hollowed (U.S.A.), Shin-ichi Ito (Japan), and Suam Kim (Korea) are the symposium convenors from PICES. Interest in the symposium has been high, and it will provide an international synthesis of our current understanding of the impacts of climate change on marine ecosystems and the implications of these changes for marine resources and their uses. Our next Annual Meeting, PICES-2010, will be held from October 22–31, in Portland, Oregon, U.S.A., under the theme “*North Pacific ecosystems today, and challenges in understanding and forecasting change*”. Science Board has selected and approved many sessions and workshops that should be of great interest to PICES and the broader scientific community. The U.S. delegation and the PICES Secretariat are hard at work in preparing the meeting, and we look forward to seeing you in Portland. In looking further ahead, planning was also initiated for PICES-2011 to be held in Russia, under the theme “*Mechanisms of marine ecosystem reorganization in the North Pacific*”.

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except for the host country. Instead, the opportunity will be provided to national delegates to make their statements at the first session of the Council meeting. Council also agreed to implement the following recommendations by the Study Group on *Restructuring the PICES Annual Meeting*, starting with PICES-2011: (1) shorten the main part of the meeting from 5 days to 4.5 days, with a possible simultaneous increase in the number of concurrent scientific sessions to a maximum of four; (2) expand the duration of the main Science Board meeting from 1 day to 1.5 days to provide more time for accommodating its new role as the FUTURE Scientific Steering Committee, and to allow for the completion of its report to Council; and (3) hold overture 1.5-hour meetings of Scientific and Technical Committees to examine and confirm the discussion points in preparation for their main meetings.

The 2010 PICES Annual Meeting will be held from October 22–31, at the Oregon Convention Center in Portland, U.S.A. The meeting is hosted by the Government of the United States of America, with logistical support provided by the Pacific States Marine Fisheries Commission. The overall theme for PICES-2010 is “*North Pacific Ecosystems Today, and Challenges in Understanding and Forecasting*

To close, it has been a busy and productive year for PICES science, and it was a particularly gratifying to see the culmination of the hard work we all did in developing FUTURE. As I look into 2010, it is the start of a year of transition as I complete my term as Science Board Chairman, and work with Sinjae for a smooth handoff to him as our next Chairman of Science Board. There is much to do, and I look forward to the opportunities to work with all of you. As we enter the new decade, I see a decade where PICES continues to be recognized globally as a leader in the science of climate change and effects on marine ecosystem; I see FUTURE meeting its goal of building on the success of the Climate Change and Carrying Capacity (CCCC) Program, increasing our focus on coastal ecosystems and providing outlooks and forecasts of how climate and human activities may affect marine species; I also see the next generation of PICEans taking important roles in leading our Organization and positioning it to be responsive, relevant, reliable and respected in addressing the key issues of our member countries and the global challenge to mitigate and respond to climate change. I am optimistic that PICES will continue to step up to the challenge with creativity, innovation and cutting-edge science.



John Stein
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Change”. The host country has kindly agreed to hold up to four concurrent scientific sessions per day.

PICES-2009 had good weather from the first to the last day. Under warm hospitality and thoughtful arrangements made by the host organization and local organizers, the attendees partook in presentations and discussions at scientific sessions and enhanced their friendship through social events, including a soccer match. Many of the participants also enjoyed scenic and marvellous landscapes of Jeju, such as Mount Hallasan and lava tubes, which were created by volcanic activities and are considered as UNESCO’s World Natural Heritage sites. On behalf of PICES and all attendees, I would like to express our sincere thanks to the organizers for their efforts to make PICES-2009 a success.



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2009 PICES Awards

The presentation ceremony for two prestigious PICES awards took place on October 26, 2009, during the Opening Session of the PICES Eighteenth Annual Meeting in Jeju, Korea.

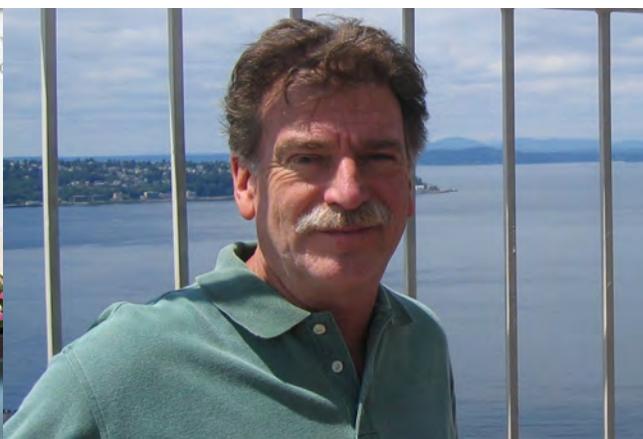
In 2000, PICES established an annual award for scientists who have made significant contributions to North Pacific marine science; have achieved sustained excellence in research, teaching, administration, or a combination of these in the area of the North Pacific; have worked to integrate the various disciplines of the marine sciences; and preferably, all of these in association with PICES. The award was named in honour of Professor Warren S. Wooster, a principal founder and the first Chairman of PICES, a world-renowned researcher of climate variability and fisheries production. Award description, nomination process and selection criteria are posted on the PICES website at http://www.pices.int/Wooster_Award/default.aspx. Prior recipients of the Wooster Award were Michael Mullin (2001), Yutaka Nagata (2002), William Percy (2003), Paul LeBlond (2004), Daniel Ware (2005), Makoto Kashiwai (2006), Kenneth Denman (2007), and Charles Miller (2008). To our deep regret Professor Wooster passed away in October 2008. He was not only a distinguished scientist,

but also an ambassador of international scientific cooperation. We will no longer be able to see him among the participants at the Annual Meetings, however, his spirit will be living in our minds through this Award.

The Wooster Award presentation ceremony was conducted by Drs. Tokio Wada (PICES Chairman) and John Stein (PICES Science Board Chairman). Dr. Wada introduced the award, and Dr. Stein announced the 2009 award recipient to be Professor Kuh Kim (Korea), an internationally distinguished physical oceanographer. The award was given in recognition of Professor Kim's scientific leadership in PICES (Chairman of the Physical Oceanography and Climate Committee from 2001 to 2004 and Chairman of the PICES Science Board from 2004 to 2007) and the global Argo array, his scientific research in the western Pacific that was pivotal in the initiation and success of the regional program on "Circulation Research in East Asian Marginal Seas" (CREAMS), and his great contribution to the development of the next generation of physical oceanographers and marine scientists. The full citation presented by Dr. Stein is included in the 2009 PICES Annual Report (http://www.pices.int/publications/annual_reports/Ann_Rpt_08/2007%20OPENING_f.pdf).



Professor Kuh Kim: (top left) giving remarks of appreciation at the 2009 Wooster Award presentation ceremony; (top right) posing with Drs. John Stein and Sinjae Yoo, the current and next Chairman of the PICES Science Board, respectively; (bottom left) enjoying conversation with Dr. Howard Freeland, his life-long friend and colleague; (bottom right) celebrating the end of a cruise with his students and Prof. Kyung-Ryul Kim.



(top left) Dr. Bernard Megrey and representatives of the Russian (Dr. Igor Shevchenko), Canadian (Mr. Robin Brown) and Japanese (Dr. Toru Suzuki) MFP teams at the 2009 POMA presentation ceremony; (top right) Mr. Allen Macklin (U.S. MFP member), who was not able to attend PICES-2009; (bottom left) members of the Korean and U.S. MFP teams in Busan, Korea; (bottom right) members of the Chinese and U.S. MFP teams at PICES-2007 in Victoria, Canada.

Progress in many aspects of marine science is based on ocean observations, monitoring, and management and dissemination of data provided by these activities. However, these activities are often behind the scenes, attracting little attention, so that they are seldom evaluated appropriately. To remedy this, a PICES Ocean Monitoring Service Award (POMA) was established in 2007 to recognize the sustained accomplishments of those engaged in monitoring, data management, and communication. This award aims at acknowledging organizations, groups and outstanding individuals who have contributed significantly to the advancement of marine science in the North Pacific through long-term ocean monitoring and data management. Award description, nomination process and selection criteria are posted at http://www.pices.int/awards/POMA_award/POMA_award.aspx. The first award was presented in 2008 to the training ship T/S *Oshoro-maru* of Hokkaido University, Japan, for her long-term ecological monitoring activities in the northern North Pacific.

At the POMA presentation ceremony, Dr. Wada introduced the award, and Dr. Stein announced that the 2009 award be given to Dr. Bernard Megrey of NOAA-Fisheries' Alaska Fisheries Science Center and Mr. S. Allen Macklin of NOAA's

Pacific Marine Environmental Laboratory for their sustained efforts, vision, and leadership in building an inventory of biophysical data for the North Pacific, and for creating the PICES Marine Metadata Federation. The full citation presented by Dr. Stein is included in the 2009 PICES Annual Report (http://www.pices.int/publications/annual_reports/Ann_Rpt_08/2007%20OPENING_f.pdf). In this citation and the remarks of appreciation given by Dr. Megrey, who accepted the award, it was highlighted that the Metadata Federation Project (MFP) was not accomplished by just two people. Rather, it is the product of the collective effort of many experts representing national contributions from all PICES member countries, coordinated and solidly supported by the PICES Technical Committee on Data Exchange. The following individuals were specifically acknowledged: Kimberly Bahl (Joint Institute for the Study of the Atmosphere and Ocean, U.S.A.), Kyu-Kui Jung and Hae-Seok Kang (Korean Oceanographic Data Center), Toru Suzuki (Marine Information Research Center, Japan), Ruguang Yin and Jixiang Chen (National Marine Data and Information Service, China), Igor Shevchenko, Olga Vasik and Igor Burango (TINRO-Centre, Russia), and Robin Brown and John Holmes (Fisheries and Oceans Canada).

We congratulate Professor Kuh Kim, Dr. Bernard Megrey, Mr. Allen Macklin and all PICES Metadata Federation Project national teams, as recipients of the Wooster and POMA awards for 2009.

New Chairmen in PICES

Science Board

In 2006, to facilitate the continuity of Science Board affairs, the Governing Council established a Science Board Chairman-elect position to allow the election of the Science Board Chairman 1 year before the official change of the chairmanship. At PICES -2009, Dr. Sinjae Yoo (Korea) was unanimously elected for this position.



Sinjae Yoo was born in Daegu, a city located in the south-eastern province of Korea, in 1955. During his junior high and high school years, Sinjae was interested in history and biology. He was also fascinated by various hand-on experiments, including launching home-brewed rockets. After entering the College of Natural Sciences of Seoul National University, he came across a drama group with which he spent more time than with other activities. During his college years, he participated in six productions with this group as an actor and later as a director. After receiving his B.Sc. in oceanography, Sinjae hesitated about his future direction for a while, but finally chose to continue studying sciences. In the graduate school of Seoul National University, he studied the spatial distribution of phytoplankton in the southern Yellow Sea. Reading G. E.

Hutchinson, in particular, “*The ecological theater and evolutionary play*”, changed his thinking forever. Eager to learn more about biological evolution, Sinjae moved to the Department of Ecology and Evolution in the State University of New York at Stony Brook in 1982. He did theoretical and experimental studies to explain the evolutionary mechanisms of gamete dimorphism, with which he received his Ph.D. in 1987. After returning to Korea in 1988, he has been a research scientist with KORDI (Korea Ocean Research and Development Institute), which is based in Ansan. There, Sinjae studied primary production and phytoplankton dynamics in Korean waters. In the early 1990s, he became fascinated by the synoptic views provided by remote sensing and began to use satellite data to study phytoplankton. Recently, Sinjae has changed his research direction to the theoretical study of ecological interactions.

He regularly lectures at various universities and has been involved in many research projects, including the Yellow Sea Large Marine Ecosystem. He was a panel member of IOCCG (International Ocean Colour Coordinating Group) and CGOOS (Coastal Ocean Observing System). He also served on the Advisory Committee for the Korea Science and Engineering Foundation. He is now on the Scientific Steering Committee of the International IMBER (Integrated Marine Biogeochemistry and Ecosystem Research) Project. Over the years, Sinjae has been involved in PICES activities, serving on the MODEL Task Team of the CCCC (Climate Change and Carrying Capacity) Program, the Biological Oceanography Committee, and the Science Board, for the last two years as its Vice-Chairman.

Marine Environmental Quality Committee

At PICES-2009, Drs. Steven S. Rumrill (U.S.A.) and Mitsutaku Makino (Japan) were elected as Chairman and Vice-Chairman of the Marine Environmental Quality (MEQ), respectively, to replace Drs. Glen Jamieson (Canada) and Hak-Gyoon Kim (Korea). PICES thanks Drs. Jamieson and Kim for their dedicated service as leaders of MEQ since 2006. They will continue to contribute to PICES as members of the Committee.

Steven Rumrill was raised along the spectacular coastlines of central California and Hawaii, where he cultivated a deep sense of adventure and curiosity about the marine environment and the people that live along the shore. As a youngster, he took up skim-boarding, body-surfing, and climbing coconut trees on Oahu. After moving to Monterey Bay, Steve donned a wetsuit to enjoy surfing,

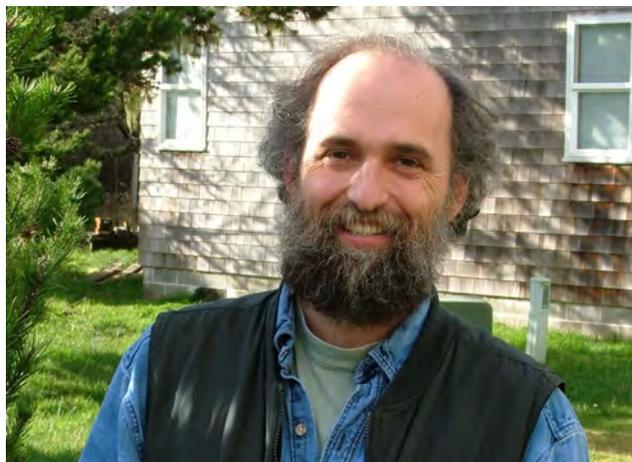
scuba diving, and spear-fishing in the colder waters as he explored the reefs, kelp beds, tide-pools and boulder fields.

Steve received his B.Sc. in Biology (1981) and M.Sc. in Marine Biology (1983) from the University of California at Santa Cruz, where he worked under the mentorship of Drs. John Pearse, Todd Newberry, and Andrew Cameron. His

early-career introduction to marine sciences led to publications on the larval abundance and recruitment of sand-dollars, larval settlement and metamorphosis of chitons, and a broad-scale comparison of the reproductive biology and life-history traits of intertidal and sub-tidal brittle stars. Steve moved north to Edmonton (Alberta) and Vancouver Island (British Columbia) for further graduate studies, where he worked with Dr. Fu-Shiang Chia to complete his dissertation on differential mortality during the embryonic and larval lives of Pacific coast echinoderms (University of Alberta; Ph.D. 1987). He migrated temporarily to the Atlantic coast for post-doctoral studies with Dr. Mary Rice (Smithsonian Institution; trans-oceanic dispersion of asteroid larvae) and Dr. Robert Woollacott (Harvard University; delay of metamorphosis in sea urchins), before returning to the Pacific coast in 1990, to take a permanent position with the South Slough National Estuarine Research Reserve (NERR; Charleston, Oregon), a 5,000 acre special-use area that is dedicated to long-term research, monitoring, and education about the estuarine environment. Steve concurrently holds academic appointments at the University of Oregon – Oregon Institute of Marine Biology (Associate Professor: Department of Biology) and at Oregon State University (Graduate Faculty: College of Oceanic and Atmospheric Sciences – Marine Resource Management Program).

As the Chief Scientist and Research Program Coordinator for the South Slough NERR, Steve has focused his scientific interests over the past two decades on the dynamics of estuarine ecosystems located at the interface between the land and sea. He conducts ongoing investigations of physical and biotic interactions between Oregon estuaries and the nearshore Pacific Ocean, and is a contributing member of the science team that studies upwelling and hypoxia along the Oregon continental shelf. Steve worked with his colleagues throughout the United States to initiate the NERR System-Wide Monitoring Program (SWMP; 1995–2009+) to document short-term variability and long-term changes in estuarine conditions, including nutrient loading, seasonal changes in oceanic and watershed delivery systems, and detection of eutrophication.

He has conducted numerous investigations of the ecology and restoration of eelgrass beds (*Zostera marina*) and their associated communities in Pacific Northwest estuaries, and he collaborates with commercial shellfish growers and natural resource agencies to determine the best management practices for mariculture of Pacific oysters in eelgrass habitats. Steve recently started a new program to restore and recover populations of native Olympia oysters (*Ostrea*



lurida) in Coos Bay and other Oregon estuaries, and to document interactions between the oysters and non-indigenous invertebrates. He has participated as a member of numerous graduate student thesis advisory committees, and he currently serves on the West Coast Governors' Integrated Ecosystem Assessment Action Team (Chairman), the NERR System-Wide Monitoring Program Guidance Committee (Chairman), the Governing Council to the Northwest Association of Networked Ocean Observing Systems, the California Marine Life Protection Act Science Advisory Team, the Pacific Estuarine Research Society (President), and the Oregon International Port of Coos Bay Technical Advisory Committee (Chairman). Steve recently helped to complete a synthesis of marine science needs along the coastlines of Washington, Oregon, and California, and he is a co-author of the U.S. West Coast Marine Research and Information Plan (2009).

Steve has been a member of PICES MEQ Committee since 2007. As the new Chairman, he looks forward to the opportunity to work with his PICES colleagues to promote and coordinate interdisciplinary studies on the ecology of harmful algal blooms, to investigate the environmental aspects of finfish and shellfish mariculture operations, to investigate the transport and ecological impacts of non-indigenous species introductions, to document the sources and fates of contaminants in North Pacific marine ecosystems, and to help advance international collaborations and progress toward ecosystem-based management. Steve foresees that work-tasks on the immediate horizon for MEQ include a revision of the MEQ Action Plan adopted in 2006, and coordination of studies of coastal anthropogenic influences throughout the northern Pacific Ocean that will add to the Science Plan of the PICES integrative science program, FUTURE.

Mitsutaku Makino was born in 1973 in a small coastal village near Karatsu on Kyushu Island, Japan. His father worked in a pearl farming company, and Mitsutaku's early life in this local fisheries community formed a part of his personality as well as his professional interests today.

Entering the Department of Fisheries at Kyoto University in 1992, he studied fisheries oceanography, resource management, and fisheries economics. After getting an M.Sc. degree from the University of Cambridge in 2000, he received his Ph.D. for the institutional and economic

analyses on the snow crab fisheries in Japan from Kyoto University in 2003.

During his student days in Kyoto, he leaned to play the Shakuhachi flute, which is a Zen Buddhist's ascetic training instrument made of bamboo. He was conferred mastership from his Shakuhachi mentor and got a musician name "Taku-Sui (琢水)", in which one Chinese character is inherited from his mentor's name "Ro-Sui (蘆水)". Also, he found his better half, Mikako, at a student concert of Japanese traditional music. She plays Koto, a Japanese harp.

Mitsutaku began his professional career at the Yokohama National University as a post-doc researcher. Then, in 2005, he joined the Fisheries Research Agency of Japan and was assigned to the Fisheries Management Section at the National Research Institute of Fisheries Science at Yokohama. His research subjects range from the small-scale artisanal fisheries collecting sea cucumber to the large-scale offshore purse seiners catching sardine and mackerels. Also, he has been an active member of the Scientific Committee of the Shiretoko World Natural Heritage, and has contributed to the planning process for the ecosystem-based management in the heritage area. Based on this experience, he became a member of the PICES Working Group on *Ecosystem-based Management Science and its Application to the North Pacific* (WG 19) and a member of MEQ. Mitsutaku is also appointed to chair a new Study Group on *Human Dimensions*, which is expected to review the role of social sciences practices in ecosystem-based management.

FUTURE Program

Following the adoption of the Implementation Plan for the new PICES integrative science program on "Forecasting and Understanding Trends, Uncertainty and Responses of North Pacific Marine Ecosystems" (FUTURE), three Advisory Panels: Anthropogenic Influences on Coastal Ecosystems (AICE-AP), Climate, Oceanographic Variability and Ecosystems (COVE-AP) and Status, Outlooks, Forecasts, and Engagement (SOFE-AP) were established to provide continuing direction, leadership, coordination, and synthesis within PICES toward attaining the FUTURE goal. At PICES-2009, Dr. Thomas Therriault (Canada), Dr. Hiroaki Saito (Japan) and Mr. Robin Brown (Canada) were appointed as Chairmen of AICE-AP, COVE-AP and SOFE-AP, respectively.

Thomas Therriault was born and raised in southwestern Ontario, Canada. Pursuing his interest in biological sciences, Tom received his B.Sc. in Biology from Wilfrid Laurier University in 1993, where his honour's thesis explored the ecology and distribution of the introduced Chinese mystery snail (*Cipangopaludina chinensis malleata*). In 1996, he completed his M.Sc. at the Memorial University of Newfoundland in St. John's, where his research was focused on modelling the mercury concentration increase in fish species of differing trophic levels following reservoir impoundment. He earned his Ph.D. in 2000 from McMaster University. His doctoral thesis was on environmental and temporal determinants of community variability using natural aquatic microcosms, research that was conducted at



Recently, Mitsutaku became interested in seafood cooking. Almost every weekend, he stands in the kitchen after finding fresh seafood at a local seafood market or Yokohama Fisheries Cooperative Association. He is now trying to learn how to prepare seafood from cookbooks. His dishes are not very delicious at the moment, but his wife likes them very much.

the Discovery Bay Marine Laboratory in Jamaica. Upon earning a Natural Sciences and Engineering Research Council (NSERC) postdoctoral fellowship, Tom shifted his research focus to invasion biology, and worked as a post-doc at the University of Windsor's Great Lakes Centre for Environmental Research. There, he developed and applied different molecular techniques to better understand invasion dynamics. In 2002, Tom moved to the Fisheries and Oceans Canada's Pacific Biological Station in Nanaimo, British Columbia. His initial projects dealt with characterizing and understanding the ecological role of several forage fish species, including Pacific herring, eulachon and surf smelt. More recently, his research shifted to non-indigenous (invasive) species. Through the

Department of Fisheries and Oceans (DFO), he has several on-going projects related to risk assessment, research on priority species (e.g., European green crab, tunicates, including *Didemnum vexillum*), monitoring new and existing introductions, and development of rapid response plans. Tom is also an active researcher and scientific committee member of the Canadian Aquatic Invasive Species Network (CAISN) and DFO's Centre of Expertise for Aquatic Risk Assessment (CEARA).

Tom's involvement in PICES activities started in 2006 when the Working Group on *Non-indigenous Aquatic Species* (WG 21) was formed under the direction of Fishery Science (FIS) and Marine Environmental Quality (MEQ) Committees. With a voluntary contribution provided by the Government of Japan in 2007 for a PICES project entitled "*Development of the prevention systems for harmful organisms' expansion in the Pacific Rim*", Tom launched a Taxonomy Initiative to better characterize and understand the distribution and dynamics of non-native species in the North Pacific. This initiative will help identify the taxonomic needs of each PICES member country and ultimately lead to the development of taxonomic information systems and tools that can be applied both within the PICES arena and beyond. Specific research

activities include rapid assessment surveys for native and non-native species, and collector surveys to characterize the distribution of fouling organisms.

During his non-working hours, Tom enjoys spending time with his wife and two children, and like any good Canadian curls in the winter.



Dr. Hiroaki Saito is the Chief of the Biological Oceanography Section at the Fisheries Research Agency's Tohoku National Fisheries Research Institute (TNFRI) in Shiogama, Japan. He received his B.Sc. and Ph.D. in Agriculture from the Tohoku University.

Hiroaki was born and raised in Fukushima, Japan. During his childhood, Hiroaki often went to the country where his grandparents lived, and enjoyed collecting insects, fishing carps and crawfish, harvesting rice and fruits, finding brilliant stones and fossils, and developed a unique eye for nature. During his undergraduate years in the mid-to-late

1980s, Hiroaki enjoyed the peculiar circumstances of the economic bubble in Japan, and spent many nights for parties, but finally tired of frolics. It was at that time when he received a course of lectures on oceanography from Professor Satoshi Nishizawa, and met friendly but quite hardworking graduate students in the Oceanography Laboratory at the Tohoku University. He learned a true attitude to science in this period.

Hiroaki started his career at the Hokkaido National Fisheries Research Institute in Kushiro, working for the resource management of squid for 3 years, and then moved to the Biological Oceanography Section as a research scientist. He is one of the establishing members of the A-line monitoring programme and has been serving this line for over 20 years. In Hokkaido, he studied mainly biology and ecology of copepods and their roles in fish population dynamics.

After his Hokkaido period, interrupted for a year by stay at the Danish Institute for Fisheries Research as a guest scientist to join the PROVESS (Processes of Vertical Exchange in Shelf Sea) project, Hiroaki moved to Shiogama in 2001. Although he studied various scientific issues on nutrient and plankton dynamics in marine ecosystems, all these studies are related to his interest on the role of organisms in the marine ecosystem and biogeochemical dynamics. Since moving to TNFSI, he has led extensive research projects, such as DEEP (Deep Sea Ecosystem Exploitation programme, 2002–2006), SPINUP (Study for Plankton and Iron Dynamics in the western

Subarctic Pacific, 2003), and SUPRFISH (Studies on Prediction and Application of Fish Species Alternation, 2007–2012). He was also a core member of a series of meso-scale iron fertilization experiments in the subarctic Pacific, Subarctic Pacific Iron Experiment for Ecosystem Dynamics Study (SEEDS-I and SEEDS-II) and Subarctic Ecosystem Response to Iron Enrichment Study (SERIES), which were recommended by the PICES Advisory Panel on *Iron Fertilization Experiment in the Subarctic Pacific Ocean*.

Hiroaki has been involved in IMBER (Integrated Marine Biogeochemistry and Ecosystem Research), an IGBP/SCOR core project, from the planning stage, and served as a member of the IMBER Scientific Steering Committee and the Chairman of IMBER-JAPAN from 2004–2008. He began his association with PICES in 1994, attending the

Third PICES Annual Meeting in Nemuro, Japan. Later, Hiroaki served as a member of the MODEL Task Team, Advisory Panel on *Iron Fertilization Experiment in the Subarctic Pacific Ocean*, Study Group on *Future Integrative Scientific Program(s)* and the FUTURE Science Plan Writing Team, and as Co-Chairman of the FUTURE Implementation Plan Writing Team. He is also an active member of the Biological Oceanography Committee and Working Group on *Iron Supply and its Impact on Biogeochemistry and Ecosystems in the North Pacific Ocean*. At PICES-2009, Hiroaki was appointed Chairman of COVE-AP. He is very excited at starting the new PICES science program as FUTURE's science largely overlaps with his research interests, and because he believes serious effort to answer the key questions of FUTURE is one of the obligations for scientists in the Anthropocene.



Robin Brown is the Manager of the Ocean Science Division of the Fisheries and Oceans Canada's Science Branch, located at the Institute of Ocean Sciences in Sidney, British Columbia. This is the institution that is

usually referred to informally as "Club Fed", due to its picturesque location on Patricia Bay. Robin is really old and has been at the ocean science game in various jobs for 32 years. In his attempt to find steady work, he has worked in biological, chemical and physical oceanography, studying marine bugs, water properties, currents, waves and sea ice. He has worked in the North Pacific, the Arctic and the North Atlantic. Along the way, he has dabbled in remote sensing and data management. In 1999, he was declared unfit for any real productive work and immediately promoted to management. He is responsible for a team of 70 scientists and technicians whose work is focused on the coastal waters of British Columbia, the North Pacific and the Arctic.

Robin has been involved in PICES activities since the inception of the Organization and served as a member and Chairman of the Technical Committee on Data Exchange, Chairman of the Study Group on *Ecosystem Status Reporting*, and a member of the Finance and Administration Committee.

PICES Interns



We offer sincere thanks to Mr. Yongling Zhu (left), the 2009 PICES intern from the Second Institute of Oceanography of the State Oceanic Administration (Hangzhou, PR China), who will complete his term at the PICES Secretariat in February. We appreciate his dedicated work during this past year and wish him a successful career.

We are glad to announce that Ms. Tatiana Semenova (right) will join the Secretariat in March as the 2010 PICES Intern. She graduated from the Institute of International Studies at the Far Eastern State University and has worked at the International Department of the Pacific Research Fisheries Centre (TINRO-Centre) in Vladivostok, Russia, since 2007. We look forward to her involvement in PICES activities.

The State of the Western North Pacific in the First Half of 2009

by Shiro Ishizaki

Sea surface temperature

Figure 1 shows the monthly mean sea surface temperature (SST) anomalies in the western North Pacific from January to June 2009, computed with respect to JMA's (Japan Meteorological Agency) 1971–2000 climatology. Monthly mean SSTs are calculated from JMA's MGDSSST (Merged satellite and *in-situ* data Global Daily SST), which is based on NOAA/AVHRR data, microwave sensor (AQUA/AMSR-E) data and *in-situ* observations. Time series of 10-day mean SST anomalies are presented in Figure 2 for the 9 regions indicated in the bottom panel.

From January to April, SSTs were above normal in the area east of the Philippines, but SST anomalies turned negative in May. In the South China Sea, positive SST anomalies exceeding +1°C appeared in March, and negative SST anomalies exceeding -1°C were found in May and June. In January, positive SST anomalies exceeding +1°C were found in the seas southeast of the Kamchatka Peninsula. In April and May, SSTs were below normal in the seas east of the Kamchatka Peninsula. In February and March, SSTs were above normal in the region south of Japan, the East China Sea and the Sea of Japan. In June, negative SST anomalies prevailed in the seas around Japan.

Kuroshio and Oyashio

Figure 3 shows a time series outlining the location of the Kuroshio path from January to June of 2009, at intervals of 10 days. The Kuroshio took an offshore non-large-meander path far off the coast to the south of Honshu Island (between 135°E and 140°E). Its southernmost position in relation to Honshu Island was generally around the Izu Ridge (about 140°E). Except in the middle of April, it flowed south of Hachijo Island (33°N, 140°E).

Figure 4 presents the subsurface temperatures at a depth of 100 m in the seas east of Japan for April 2009. This chart is based on the numerical ocean data assimilation system (JMA's Ocean Comprehensive Analysis System).

The Oyashio cold water (defined as areas with temperatures of less than 5°C in Fig. 4) is known to extend southward in spring and return northward from summer until autumn (indicated by the green line in Fig. 5). It can be seen that from March to May of 2009, the coastal branch of the Oyashio cold water was located significantly north of its normal position. Its southernmost point in April was 40.5°N, 143.0°E, which is 200 km north of its normal location.

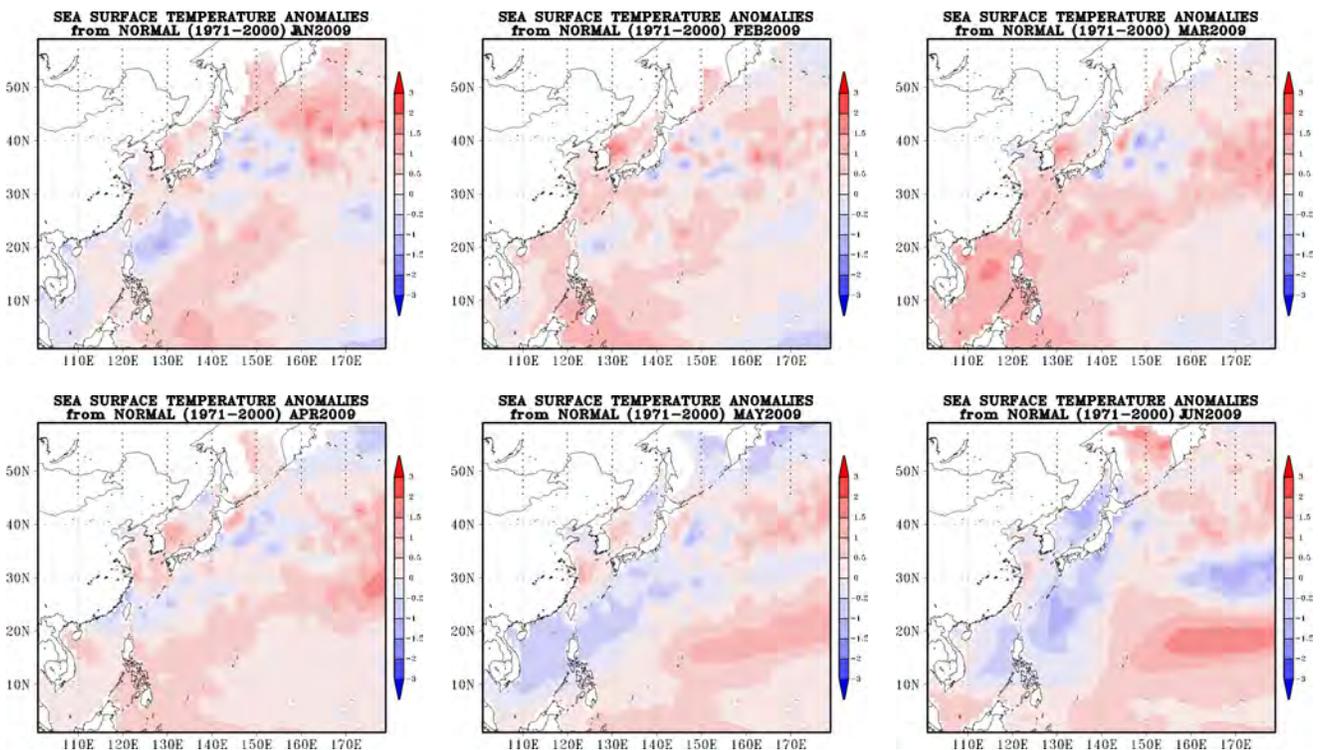


Fig. 1 Monthly mean sea surface temperature anomalies (°C) from January to June 2009. Anomalies are deviations from JMA's 1971–2000 climatology.

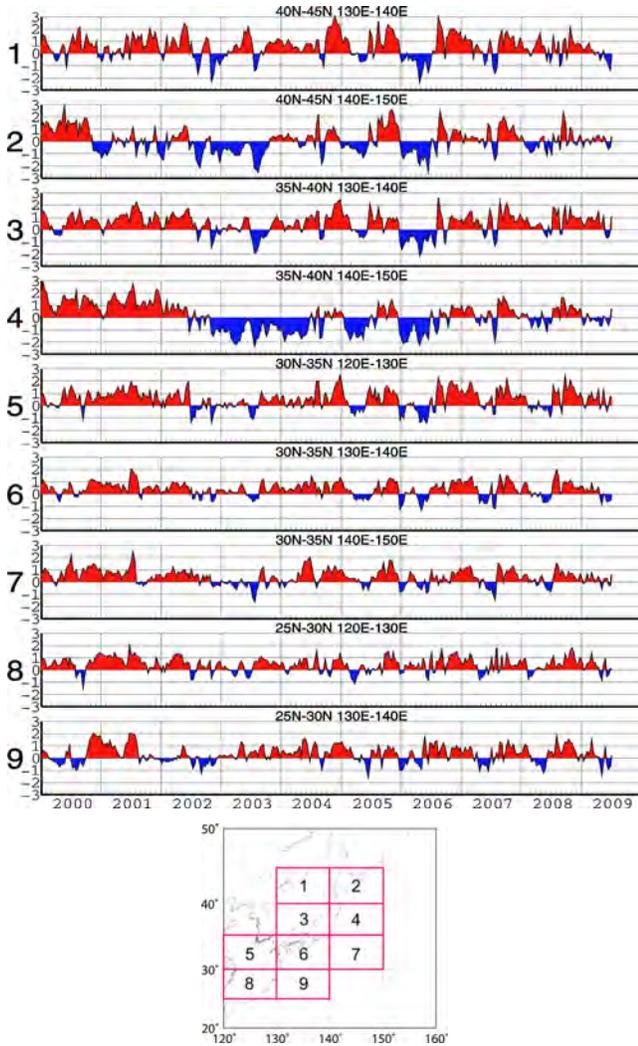


Fig. 2 Time series of 10-day mean sea surface temperature anomalies (°C) averaged for the sub-areas shown in the bottom panel. Anomalies are deviations from JMA's 1971–2000 climatology.

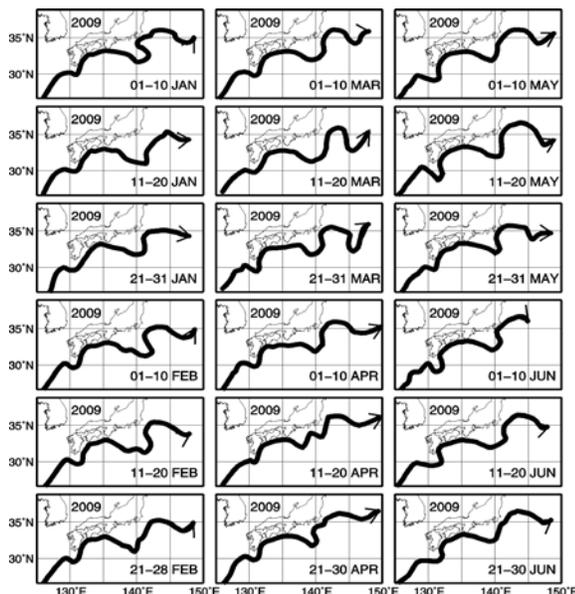


Fig. 3 Location of the Kuroshio path from January to June 2009.

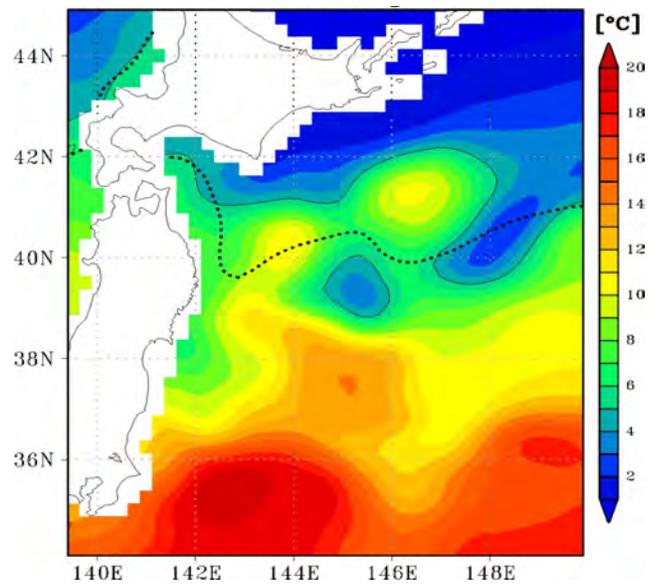


Fig. 4 Subsurface temperatures (°C) at a depth of 100 m east of Japan for April 2009. The solid line denotes the 5°C isotherm, while the dotted line is its climatology (30-year average values from 1971 to 2000).

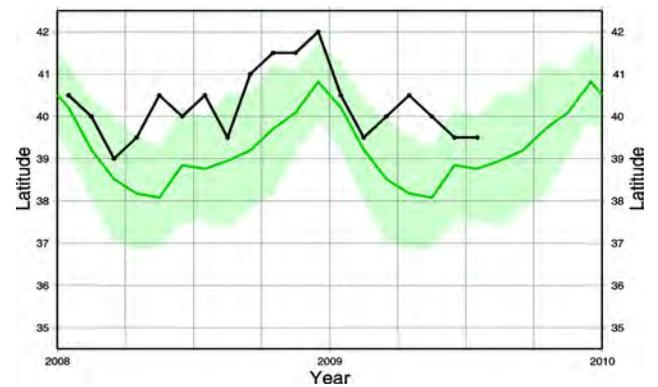


Fig. 5 The southernmost position of the coastal branch of the Oyashio cold water from January 2008 to July 2009 (black line), and the 30-year average values (green line), with a range of one standard deviation (green shading) from 1971 to 2000.

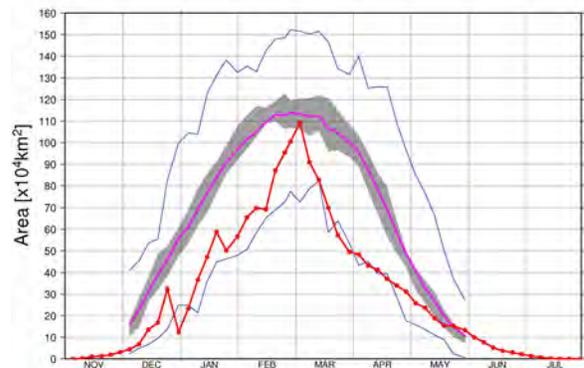


Fig. 6 Time series of sea ice extent in the Sea of Okhotsk from November to July 2009 (red line: 2008–2009 analysis; pink line: JMA's 1971–2000 climatology; blue lines: maximum/minimum sea ice extent since 1971; gray area: normal range).

(continued on page 27)

The State of the Northeast Pacific in 2009

by William Crawford, David Mackas, William Peterson and Skip McKinnell

The beginning of 2009 brought La Niña conditions back to the equatorial Pacific and to the Northeast Pacific Ocean, maintaining the pattern of cool ocean surface temperatures along the Canadian and U.S. and Alaskan coasts (Fig. 1a). In general, a La Niña sets up a basin-scale wind pattern that brings cooler than normal surface waters to the coastal Northeast Pacific. With the relaxation of La Niña and the onset of an El Niño pattern from April to July 2009, equatorial and Northeast Pacific coastal waters warmed through the boreal spring (Fig. 1b).

Zooplankton surveys of the Vancouver Island continental margin were done in June and September 2009. Continuing the “cool ocean” pattern from 2008, the June 2009 samples contained above average abundances of large “cool water” species (e.g., copepods *Calanus marshallae*, *Neocalanus plumchrus*, and *N. cristatus*; euphausiids *Thysanoessa spinifera* and *Euphausia pacifica*; chaetognath *Parasagitta elegans*). However, by September, several warm water oceanic taxa had become the community dominants at deeper and more offshore locations along the continental

margin (especially, the doliolid *Doliolletta gegenbauri* off southern Vancouver Island, and the pteropod *Clio pyramidata* off northern Vancouver Island). A cool water crustacean-dominated community remained abundant at more nearshore locations. This combination suggests that the source and delivery path for the warm water zooplankton was by northeastward transport of oceanic surface water during the mid- and late summer.

Hydrographic and zooplankton surveys off central Oregon (Newport) continued on a fortnightly basis throughout the year. Anomalously cold ocean conditions observed throughout 2008 continued into 2009, but only until mid-July (−1°C to 2°C SST anomalies). The Pacific Decadal Oscillation (PDO) turned to positive in August and much of August and September was characterized by +2°C to +3°C SST anomalies, due to onshore transport of oceanic waters. The PDO reverted to negative in November 2009. Regardless, the zooplankton community of the mid-shelf continued to be dominated by cold water neritic copepods (*Pseudocalanus mimus*, *Calanus marshallae* and *Acartia*

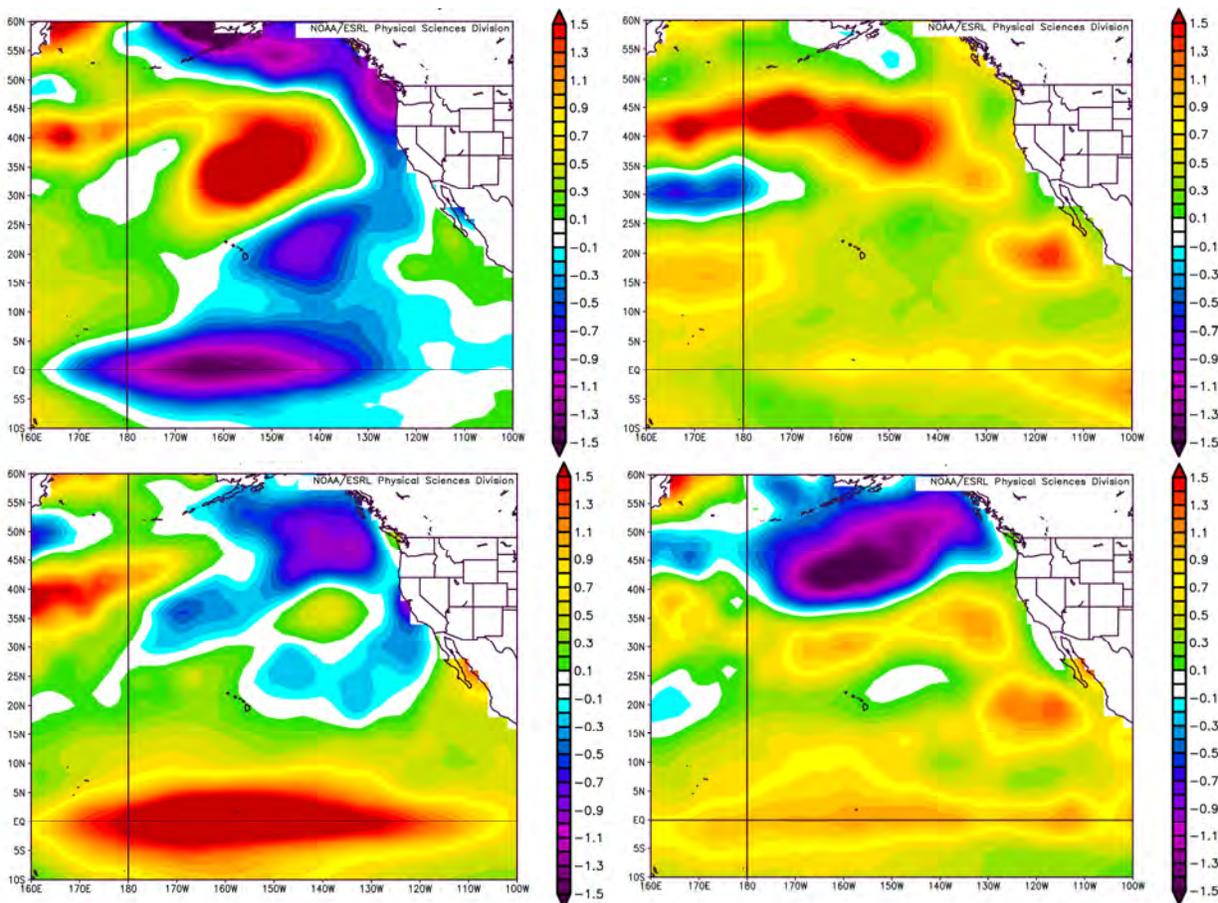


Fig. 1 (Clockwise from top left) Sea surface temperature anomalies (°C) in 2009 for the months of January, June, September and November.

longiremis) through mid-September. As was noted off Vancouver Island, sampling at the continental margin found unusually large numbers of *Dolioletta gegenbauri* in late July. A transition to a warm water neritic community was initiated in mid-September, and by October, the numerically dominant copepod species was *Paracalanus parvus*.

The change observed in August and September may have led to the demise of coho salmon off Oregon, as numbers of juveniles caught during the September salmon survey were the lowest in 12 years of sampling. Among the more common fishes seen in coastal waters during this survey was the ocean sunfish (*Mola mola*). Another unusual event was a bloom of the harmful alga, *Akashiwo sanguinea*, which persisted off Washington and Oregon from September through November. This dinoflagellate was responsible for the deaths of thousands of sea birds along the U.S. West Coast.

Newport, Oregon was the northern extent of a region of reduced average upwelling during the summer of 2009. In southern California, the mean monthly upwelling index in summer was >1 s.e. below normal (Fig. 2, top), while the reverse was true from northern Washington into Canada (Fig. 2, bottom).

By the end of November 2009, ocean temperature anomalies in the Niño 3.4 region in the central equatorial Pacific had been above +0.5°C for five consecutive overlapping three-month intervals, indicating that an “official” El Niño was underway. In general, the west coasts of the U.S. and British Columbia have positive temperature anomalies during the boreal winter of an El

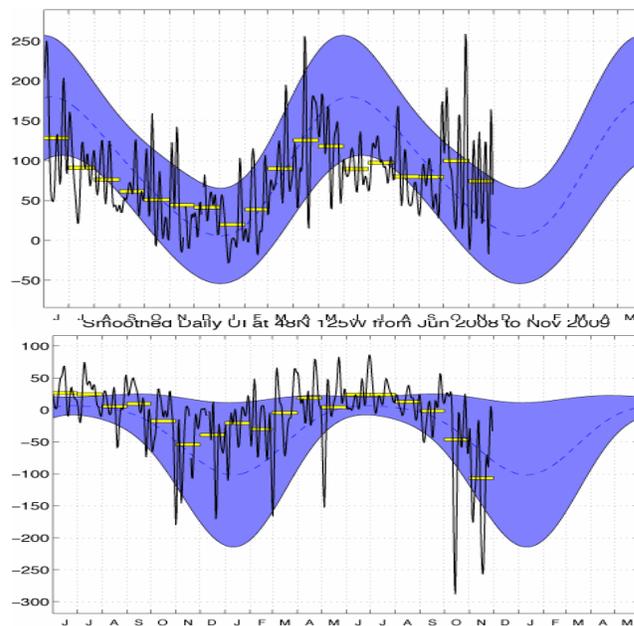


Fig. 2 Solid line is smoothed daily coastal upwelling off (top) southern California, and (bottom) northern Washington from June 2008–November 2009. The dashed curve is a biharmonic fit to the period 1967–1991. The shaded area denotes ± 1 s.e., and the yellow bars denote monthly means (Source: NOAA/PFEL website).

Niño rather than the negative anomalies observed in November 2009. As the winter season begins in December, perhaps it is a little too early to say whether this El Niño is abnormal for the West Coast, but clearly, at the onset of Canadian and U.S. winter, typical El Niño temperatures were not evident.



Left: Dr. William (Bill) Crawford (Bill.Crawford@dfo-mpo.gc.ca) is a Research Scientist with Fisheries and Oceans Canada at the Institute of Ocean Sciences in Sidney, British Columbia. He is co-editor of Canada’s annual State of the Pacific Ocean Report and serves as president of the Canadian Meteorological and Oceanographic Society.

Center left: Dr. David Mackas (Dave.Mackas@dfo-mpo.gc.ca) is a biological oceanographer at the Institute of Ocean Sciences. His research focuses on zooplankton spatial distributions, and (especially lately) on how low-frequency zooplankton temporal variability is linked to ocean climate. Dave has been a member of several PICES standing committees and expert groups.

Center right: Dr. William (Bill) Peterson (bill.peterson@noaa.gov) is an oceanographer and zooplankton ecologist at the Hatfield Marine Science Center in Newport, Oregon. His research focuses on climate effects on zooplankton, particularly euphausiids and copepods, and on forecasting return rates of salmon to their natal streams one year in advance. Bill has served on several PICES expert groups and is currently a member of the Biological Oceanography Committee and Co-Chairman of the Working Group on Comparative Ecology of Krill in Coastal and Oceanic Waters around the Pacific Rim.

Right: Dr. Stewart (Skip) McKinnell (mckinnell@pices.int) is Deputy Executive Secretary of PICES. Among the many things Skip is involved in, his main focus now is on co-editing of the upcoming PICES report on status and trends of the North Pacific.

The Bering Sea: Current Status and Recent Events

by Jeffrey Napp

Current status of the Bering Sea ecosystem

As reported in the previous issue of PICES Press (July 2009, Vol. 17, No. 2, pp. 30–31), the eastern Bering Sea was in its fourth straight year of cool or cold conditions in 2009. The pool of cold water over the eastern shelf during summer extended all the way to the Alaska Peninsula (Fig. 1). A video loop of annual bottom water temperatures for the southeastern shelf can be viewed at <http://www.afsc.noaa.gov/RACE/groundfish/images/eb/btemps.gif>.

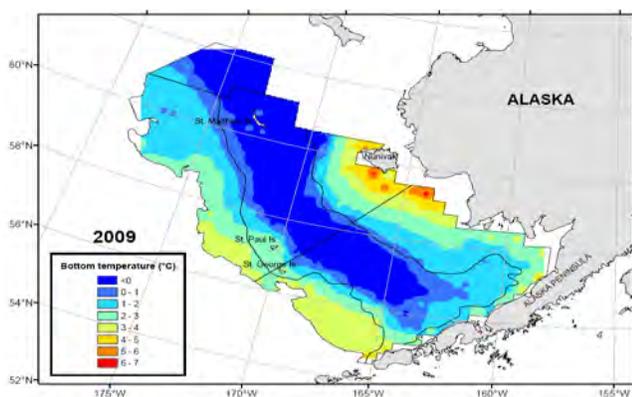


Fig. 1 Bottom water temperature on the eastern Bering Sea shelf sampled during the 2009 NOAA-Alaska Fisheries Science Center (AFSC) summer bottom trawl survey. The cold pool is defined as the water with temperature ≤ 2 °C. Figure courtesy of R. Lauth (NOAA-AFSC).

Late summer/early fall cruises of NOAA’s Ecosystems and Fisheries Oceanography Coordinated Investigations (EcoFOCI) and Bering-Aleutian Salmon International Surveys (BASIS) encountered surface coccolithophorid blooms in the eastern Bering Sea. During the BASIS cruise, the aquamarine waters were seen in the area between 56.7–59.4°N and 165.2–170.7°W from September 11–27. Age-0 walleye pollock relative abundance from surface trawls (0–15 m) was the lowest BASIS has measured for the last seven years; capelin abundance was higher than other years, and juvenile salmon CPUE was low over the southeastern shelf.

The large cold pool in 2009 was the result of early and extensive ice penetration into the southeastern portion of the shelf. While winter 2009 water temperatures were comparable to 2007 and 2008, the maximum depth-averaged summer temperature at the M2 location was almost 2°C colder during 2009 than any other year in the time series, except for 1995 (Fig. 2, top). The trend from 2006 through October of 2009 was for increasingly colder temperatures (increasing negative anomalies) from the mean (Fig. 2, bottom). Comparison of the eastern Bering Sea to other

PICES regions (using synopses from the soon to be published PICES North Pacific Ecosystem Status Report) indicates that this region is one of the few areas that has been colder than average during the last several years.

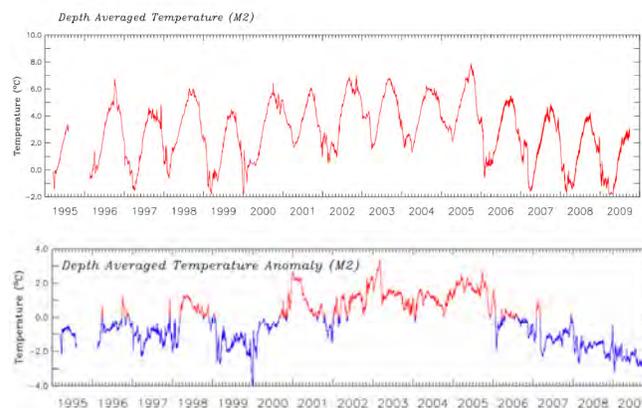


Fig. 2 Depth-averaged water column temperatures (top) and depth-averaged water column temperature anomalies (bottom) measured at NOAA mooring M2 in the southeastern Bering Sea. Figure courtesy of P. Stabeno (NOAA-PMEL, EcoFOCI).

Fall 2009 water temperatures in the eastern Bering Sea were much colder than usual, however, at the time of this writing the marginal ice edge was still well north of the Pribilof Islands. January solid ice cover of 10/10^{ths} began just south of St. Matthew Island. This past fall (October) also saw a historical low in the ice extent for the Arctic (P. Stabeno, pers. comm.). The Arctic waters had high heat content from the previous summer, and ice formation was delayed. This may have also delayed the formation of ice in the northern Bering Sea, by warming the air and winds that blow over the Arctic on their way to the Bering Sea. Sea ice of lesser coverage was pushed south into inner Bristol Bay. In the western Bering Sea, 10/10^{ths} ice covered the Gulf of Anadyr south to about Beringovski, and along the continental shelf off Korjakskoje Nagorje.

Some of the atmospheric conditions and indices that existed during the cool to cold period of 2006–2009 are changing. The Multivariate ENSO Index (MEI) is now positive, although the current moderate El Niño is predicted to weaken to more neutral conditions during the first half of 2010 (<http://meteora.ucsd.edu/~pierce/elnino/elnino.html>). This can be contrasted with the La Niña conditions that existed at the equator during the cool to cold period. The Pacific Decadal Oscillation (PDO) Index was moderately negative from January through July and became positive in August, with another reversal in November. It is currently weakly positive. The Arctic Oscillation (AO) Index became strongly negative in December of 2009, and remained

negative at the time of this writing. This coincided with intrusions of frigid Arctic air into the temperate and subtropical regions of North America and Europe which affected winter holiday travel and food crops. Winter values for the AO Index have not been of this sign and magnitude since the late 1970s (January 1977 = -3.767 and February 1978 = -3.014).

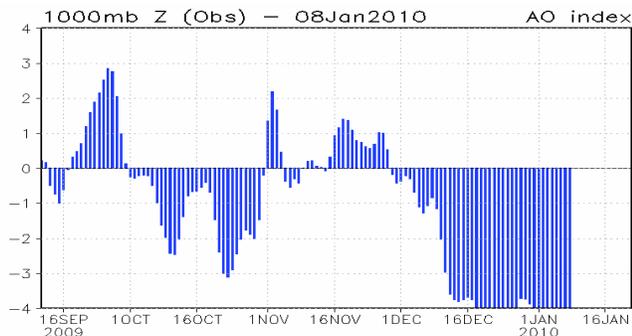


Fig. 4 Daily Arctic Oscillation Index (http://gcmd.nasa.gov/records/GCMD_NOAA_NWS_CPC_AO.html).

2010 Bering Sea field season

This will be the last field year for the current BEST/BSIERP partnership (<http://bsierp.nprb.org>). Due to scheduled maintenance for the USCGC *Healey*, the BEST/BSIERP spring cruise will be later than in the past two years and will be accomplished from the R/V *Thomas G. Thompson*. As in previous years, there will be an early cruise to the ice (USCGC *Polar Sea*, March) and a summer cruise (R/V *Thompson*).

The U.S. intends to expand its annual summer bottom trawl survey into the Northern Bering Sea Research Area this summer (http://www.fakr.noaa.gov/NPFMC/current_issues/ecosystem/NBSRA_files/NBSRA_outline509.pdf). NOAA's Groundfish Assessment Program at the Alaska Fisheries Science Center plans to sample a grid of stations in the northern Bering Sea from approximately St. Matthew Island to the Bering Strait. This area is currently closed to bottom trawling by the North Pacific Fishery Management Council (NPFMC). The survey goals are to: (1) determine baseline (non-fished) conditions, measure the expanded distributions and abundances of species that fall outside the traditional sampling grid of the standard annual survey; and (3) fulfill a research plan requirement from NMFMC. The research plan demands a recurring and systematic standardized bottom travel survey of that region before it

can be determined if the area should be opened to commercial bottom trawling.

Recent developments for the Arctic

Last October, an international symposium on Arctic fisheries was held in Anchorage, Alaska (<http://www.nprb.org/iafs2009>). More than 150 participants from 9 countries spent 3 days listening and contributing to discussions covering the scientific, political, socioeconomic, and cultural issues associated with living marine resources in the Arctic.

The U.S. Minerals Management Service (MMS) is funding multiple projects in the U.S. portion of the Chukchi Sea this summer. The MMS is the U.S. federal agency responsible for the lease of oil and gas rights in territorial waters. A field work coordination meeting is being held at the 2010 Alaska Marine Science Symposium in Anchorage.

Upcoming scientific meetings

There are multiple scientific symposia and workshops occurring in 2010 that will feature research results from the Bering Sea. Among these are:

- Alaska Marine Science Symposium, January 18–21, Anchorage, Alaska, U.S.A.;
- Ocean Science Meeting, February 22–26, Portland, Oregon, U.S.A.;
- State of the Arctic Conference, March 16–19, Miami, Florida, U.S.A.;
- PICES/ICES/FAO Symposium on “Climate Change Effects on Fish and Fisheries”, April 26–29, Sendai, Japan;
- ESSAS (Ecosystem Studies of Sub-Arctic Seas) Annual Science Meeting, August 30–September 2, Reykjavik, Ireland.

ESSAS, now the Regional Program of IMBER (Integrated Marine Biochemistry and Ecosystem Research), is in the process of planning its second Open Science Meeting scheduled for the late spring of 2011 in the Seattle area. It is expected that the date and venue will be chosen by mid-February. Details of the scientific program will be available shortly thereafter.

Acknowledgements: Many thanks to the following PICESans who helped create this report: Drs. Ed Farley, Lisa Eisner, Robert Lauth, and Phyllis Stabeno.



Dr. Jeffrey (Jeff) Napp (jeff.napp@noaa.gov) is a biological/fisheries oceanographer at the Alaska Fisheries Science Center of NOAA-Fisheries. He is Head of the Recruitment Processes Program at the Center and co-leader (with Dr. Phyllis Stabeno) of NOAA's Ecosystems and Fisheries Oceanography Coordinated Investigations (EcoFOCI). His research is focused on physical and biological processes at lower trophic levels that affect recruitment variability in fish populations. He is a Principle Investigator on an NPRB-sponsored Bering Sea Integrated Ecosystem Research Plan (BSIERP) project. In PICES, Jeff is a member of the Technical Committee on Monitoring (MONITOR) and Advisory Panel on the Continuous Plankton Recorder Survey in the North Pacific.

2009 PICES Summer School on “Satellite Oceanography for the Earth Environment”

by Kyung-Ae Park, Kyung-Ryul Kim and Yu-Hwan Ahn

Satellite remote sensing techniques have long been developed to understand the diverse oceanographic and atmospheric processes that are responsible for the current environmental changes on the earth as well as future climate change. The ocean is one of the largest reservoirs of heat on the earth, and it affects our lives by influencing the atmosphere and the earth’s environment through multiple air–sea interactions and feedback mechanisms. To understand and predict the changes in the ocean environment, high-quality earth/ocean observational data and *in-situ* measurements are required. Numerous satellites and sensors have provided us with a large number of measurements of the ocean and earth. Such a tremendous satellite database has enabled us to investigate the spatial structures of oceanic phenomena and their temporal changes over decades. Satellite oceanography requires researchers to possess diverse skills and abilities in the areas of computer programming, high-level mathematics and physics, in addition to in-depth knowledge of the specific subjects involved.

The third PICES international summer school entitled “*Satellite Oceanography for the Earth Environment*” was held from August 25–28, 2009, at Seoul National University, Seoul, Korea. The summer school was sponsored by PICES, the Scientific Committee on Oceanic Research (SCOR),

Research Institute of Oceanography (RIO) at Seoul National University (SNU), East Asian Sea Time-series (EAST-1) project of the Ministry of Land, Transport and Maritime Affairs (MLTM), “Brain Korea 21” Program (BK21), Korea Ocean Research and Development Institute (KORDI), Pukyong National University (PNU), Sea Space Corporation, OTRONIX Corporation, and the Special Monitoring and Coastal Environmental Assessment Regional Activity Center of the Northwest Pacific Action Plan (CEARAC/NOWPAP). The conveners for the summer school were Kyung-Ae Park (Korea), Joji Ishizaka (Japan), Kyung-Ryul Kim (Korea), and Yu-Hwan Ahn (Korea), who comprised the international Organizing Committee, and Sei-Ichi Saitoh (Japan), Sinjae Yoo (Korea), and Junwu Tang (China), who comprised the international Advisory Committee. All summer school materials are posted on the PICES (www.pices.int/meetings/summer_schools/2009_summer_schools/2009-Seoul-ss/2009-Seoul-main-ss.aspx) and SNU (seoul.snu.ac.kr/pices2009/) websites.

The objective of the summer school was to help and motivate postgraduate students, early-career scientists, and other professionals, including those who are new to satellite oceanography, by providing a basic concept and knowledge of remote sensing for advanced applications. The four-day school covered satellites and sensors, and the principles



Students and professors at the third PICES summer school on satellite oceanography at Seoul National University, August 25–28, 2009.

of deriving oceanic parameters from satellite data in three major areas (optical, infra-red, and microwave) of satellite oceanography. The courses involved lectures and hands-on training in satellite data processing techniques, including data calibration, image processing, and examples of case studies on applications. In particular, a part of this summer school was devoted to introducing the first Korean geostationary satellite, “COMS” (Communication Ocean Meteorological Satellite), which was supposed to be launched in the middle of 2009, but its status for further action is still “alert”.

A total of 35 students and early career scientists from 7 countries attended the summer school: 10 from China, 1 from India, 3 from Indonesia, 1 from Italy, 2 from Japan, 2 from Russia, and 16 from Korea. Among the participants, 24 were postgraduate students (16 Ph.D. students and 12 M.Sc. students), 3 were early-career scientists, 3 were undergraduate students, and 1 belonged to a company. Most of the participants majored in physical oceanography, biological oceanography, or earth science. Genki Terauchi and Hidemasa Yamamoto (CERAC/NOWPAP) participated as observers. Genki Terauchi made a great effort to familiarize the students with each lecturer’s career at the beginning of each course. As other observers, 3 students majoring in atmospheric science at Seoul National University were part-time participants in some lectures that interested them, particularly all of Prof. Huang’s lectures.

The summer school consisted of 16 lectures and practical exercises. During the first two days, optical ocean remote sensing was covered, organized by Joji Ishizaka (Nagasaki University, Japan) and Sinjae Yoo (KORDI). During the last two days, the concepts of infrared and microwave remote sensing were covered, organized by Kyung-Ae Park (SNU).

The lectures given on Day 1 included: *Introduction to satellites and sensors for oceanography and principles of ocean optics* by Yu-Hwan Ahn (KORDI), *Methods of ocean color remote sensing* by Junwu Tang (National Ocean Technology Center, China) and *SeaDAS optical data processing I* by Young Baek Son (Nagoya University, Japan). Six SNU students – Kang-Sun Seo, Minseon Lee, Hwa-Jung Chae, Tsi-Sung Kim, Eun-Young Lee, and Bayrasaikhan Uudus – assisted lecturers and students by addressing some hardware and software problems associated with the SeaDAS software and IMAPP (International MODIS/AIRS Processing Package) software during practical exercises. The lectures held on Day 2 were: *Estimation of primary production from space* by Sinjae Yoo, *Monitoring the earth biosphere using ocean color* by Joji Ishizaka, and *Social applications in fisheries and aquaculture using satellite remote sensing and marine-GIS* by Sei-Ichi Saitoh (Hokkaido University, Japan). After a training course on Day 1, a lecture on *SeaDAS optical/IR data processing II* was held by Young Baek Son over the entire afternoon on Day 2. The lectures on Day 3

included: *Sea surface temperature retrievals from multi-satellites and merging methodology* by Kohtaro Hosoda (Tohoku University, Japan), *Sea surface temperature errors and role of satellite scatterometer winds on understanding the earth/ocean environment* by Kyung-Ae Park, and *Multiple and hyper-spectral infrared sensing of SSTs: Theory and laboratory exercises* and *IMAPP software overview and processing* by Allen Huang (Space Science and Engineering Center, University of Wisconsin-Madison, U.S.A.). The lectures on Day 4 were: *NOAA’s satellite remote sensing activities* by Kenneth Casey (National Oceanographic Data Center, U.S.A.), *Overview of infrared radiative transfer theory and modeling* by Allen Huang, *Introduction to COMS MI (Meteorological Imager) sensors and meteorological parameter retrievals* by Mi-Lim Oh (Korea Meteorological Administration), and *Land-ocean interaction study by using remotely-sensed data* by Joo-Hyung Ryu (KORDI).

Before the beginning of the courses, a brief history of satellites and sensors, from visible to microwave, was presented by Yu-Hwan Ahn, who is the Principle Investigator of GOCI (Geostationary Ocean Color Imager) sensor development. This lecture covered the details on how the sensors have been operating and what kinds of products have been generated from multi-satellites and multi-sensors. He started the optical remote sensing session with the principles of ocean optics, which deal with the characteristics of in-water light rays and atmospheric correction. He and his team have wide experience in the development of the first geostationary ocean color sensor, and this seems to have been favorable for helping students to develop a deep understanding of the fundamental ocean optical sensors and related optical theory. Ahn’s lecture was believed to endow students with a challenge of new-generation sensor evolution. In the next lecture, Junwu Tang presented methods of ocean color remote sensing for each data product, and methods for calibrating the ocean color data and determining ocean color variables (e.g., chlorophyll-*a* concentration of phytoplankton). It is believed that when students were given a shortened version of the comprehensive summary of data processing, they gained the most fundamental knowledge on how satellite data could be used for biological oceanography. Subsequently, Young Baek Son covered SeaDAS software and processing of SeaWiFS satellite optical data in advance for the first two days, so that all trainees had a first-hand opportunity to process the SeaWiFS ocean color data. This training course introduced all the aspects and applications of SeaDAS software.

On the following day, optical remote sensing was covered without interruption, with the aim of increasing the students’ interest in primary production estimation from space. Its principles, algorithm development, and related data processing were presented by Sinjae Yoo. With the help of Joji Ishizaka, students were able to gain knowledge on ocean colors that is obtained by navigating through the earth’s biosphere,



Students' whole-hearted participation in lectures given by Dr. Sinjae Yoo (top left) and Dr. Joji Ishizaka (top right); Dr. Joji Ishizaka and students at the Welcome Reception (middle left); Dr. Yu-Hwan Ahn awards a graduation certificate to Mr. Robinson Mugo from Hokkaido University (middle right); a quiz contest during the Farewell Dinner Party (bottom left); and Ms. Susi from Indonesia expressing her joy over receiving a prize as the winner of one of the quizzes (bottom right).

including insights into local and global changes. By obtaining fundamental understanding of data processing and algorithms for the estimation of ocean color variables, students could engage in research on a wide variety of applications such as fisheries and aquaculture using satellite remote sensing methods and a marine GIS (Geographic Information System) technique; their activities were guided by Sei-Ichi Saitoh. Practical exercises conducted by Young Baek Son were followed, covering another utilization of SeaDAS software, this time for infrared data processing.

The central theme on the third day was sea surface temperature (SST), which is one of the most fundamental oceanic parameters to discover and explain oceanic phenomena such as mesoscale eddies, fronts, and distribution of currents. SST, along with other satellite data products like ocean color, sea surface height, and sea surface wind, have provided a key to understanding physical and biogeochemical oceanic processes in space and time. In addition, SST has

played an important role in air–sea interaction and heat flux change as an indicator of abrupt global/local climate change, and has also been utilized as essential input data in air–sea numerical models. The SST session started with Kohtaro Hosota's lecture on how to retrieve SST and merging methodology using near-polar orbit satellite data from the NOAA geostationary satellite of MTSAT-1R and microwave satellite sensor of AQUA/AMSR-E. Since infrared SST products have had serious limitations in terms of temporal coverage and cloud contamination problems, microwave sensor data have been obtained by multi-satellite, multi-sensor merging techniques. However, SST products themselves have had a variety of errors. The characteristics and causes of the errors were described in depth by Kyung-Ae Park. Her lecture started with an introduction to all the procedures for determining SST from the satellite data and covered cloud removal techniques. It also covered the differences between *in-situ* temperature measurements and satellite-observed SSTs, and addressed

the importance of the existence of different kinds of SST measurements, from satellite to bulk temperature observations. Allen Huang guided the trainees through the use of the IMAPP software, developed by his team at Wisconsin University, by presenting all possible methods for handling IMAPP image processing. He also gave a lecture on multiple sensors and hyper-spectral infrared sensing of SST; the lectures involved theory followed by laboratory exercises. Huang also conducted another lecture on the last day, in which he provided an overview of theory and modeling based on infrared radiative transfer theory.

The fourth day began with a lecture by Kenneth Casey who presented an extensive summary of the history of satellites, sensors, and applications developed thus far. Students used this opportunity to learn about NOAA's past, present, and future activities across all satellite oceanographic applications, from visible to microwave wavelengths. Since COMS has two representative sensors, GOCI for the ocean and MI for the atmosphere, Mi-Lim Oh provided students with a summary of information on the COMS MI sensor and 16 products, including the Korean Meteorological Agency's plan of data distribution. The importance of land-ocean interaction was presented by Joo-Hyung Ryu in the form of many case studies, from basic to applied studies, including studies on tidal flats along the western coast of Korea. After the formal courses were completed, one of the participants, La Regina Veronica from Italy, briefly introduced the Cosmo-Skymed system and its applications. A questionnaire was then distributed to all participants for collecting suggestions on improving future summer schools. Overall, the students' responses indicated that the

summer school was well organized and successful. Most of them believed that they had good opportunities to be exposed to the latest knowledge and skills, and learned about new concepts to keep up with the fast progress in satellite data processing methods.

After all the courses and training were completed, a graduation ceremony and a farewell dinner party were held. Certificates signed by the Executive Secretary of PICES (Alexander Bychkov) and three of the conveners (Kyung-Ryul Kim, Yu-Wahn Ahn and Kyung-Ae Park) were given to all students at the end of the school. The students' knowledge and understanding of the lecture content were tested in a quiz contest for which all the lecturers willingly submitted "problems". Small prizes were given to the winner of each question.

Satellite oceanography is one of the most advanced and rapidly progressing fields in the investigation of ocean phenomena. Many countries have formulated a variety of plans on earth monitoring from space and, as a result, progress in satellite oceanography might be even more accelerated. This suggests that more advanced summer schools should be conducted continuously in order to provide a labor force that is skilled in the increasing number of space-related tasks. The summer school on "Satellite Oceanography for the Earth Environment" is believed to be timely and is an important step toward helping the next generation of scientists to comprehend the current status of the earth's environment or ocean environments and predict their future.



Dr. Kyung-Ae Park (kapark@snu.ac.kr) is an Assistant Professor at the Department of Earth Science Education, and Head of the Satellite Remote Sensing Center, Research Institute of Oceanography (RIO), Seoul National University (SNU) in Korea. Dr. Park has been operating a NOAA/HRPT receiving station at RIO/SNU since 1989. Her research focuses on the understanding of physical oceanic processes and air-sea interaction using multi-satellite data and oceanic in-situ measurements.

Dr. Kyung-Ryul Kim (krkim@snu.ac.kr) is a Professor at the College of Natural Sciences, Seoul National University, Korea. His research interests are on chemical tracer studies in the East/Japan Sea and monitoring and diagnosing greenhouse gases in the East Asian region. In PICES, Dr. Kim co-chairs the Advisory Panel for a CREAMS/PICES Program in East Asian Marginal Seas and also serves as a member of the Section on Carbon and Climate and Working Group 22 on Iron Supply and its Impact on Biogeochemistry and Ecosystems in the North Pacific Ocean.

Dr. Yu-Hwan Ahn (yhahn@kordi.re.kr) is a Research Scientist at the Ocean Satellite Research Group of the Korea Ocean Research and Development Institute (KORDI), Korea. His research interests are on ocean color algorithm development and ocean optics.

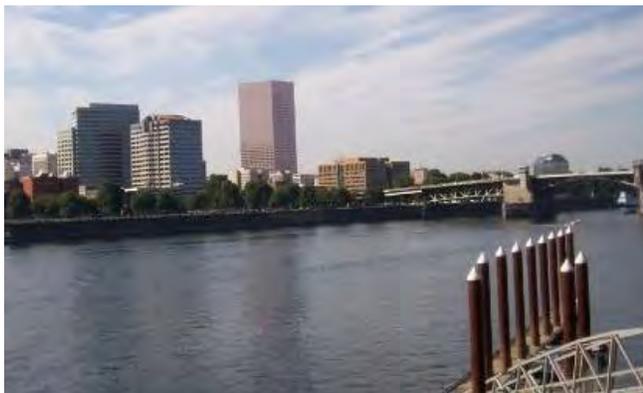
2009 International Conference on “*Marine Bioinvasions*”

by Thomas Therriault

From August 24–27, 2009, about 200 bioinvasion biologists from around the globe descended on Portland, Oregon, U.S.A., to exchange ideas and information at the 6th International Conference on “*Marine Bioinvasions*”. An additional meeting between PICES Working Group on *Non-indigenous Marine Species* and two ICES Working Groups on *Ballast Waters and Other Ship Vectors* and on *Introductions and Transfers of Marine Organisms* held immediately following this conference on August 28, allowed continued discussions about the role and impact of non-indigenous species worldwide, and how these two major regional scientific organizations could work together on this important topic.

The conference Scientific Steering Committee (SSC) was composed of: Jeb Byers (University of Georgia, U.S.A.),

Jeff Crooks (Tijuana River National Estuarine Research Reserve, U.S.A.), Lisa Drake (Naval Research Laboratory, U.S.A.), Anders Jelmert (Institute of Marine Research, Norway), Yoon Lee (National Fisheries Research and Development Institute (NFRDI, Busan, Korea), Whitman Miller (Smithsonian Institution, U.S.A.), Henn Ojaveer (Estonian Marine Institute, Estonia), Gil Rilov (Oregon State University and University of Haifa, U.S.A./Israel), Mark Sytsma (Portland State University, U.S.A.), Thomas Therriault (Department Fisheries and Oceans, Canada), and Chela Zabin (Smithsonian Institution and University of California-Davis, U.S.A.). In addition, the SSC benefited from input of two advisors: Jim Carlton (Williams College, U.S.A.) and Judith Pederson (Massachusetts Institute of Technology Sea Grant College Program, U.S.A.).



The 6th International Conference on “*Marine Bioinvasions*” was held in Portland: downtown Portland across the Willamette River (left) and the Portland Classical Chinese Garden – place for the conference Welcome Reception (right). Located near the confluence of the Willamette and Columbia rivers, Portland has been referred to as the most environmentally friendly or “green” city in the United States, and the second most in the world. In October 2010, Portland will host the 2010 PICES Annual Meeting.

The conference was hosted by the Portland State University, with Mark Sytsma leading the local organizers. Sponsors for the conference were: the North Pacific Marine Science Organization (PICES), the International Council for the Exploration of the Seas (ICES), the Pacific States Marine Fisheries Commission (PSMFC), the Aquatic Bioinvasions Research and Policy Institute at the Portland State University, the U.S. National Sea Grant College Program, and the U.S. National Oceanic and Atmospheric Administration (NOAA).

ICES and PICES supported the three invited plenary speakers at this year’s conference. These were: Dr. Anna Occhipinti-Ambrogi (University of Pavia, Italy), who spoke on alien species as an aspect of global change; Professor Sergej Olenin (Unifob AKSIS, Bergen, Norway and Coastal Research and Planning Institute, Klaipeda University, Lithuania), who summarized patterns and impacts of marine bioinvasions in Europe; and Professor Yoon Lee (NFRDI, Korea), who reviewed marine bioinvasions in Asia.

The conference agenda was an energetic one with two concurrent oral sessions on each of the four days (a total of 127 talks) and a poster session (24 presentations) required to accommodate the increased number of contributed papers over previous meetings. The number of increased contributions reflects increased research activities on non-indigenous marine species around the globe. The conference featured a nice mix of topics, with species-specific sessions focused on lionfish, spartina, and European green crab, vector/pathway specific sessions (*Propagule Pressure*, and *Measuring and/or Predicting Spread*), sessions on applied approaches to non-indigenous species (*Detection, Identification, and Tracking-to-Origin* [including *Advances in Detection*], *Predicting the Scale Diversity of Invasions*, and *Management, Rapid Response, Education, and Restoration*), and sessions that provided insights to broader patterns and implications of non-indigenous species (*Changing Global Conditions and Bioinvasions, Ecology and Evolution*, and *Invasion Patterns over Time and Space*).

In addition to these theme sessions, this year's conference hosted four workshops. The *Green Crab Management* Workshop benefited from input from green crab researchers from around the world to help consider options for management of this high profile invader. Similarly, the participants at the *Invasive Tunicate* Workshop provided input to Washington State's Action Plan to address invasive tunicates in Puget Sound. Workshops on *Spartina/Seaweeds and Shipping Activities* brought together conference participants working in these fields to formulate larger-scale research initiatives that can be conducted in future years. The addition of workshops to the program of the conference was valued by participants.



The Poster Session in front of the Hoffman Hall, Portland State University.

With such a full academic agenda it is important to have a balanced social agenda as well. Conference participants had many opportunities for informal discussions with colleagues and new friends. As with previous conferences on “*Marine Bioinvasions*”, participants were provided breakfast and lunch on site, which allowed more discussion and less travel to seek restaurants off-site. Portland is a very

easy town to get around with free public transportation in the downtown core that allows wider access to shopping, restaurants, and microbreweries. But the real highlight of the conference was the social evening hosted at the Chinese Gardens in the Chinatown District of downtown Portland. These gardens show what can happen when a small group of individuals come together to convert a vacant urban lot to a tranquil and relaxing environment. Participants were even more relaxed when they found out that snacks and drinks were included!

The conferences on “*Marine Bioinvasions*” have always been a place to showcase emerging research in this fast-paced field. Thus, conference organizers and sponsors encourage presentations by early career scientists. This year was no exception. Thanks to contributions from the co-sponsoring organizations, it was possible to provide travel support to all of the graduate students and postdoctoral fellows who requested it. PICES supported the travel of six graduate students (Heidi Gartner, Stephanie Green, Veronica Lo, Lisa Needles, Kimberly Peyton, and Cascade Sorte) and four post-docs (April Blakeslee, Jennifer Dijkstra, Anya Epelbaum, and Joshua Mackie) from Canada and U.S.A.

As a PICES representative on the conference SSC, I would like to express my thanks to the PICES Secretariat for their professional assistance on the conference planning stage, and especially to Julia Yazvenko (PICES Database and Web Administrator) for her valuable help on site.

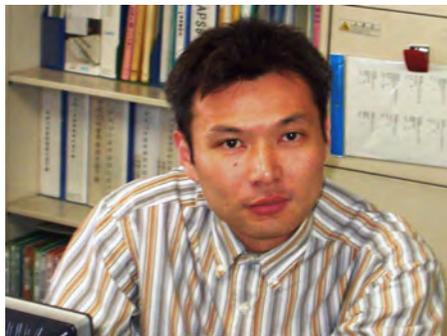
Planning has already started on the 7th International Marine Bioinvasions Conference, so feel free to contact any of the Scientific Steering Committee members, especially your PICES representatives, and watch for further details in future issues of PICES Press.

(continued from page 17)

Sea ice in the Sea of Okhotsk

The extent of sea ice in the Sea of Okhotsk was below normal (30-year average values from 1971 to 2000) throughout almost the whole period from December 2008 to May 2009 (Fig. 6). It reached its seasonal maximum of $109.34 \times 10^4 \text{ km}^2$ on March 5, which was slightly less than

that of the previous season ($110.69 \times 10^4 \text{ km}^2$) exceeding the highest value for the previous season. The accumulated sea ice extent, defined as the sum of the 5-day sea ice areas from December to May, was the second lowest on record since 1971, following the record-setting 2006 extent. Its ratio to the normal value (1971–2000 average of $2568.22 \times 10^4 \text{ km}^2$) was about 64.4%.



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 works 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. Shiro is now involved in developing a new analysis system for temperature, salinity and currents that will be altered with the *Ocean Comprehensive Analysis System*.

A New PICES Working Group Holds Workshop and Meeting in Jeju Island

by Kevin Amos and Katsuyuki Abo

The newly formed PICES Working Group on *Environmental Interactions of Marine Aquaculture* (WGEIMA; WG 24) convened its inaugural meeting and sponsored a workshop at the 2009 PICES Annual Meeting held in October, in Jeju, Korea. This Working Group operates under the auspices of the Marine Environmental Quality (MEQ) and Fishery Science (FIS) Committees.

As marine aquaculture evolves around the world, significant fish and shellfish culture activities are occurring in PICES member countries. Considering that the potential exists for interactions to occur between culture facilities and the surrounding ecosystems, WGEIMA has embarked on an effort to better understand these interactions and assess their risk. Our primary mission is to develop standard methods and tools to assess and compare the environmental interactions and characteristics of existing and planned marine aquaculture activities in PICES member countries. The following action plan (terms of reference) were approved at the formation of WGEIMA:

1. Evaluate approaches currently being used in PICES member countries to assess and model the interactions of aquaculture operations with surrounding environments. (This will involve conducting a comparative assessment of the methodologies, applications, and outputs of different approaches to assess finfish, shellfish, seaweed, and/or integrated multi-tropic aquaculture.)
2. Review and evaluate current risk assessment methods used to assess environmental interactions of aquaculture and determine what, if anything, should be changed for their application in PICES member countries to reflect ecosystem-specific aspects. Following the review and assessment, identify appropriate case studies to compare results among countries in the PICES region. (This will be achieved by holding a workshop in the second or third year to compare and discuss possible standardization of methodologies and the selection of potential case studies for assessment with a standardized approach. Functions and responsibilities of the sub-group undertaking this task will be similar to the ICES Working Group on *Environmental Interactions of Mariculture*, so the feasibility of holding a joint meeting with this group will be explored.)
3. Assess methods to detect, identify, evaluate and report on infectious disease events and potential interactions between wild and farmed marine animals. If appropriate, develop a recommended standardized approach for detection/evaluation/reporting from wild and cultured populations. The focus of this activity will be on OIE-notifiable diseases and other infectious diseases of regional/economic importance. (This will

involve discussing and documenting new and emerging infectious diseases in the PICES region, methods for their detection, and developing models to conduct risk assessments of their potential impacts on both endemic wild and farmed species. Functions and responsibilities of the sub-group undertaking this task will be similar to the ICES Working Group on *Pathology and Diseases of Marine Organisms*, so the feasibility to hold a joint meeting will be explored.)

On October 24, WGEIMA held its first major activity – a workshop on “*Interactions between aquaculture and marine ecosystems*” co-convened by Katsuyuki Abo (Japan), Kevin Amos (U.S.A.), Galina Gavrilova (Russia) and Hyun Jeong Lim (Korea). The major objective of the workshop was to discuss tools and models currently used by PICES member countries to evaluate interactions of marine aquaculture and assess the risks of these interactions. Three noted experts were invited to the workshop to share with us their models and research. Dr. Dario Stucchi (Fisheries and Oceans Canada) has been studying how currents, tides, and other oceanographic conditions disperse sea lice larvae from salmon farms to the marine ecosystems in the Broughton Archipelago, British Columbia, Canada. There is concern that lice from salmon farms may be infecting, and subsequently impacting, wild salmon populations, and Dr. Stucchi’s models will be utilized in helping to better understand this potential pathogen interaction.

The fate of effluent and nutrients from marine farms is the focus of *AquaModel* developed by Dr. Jack Rensel (Rensel Associates Aquatic Sciences, U.S.A.). Like Dr. Stucchi’s models, his model explores physical and chemical oceanographic phenomena to determine if and how effluents from fish farms may interact with marine ecosystems. His data suggest that improperly sited farms may have negative impacts while properly sited farms have no impact or possible benefits on nutrient-poor ecosystems.

Dr. Tamiji Yamamoto (Hiroshima University, Japan) has been focusing on effects of culture density on the growth and fecal production of the oyster *Crassostrea gigas* in Hiroshima Bay. His model expresses physiological processes of the oyster as well as physical and chemical oceanographic phenomena. His study has suggested the appropriate cultivation density under the environmental conditions of the Bay.

Many other speakers presented interesting research on various aspects of marine aquaculture, including possible interactions of effluents, pathogens, and genetics. Brief information on all presentations can be found in the Book

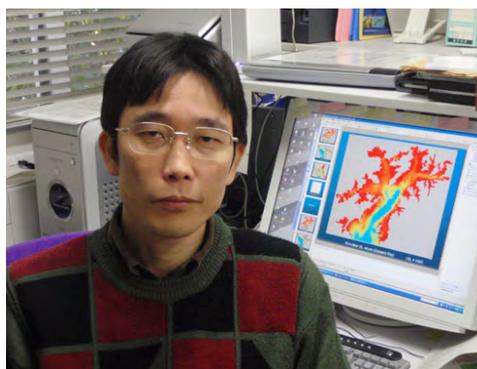


Participants of the WGEIMA workshop and meeting at the end of a field trip, October 25, 2009, Jeju, Korea.

of Abstracts for PICES-2009, along with contact information for each author.

After the successful workshop, WGEIMA held a half-day meeting to discuss the next steps to be taken. In the near term, we will attempt to reach consensus on types/methodologies of aquaculture that have commonality in all PICES member countries and then start to identify and develop risk assessments associated with these technologies. For more details on the meeting please refer to the 2009 PICES Annual Report. Next time, WGEIMA will meet in conjunction with the 2010 PICES Annual Meeting (Portland, U.S.A.), but there will be much interaction among the Working Group members before we gather together again in Portland.

Our activities in Jeju were capped off by an excellent field trip hosted by Korea and organized by Dr. Hyun Jeong Lim. This half-day trip took us first to a flounder aquaculture farm operated by *Bibong Aquaculture*. The flounder were being raised in land-based concrete tanks with seawater being pumped through volcanic rock immediately adjacent to the ocean. Our next stop was an abalone farm operated by *Jeil Hatchery*. Like the flounder farm, this farm was utilizing pumped seawater into land-based tanks. The abalone are fed kelp and take 3 to 4 years to reach market size. Our final stop was a visit to a Korean Culture Park that exhibited the various life styles, dwellings, and historic farming techniques utilized by the Korean natives in the countryside. All participants greatly enjoyed the trip – thanks Dr. Lim!!!



Dr. Kevin Amos (Kevin.Amos@noaa.gov) is the Aquatic Animal Health Coordinator for the U.S. National Marine Fisheries Service. His professional interests include aquatic animal health policy, international commerce of aquatic products, and marine aquaculture. In PICES, Kevin serves as Co-Chairman of the Working Group on Environmental Interactions of Marine Aquaculture. Out of the office you might find Kevin on the golf course or pursuing salmon with a rod and reel.

Dr. Katsuyuki Abo (abo@fra.affrc.go.jp) is a senior researcher at the National Research Institute of Aquaculture, Fisheries Research Agency, Japan. His research focuses on water and benthic qualities of marine aquaculture area, using numerical models to estimate the assimilative capacity. His scientific interest includes modeling study to predict occurrences of harmful algal blooms and oxygen depletion in coastal seas. In PICES, Katsuyuki co-chairs the Working Group on Environmental Interactions of Marine Aquaculture.

The Second Marine Ecosystem Model Inter-comparison Workshop

by Bernard Megrey, Harold Batchelder and Shin-ichi Ito

The objective of the PICES Marine Ecosystem Model Inter-comparison Project (MEMIP) is to compare the performance of various lower trophic level (LTL) marine ecosystem simulation models (Fig. 1) at predicting the abundance and distribution of coastal zooplankton functional groups. Models with high performance (*i.e.*, models that show good agreement between model predictions and observational data) will be used to examine the future state of marine ecosystems, especially their responses to global climate change. Model comparisons at multiple locations will provide information on the spatial-temporal robustness of particular model structures and parameterizations. It will also help estimate the uncertainty and robustness of predictions when we examine the future responses of coastal marine ecosystems to global climate change.

The first MEMIP workshop was held at PICES-2008 in Dalian, China. The second workshop was convened on October 24–25 at PICES-2009 in Jeju, Korea. Twenty-six participants attended the meeting. The first day opened with a brief introduction by Bernard Megrey (U.S.A.) who summarized the accomplishments made in 2008 and set the goals of the workshop. Invited presentations were given by Yvette Spitz (U.S.A.), Angelica Peña (Canada) and Naoki Yoshie (Japan). Yasuhiro Yamanaka (Japan) presented an update on the goals and progress of the European MARine Ecosystem Model Intercomparison Project (MAREMIP), which is an ecosystem model inter-comparison focusing on hindcasting phytoplankton concentrations as measured by the ocean color SeaWiFS and MODIS sensors (<http://lmgmacweb.env.uea.ac.uk/maremip/index.shtml>). The

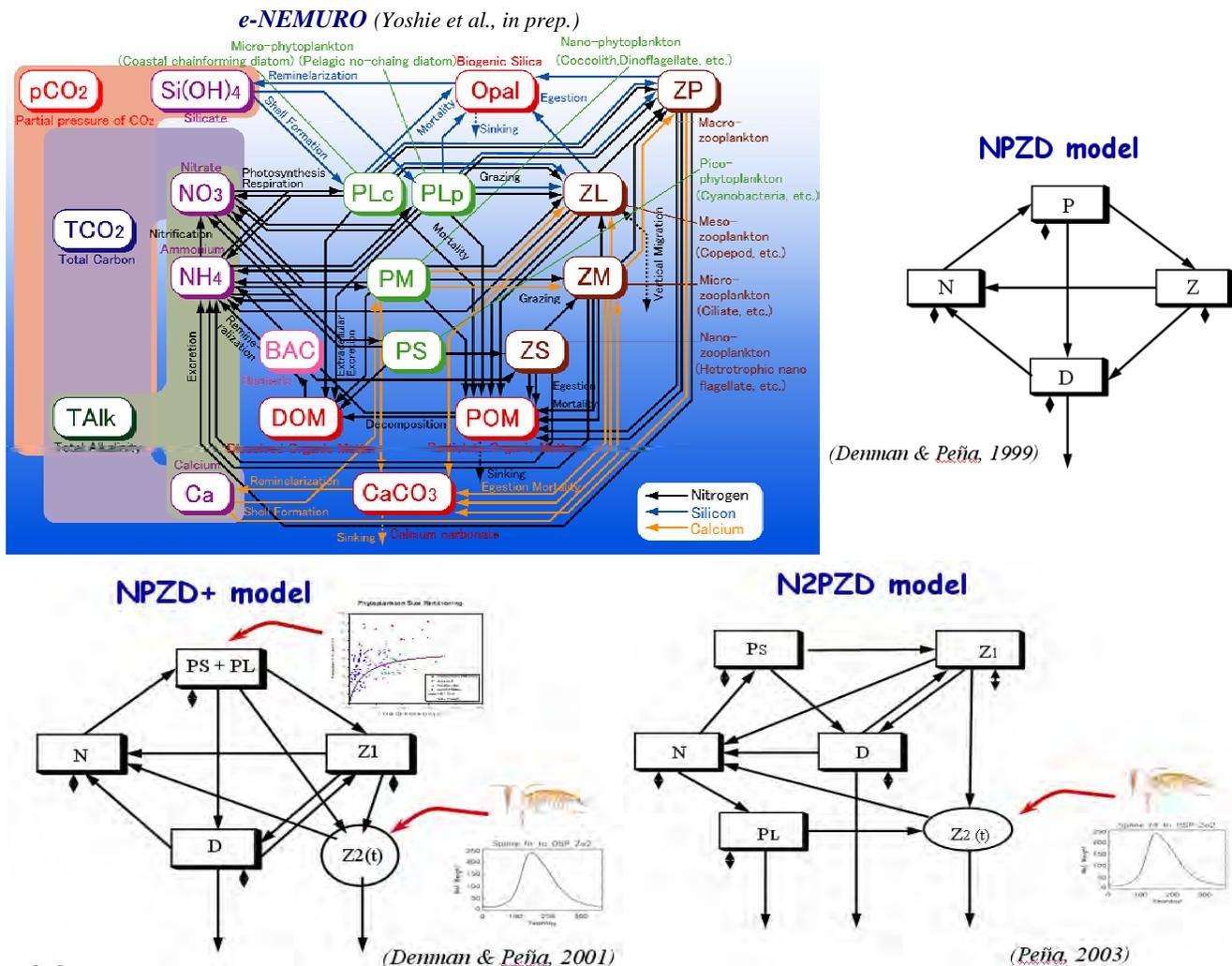


Fig. 1 Alternate representations of lower trophic level marine ecosystem models of various complexity.

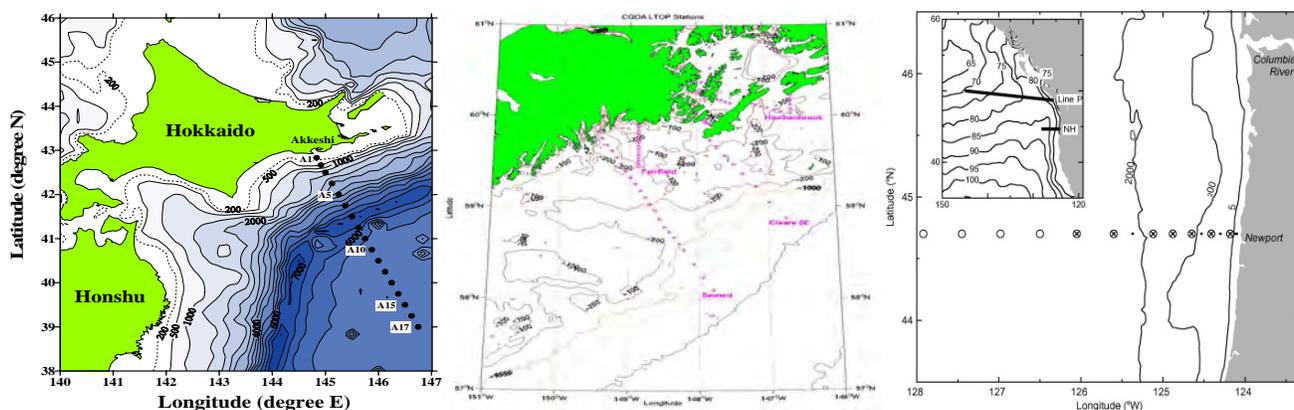


Fig. 2 Maps showing the location of the three MEMIP test bed locations: the A-line off Hokkaido Island, Japan (left), the Gulf of Alaska (GAK) line off Seward Peninsula, northern Gulf of Alaska (middle), and the Newport Hydrographic (NH) line, off Oregon, U.S.A. (right).

goals of MAREMIP and MEMIP seemed complementary and not redundant or duplicative.

Three test bed locations that represented a good spatial contrast across the basin were identified for the North Pacific (Fig. 2). These locations also have exceptional data sets which allow the calibration and validation of marine ecosystem model applications. The model chosen to apply to the test locations will be a 2-dimensional Regional Ocean Modeling System (ROMS) model (transects from the nearshore to stations far from shore, and by depth) coupled with a marine ecosystem model. It was decided that this would best describe coastal upwelling regions which have strong cross-shelf gradients in nutrient supply, primary production and grazer responses. The 2-D ROMS model will not include the influence of alongshore (or 3-D) horizontal advection. The physical model framework is a compromise between what can be accomplished computationally—short of the implementation of a full 3-D ROMS model at each test bed location. The main question for the comparison is “which model representation of the lower trophic levels is the most general (*i.e.*, portable) to multiple locations within the North Pacific basin”.

At the workshop, presentations were also made on the physical and biological characteristics and availability of data for all three test bed locations: for the A-line by Shin-ichi Ito (Japan), and for the GAK line and NH line by Hal Batchelder (U.S.A.). Both presentations used a predefined rubric for comparing the characteristics of the test bed locations with respect to physics, biology and available data. The difference between MEMIP and MAREMIP and other ecosystem model inter-comparison projects, such as Friedrichs *et al.* (*J. Geophys. Res.*, 2007, Vol. 112; doi: 10.1029/2006JC003852), the Ocean Carbon-cycle Model Inter-comparison Project (<http://www.ipsl.jussieu.fr/OCMIP/>), the Coupled Carbon Cycle Climate Model Inter-comparison Project (<http://c4mip.lsce.ipsl.fr/background.html>), and the Ecosystem Model-Data Inter-comparison (<http://gaim.unh.edu/Structure/Intercomparison/EMDI/index.html>) is that MEMIP focuses on the consequences to secondary (zooplankton) production in coastal marine ecosystems, which is very

important to the production of commercial and protected species (*e.g.*, shellfish, finfish, marine mammals). Earlier, ecosystem studies primarily focused on the response of primary producers to different marine ecosystem applications.

Extensive discussions revolved around procedures to conduct controlled execution of the ecological models at the three test locations and issues related to configuring the 2-D ROMS model for each location. Participants also discussed at length the goal of MEMIP and concluded that an assessment and comparison of the generality (portability) of several state-of-the-art ecosystem models would constitute a significant contribution to the goals of the PICES FUTURE integrative science program, and to marine pelagic ecology more generally.

There are several unique aspects of MEMIP. These include: 1) specifically looking at coastal regions of the North Pacific; 2) using zooplankton abundance and distribution as the metric of model skill; 3) providing a direct food-web link to upper trophic levels, and using model investigations as a tool to evaluate the ability of the various models to hindcast biomasses and distributions of zooplankton, in addition to nutrients and phytoplankton chlorophyll. The products of the comparison will contribute to the estimation of the uncertainty and limits of forecasting. In this context, MEMIP will contribute to FUTURE.

A current version of the ROMS model code was retrieved from the ROMS distribution site, and six marine ecosystem models of varying complexity were selected for the comparison. A list of tasks was prepared and several workshop participants agreed to take responsibility of the various identified tasks. The “active team” of this project (*i.e.*, those who agreed to volunteer their time) includes: Hal Batchelder, Shin-ichi Ito, Bernard Megrey, Yvette Spitz, Angelica Peña, Guimei Liu (China) and Naoki Yoshie. Each individual will assume responsibility for executing the marine ecosystem model to a specific test bed location and/or using a specific lower trophic level ecosystem model. A timeline was established for the completion of

specific tasks and to maintain progress toward achieving the goal of MEMIP. Most of the work will occur between PICES Annual Meetings.

A proposal was prepared to hold a follow-up 2-day workshop immediately prior to the 2010 PICES Annual Meeting in Portland, U.S.A. This third workshop will be technical hands-on, and focus on parameterizing, executing and calibrating three test bed versions of biogeochemical LTL marine ecosystem models. Three to six ecosystem models will be run for each location. Specific ecosystem models (*i.e.*, NPZD, NEMURO and CoSINE) will be executed. Some ecosystem models will be tuned to hindcast data from a specific region and be tested by application to the other two North Pacific test beds. An important aspect of MEMIP is that the physical model for each test bed location will be a fixed scenario simulation, so that comparisons of ecosystem model to data, or model to model, will eliminate variability due to differently tuned physical models. Model skill will be assessed quantitatively.

In summary, MEMIP will conduct technical hands-on workshops, apply a consistent biophysical marine ecosystem model to multiple North Pacific locations, use multiple LTL ecosystem model representations, utilize a consistent ocean physics model (using a 2-D version of ROMS) at each site, use early 2000's forcing (2001–2003 in each site), provide qualitative and quantitative skill assessment concerning the models' ability to represent *in situ* data, identify mechanisms that are important controls on the level and variability of secondary production at each test bed site, and bound the levels of uncertainty in model predictions by calculating ensemble statistics. The models will be used to identify processes that are important in controlling secondary production, zooplankton biomass and variability, to bound the levels of uncertainty in model predictions, and to identify processes that are particularly sensitive to change and thereby susceptible to potential future climate variability and change. The products of the comparison will contribute to FUTURE by estimating the uncertainty and the limits of forecasting.

This research is contribution EcoFOCI-0740 to NOAA's Fisheries-Oceanography Coordinated Investigations.



Dr. Bernard Megrey (bern.megrey@noaa.gov) is a research fisheries biologist with NOAA's Alaska Fisheries Science Center where he has worked since 1982. His research involves studying the dynamics of exploited North Pacific fish populations, relationships of the environment to recruitment variability, climate impacts on marine ecosystem production, and application of computer technology to fisheries research and natural resource management. He is Co-Chairman of the ESSAS (Ecosystem Studies of Sub-Arctic Seas) Working Group on Modeling Ecosystem Response, former Co-Chairman of the PICES MODEL Task Team, and current Chairman of the PICES Technical Committee for Data Exchange (TCODE).

Dr. Harold (Hal) Batchelder (hbatchelder@coas.oregonstate.edu) is a professor of oceanography at Oregon State University. He has been the Executive Director of the U.S. GLOBEC Northeast Pacific Regional Coordinating Office since 1998. Earlier in the 1990s, Hal served for 6 years as the Scientific Director of the National U.S. GLOBEC Steering Committee Office. In PICES, he is a member of the Status, Outlooks, Forecasts and Engagement (SOFE) Advisory Panel of the Forecasting and Understanding Trends, Uncertainty and Responses of North Pacific Marine Ecosystems (FUTURE) integrative science program. Prior to that, he was Co-Chairman of the PICES Climate Change and Carrying Capacity Program. He is a zooplankton ecologist and population dynamicist, who spends more time working with models than with living (or even recently deceased) marine critters. His research uses both Lagrangian and Eulerian type models to examine the interactions of plankton populations and physical flow fields.

Dr. Shin-ichi Ito (goito@affrc.go.jp) is Chief Scientist of the Physical Oceanography Section in FRA's (Fisheries Research Agency of Japan) Tohoku National Fisheries Research Institute. Shin-ichi completed his graduate work in Theoretical Physical Oceanography at Hokkaido University and converted to an observational physical oceanographer in FRA. His research includes the development of a fish growth model coupled to the lower-trophic-level ecosystem model NEMURO.FISH (North Pacific Ecosystem Model for Understanding Regional Oceanography For including Saury and Herring). He is Co-Chairman of the ESSAS Working Group on Modeling Ecosystem Response. Within PICES, he was Co-Chairman of the MODEL Task Team and serves now as a member of the Physical Oceanography and Climate Committee (POC), FUTURE SOFE Advisory Panel and joint PICES/ICES Working Group on Forecasting Climate Change Impacts on Fish and Shellfish (WGFCCIFS).

ICES/PICES/UNCOVER Symposium on “*Rebuilding Depleted Fish Stocks – Biology, Ecology, Social Science and Management Strategies*”

by Gordon Kruse

Many fish and invertebrate stocks around the world are severely overfished and many still remain subject to overfishing. Within the PICES region, based on statistics compiled by the Food and Agriculture Organization of the United Nations (FAO), a total of 441 fish stocks have been assessed for exploitation status. Of these, 71% are “fully exploited” or “overexploited, depleted or recovering”. There has been an increasing trend in the percentage of overexploited stocks since 1974.

At the World Summit on *Sustainable Development* held in Johannesburg, South Africa, in 2002, countries from around the world pledged to restore fish stocks to levels capable of supporting maximum sustainable yield by 2015. Supportive of this pledge, the European Union (EU) funded a research project called “UNderstanding the Mechanisms of Stock ReCOVERy (UNCOVER)” to identify the strategies to recover European fish stocks. UNCOVER involves more than 120 scientists from 17 institutes from seven European countries. Research and management to rebuild depleted fish stocks have been important areas of activity in the Northwest Atlantic Ocean portion of the International Council for the Exploration of the Sea (ICES) region, as well. Likewise, in the North Pacific Ocean, rebuilding depleted fish stocks has been a topic of much interest to PICES. In fact, a special issue on “*Ecosystem Approach to Fisheries: Improvements on Traditional Management for Declining and Depleted Stocks*”, stemmed from a Topic Session held by the PICES Fishery Science Committee at our 2007 Annual Meeting (Victoria, British Columbia, Canada), was published in the journal *Fisheries Research* in September 2009 (Vol. 100, Is. 1). Effects of fishing and climate on the status of fish stocks and marine ecosystems are key components of our new science program called FUTURE, “*Forecasting and Understanding Trends, Uncertainty and Responses of North Pacific Ecosystems*”. In the past few years, multiple sessions were convened at PICES Annual Meetings on assessing and managing fishing effects on fish stocks through ecosystem approaches, including managing bycatch and ecosystem effects of fishing. PICES efforts on ecosystem approaches to fisheries involve the need to rebuild fish stocks and manage them for sustainability.

ICES, PICES, and UNCOVER forged a collaboration to co-organize a symposium on “*Rebuilding Depleted Fish Stocks – Biology, Ecology, Social Science and Management Strategies*” held from November 3–6, 2009, at Warnemünde, Germany. Dr. Gordon Kruse (U.S.A.) served as the PICES co-convenor and Dr. Toyomitsu Horii (Japan) served as a PICES member of the Scientific Steering Committee. The

host organizer institute was the Institute for Baltic Sea Fisheries, Johann Heinrich von Thünen-Institute (vTI), Federal Research Institute for Rural Areas, Forestry and Fisheries, Rostock, Germany. This institute is also the coordinator of the UNCOVER project. In addition to the EU, ICES and PICES, the symposium was co-sponsored by several research institutions or programs including vTI, Fisheries and Oceans Canada, Institute of Marine Research (Norway), North Atlantic Fisheries Organization (NAFO), and the Fish Reproduction and Fisheries (FRESH) program of the European Cooperation in Science and Technology (COST).

Research scientists, managers, policy-makers and other stakeholders were invited to present and discuss the recent status and strategies for the recovery of overexploited fish stocks. Papers on biological and ecological modeling, socio-economic and management aspects were sought. By exchanging information from ICES and PICES regions and other areas of the world, the symposium was designed to advance knowledge on how to achieve sustainable fisheries, as well as to serve as a forum to exchange ideas and views across disciplines and between scientists, the fishing industry and managers.



The small port town of Warnemünde, Germany, hosted the symposium. Located on the Baltic Sea, Warnemünde is known for shipping, shipbuilding and fishing.

The venue for the symposium was Warnemünde, Germany, an old picturesque village situated on the coastline that featured both sandy beaches and steep cliffs. The village is located at the mouth of the Warnow River, which is a major gateway to the Baltic Sea for cargo vessels, passenger ferries and fishing boats. Warnemünde is a portion of the old Hanseatic city of Rostock, which is known for its city wall, gothic brick architecture, and gabled houses.

The symposium was convened over four days, starting on Tuesday, November 3, 2009. Welcoming addresses were delivered by representatives from the three co-organizers, Dr. Cornelius Hammer (UNCOVER project coordinator and Director of the host institution), Dr. Gerd Hubold (General Secretary of ICES) and Dr. Gordon Kruse (Vice-Chairman of the PICES Fishery Science Committee). The symposium keynote lecture titled "*Rebuilding depleted fish stocks: The good, the bad and the mostly ugly*" was given by Dr. Steven Murawski, Director of Scientific Programs and Chief Science Advisor for the U.S. National Oceanic and Atmospheric Administration (NOAA). He categorized rebuilding plans as those that met their stated objectives (the "good"), those that remain "paper plans" despite assertions to the contrary (the "bad"), and those that have only been partially to completely unsuccessful despite significant management actions (the "ugly"). Attributes of successful plans were identified: consistent definition of plan objectives, support by industry, political leadership, and the public, and credible and consistent scientific monitoring of progress. Many of these successful plans also incorporate fishers into the scientific process.



The symposium keynote lecture by Dr. Steven Murawski, Director of Scientific Programs and Chief Science Advisor for the U.S. NOAA.

The symposium was structured in topical sessions. A full day Theme Session 1 dealt with the "*Impact of fisheries and environmental impacts on stock structure, reproductive potential and recruitment dynamics*". It was co-chaired by Drs. Tara Marshall (Scotland) and Toyomitsu Horii (Japan). The session's subtitle became "*Yes we can!*" (rebuild fish stocks). The motto was intended to be somewhat provocative and challenging to symposium participants.

Throughout this session in particular, and the symposium in general, it became apparent that many stocks can be and have been recovered by implementation of rebuilding plans. However, it also became apparent that others failed to recover, despite implementation of rebuilding plans, including extended periods of low fishing mortality. In some cases, climate regime shifts and associated ecosystem reorganizations have delayed the restoration of overfished stocks under rebuilding plans. Presentations in the session addressed the role of spatial processes in reproduction and recruitment, fishery-induced impacts on stock structure and reproductive potential in sexually dimorphic species, and influence of life history traits, age structure, migration dynamics and fishery-induced evolution on stock rebuilding.

A half-day Theme Session 2 on "*Trophic controls on stock recovery*" was co-chaired by Drs. Axel Temming (Germany) and Bjarte Bogstadt (Norway). This session focused on multispecies interactions, such as the role of predator-prey relationships, cannibalism and competition. Cannibalism was proved to be a significant factor affecting population dynamics of two gadid species, southern hake and Atlantic cod. It was shown that, when the capelin (prey) stock is large, the cod (predator) stock can withstand higher fishing pressure in the Barents Sea. One presentation revisited the role of cod-seal interactions on the lack of recovery of cod from the Northwest Atlantic. It concluded that seals accounted for an increasing proportion of total mortality on cod since the fishery closure in 1993, likely contributing to the lack of cod stock recovery. Mechanisms reported in this session provided explanations for the failure of some plans to rebuild depleted fish stocks.

A half-day Theme Session 3, co-chaired by Drs. Ana Parma (Argentina) and Dr. Laurence Kell (Spain), addressed "*Methods for analysing and modelling stock recovery*". A common thread through talks in this session was the level of uncertainty and how to address it. One case study recounted the sad history of severe depletion of the southern bluefin tuna, a depletion that was widely recognized but where no agreement could be reached on quotas for many years. A major breakthrough on the political impasse was the institution of a Scientific Committee charged with developing a management evaluation procedure to objectively assess management alternatives under uncertainties about various processes and parameters. Although a consensus recommendation was made in 2005, the agreed-upon management procedure was not implemented because substantial underreporting of catches became apparent, thus throwing into question the modelling analyses. A fuzzy logic approach was proposed as one means to effectively identify and communicate the environmental and fisheries indicators responsible for periods of fishery productivity, as well as periods of lack of recovery. Management strategy evaluation approaches were presented in which an operational (population) model was coupled to a management model, providing a means to evaluate uncertainty in various parameters and processes

under alternative rebuilding strategies. There was considerable discussion about exactly how much uncertainty should be presented so as not to erode the underlying motivation to take management actions necessary for stock rebuilding.

A half-day Theme Session 4, co-chaired by Drs. Denis Bailly (France) and Douglas Wilson (Denmark), focused on “*Social and economic aspects of fisheries management and governance*”. A case was made for conducting social impact assessments and community profiles to better understand the social and economic consequences of fishery collapses, as well as the implications of recovery plans on communities.

A half-day Theme Session 5, co-chaired by Drs. Joseph Powers (U.S.A.) and Fritz Köster (Denmark), covered “*Management and recovery strategies*”. Case studies for fish and crabs provided examples of rebuilding of previously heavily exploited stocks after reduction of total fishing mortality. A meta-analysis conducted by the UNCOVER project showed that the following four criteria are most important for stock rebuilding: (1) rapid reduction of the fishing mortality, (2) incorporating environmental variability into assessment and management, (3) developing approaches specific to the life history characteristics of the stocks under consideration, and (4) implementation of rights-based management criteria.

The final day of the symposium was dedicated to a four-hour panel discussion. Dr. Gordon Kruse was one of the panellists in this session. In general, it was concluded that there was clear evidence that collapsed and severely depleted fish stocks can be recovered, although climate regime shifts and ecosystem reorganization may cause recovery to be much slower than expected for some species. It was agreed that it is extremely important to avoid stock depletion in the first place by constraining fishing mortality to sustainable levels. However, in cases of stock depletion, an immediate, sharp reduction in fishing mortality is a common feature of many successful

rebuilding plans. Stock rebuilding and sustainable fishery management efforts in the U.S., and in particular in Alaska, were recognized by several participants as useful models for future stock rebuilding efforts in the North Atlantic. Another important point was the distinction between ‘recovery’ and ‘rebuilding’. Recovery considers only the increase in stock biomass to some specified level, whereas rebuilding goes further to also consider restoration of age structure, and evolutionary (*e.g.*, size at maturity) and behavioural traits (*e.g.*, migration routes). Typically, rebuilding of the stock with respect to these attributes takes a much longer time than recovery to biomass thresholds.

This well-attended symposium was highly successful. Because of the sponsorship, venue, and close timing of the symposium relative to the 2009 PICES Annual Meeting, the majority of participants and presentations represented fisheries in the Atlantic Ocean, particularly the Northeast Atlantic. However, talks and posters about fisheries in the North Pacific provided excellent contributions to and enriched the symposium. Accepted papers will be published in a special issue of the *ICES Journal of Marine Science*. Once published, this volume will be of much interest to scientists working towards recovery of depleted fish stocks in the PICES region. This compendium of case studies, modelling methods, management approaches, and social and economic considerations, in combination with those found in the PICES special issue of the journal *Fisheries Research* (September 2009, Vol. 100, Is. 1), will be very useful published resources to fishery scientists and managers in PICES member countries.

In conclusion, this symposium was another outstanding successful collaboration of PICES with other international organizations. It was a great pleasure and privilege for me to work with ICES and UNCOVER colleagues on this topic of great mutual interest. The symposium was very well organized, well run, and many participants extended their appreciation to the co-convenors and local meeting organizers, alike.



Dr. Gordon Kruse (Gordon.Kruse@alaska.edu) is the President's Professor of Fisheries and Oceanography at the School of Fisheries and Ocean Sciences, University of Alaska Fairbanks. He maintains broad interests in stock assessment modeling, population dynamics, fishery oceanography, and fishery and ecosystem-based management strategies. Gordon has worked in Alaska for 25 years on a diversity of invertebrate and fish species, with an emphasis on commercially important crab species. He teaches graduate courses in Marine Ecosystems, Management of Renewable Marine Resources, and other topics. Gordon is the former Chairman and current Vice-Chairman of the PICES Fishery Science Committee.

(Photo shows Gordon during a hike in Juneau, Alaska.)

2009 North Pacific Synthesis Workshop

by Skip McKinnell and Michael Dagg

They came from all “corners” of the North Pacific, some still with luggage in hand, to the welcome reception at the Pineapple Room for an enticing seafood feast. Some delightful conversations and a warm relaxing climate established a great collegial stage for the four days of presentations, discussion, debate, understanding, and work that followed. This international team of scientists that is leading the development and compilation of the upcoming PICES report on status and trends of the North Pacific met from December 1–4, 2009, in Honolulu, U.S.A., to review the regional chapters, to compare and contrast regional variability, and to develop thematic summaries of how, why, and where the North Pacific is changing. The objective of the workshop was to produce a first draft of a cross-cutting synthesis of what had occurred in each region from 2003–2008. It was a daunting task for a short meeting with no part of it written in advance. Perhaps it was the great venue at the East–West Center, perhaps it was the encouragement of the sun and surf to have a sunny perspective, but everyone rose to the challenge, and we left with a first draft of what will become the synthesis chapter.

In the summer of 2008, nine Lead Authors were invited by the editors, Drs. Skip McKinnell and Michael Dagg, to develop comprehensive summaries of ecosystem variability for the marginal seas of the North Pacific: Yellow/East

China Sea, Tsushima-Liman region, Okhotsk Sea, and Bering Sea; for the boundary current regions: Kuroshio, Oyashio, California, and Alaska; and one chapter for the large basin around which they are distributed. Each lead author was invited to assemble their own team to report on everything from weather and climate to seabirds and whales, and everything in between. As it had been 5 years since the first overview was developed, the focus period for this exercise was 2003–2008. By the time we met, several chapters were complete and several were undergoing final edits. Only one chapter has yet to make an appearance but it is anticipated before the final cutoff, December 31, 2009.

The approach taken by Drs. McKinnell and Dagg in developing this report was to focus on the integration of the regional results. A synthesis team was developed, comprised of the Lead Authors of the regional chapters, representatives of the PICES Technical Committee on Monitoring (MONITOR) and Disciplinary Advisors drawn from the PICES Scientific Committees, with a few invitees to fill disciplinary/thematic gaps. The project was sufficiently interesting to Frank Whitney, for example, to draw him back from semi-retirement to synthesize the nutrient/chemistry theme, and he undertook a new analysis as part of his contribution.



Workshop participants: (front) Akihiko Yatsu, **Sanae Chiba**, Jennifer Boldt, Nicholas Bond, **Sonia Batten**, Young Jae Ro, **Sinjae Yoo**; (middle) James Irvine, Frank Whitney, **Hiroya Sugisaki**, David Mackas, Michael Foreman, **George Hunt**, **Steven Bograd**; (back) Skip McKinnell, Michael Dagg, **Vyacheslav Lobanov**, Oleg Katugin. Absent: **Phillip Mundy**, Ian Perry, **Vladimir Radchenko**, John Stein, Sun Song. Locals missing: Jeff Polovina, Michael Seki, Phoebe Woodworth. Names in bold are Lead Authors of the regional chapters.



Fisheries contingent: Jennifer Boldt, James Irvine and Akihiko Yatsu.



Fish (Jennifer Boldt and James Irvine) – physics (Vyacheslav Lobanov) interaction.



Day's end: Nicholas Bond, Michael Foreman, Steven Bograd and George Hunt.

Where to go from here? As you read this in early 2010, the editors are preparing the final text and figures of the regional chapters for printing. The synthesis will be sufficiently developed by the end of January 2010 to be sent for external review. The production schedule calls for final text, graphics, and photographs for all regional chapters and the synthesis to be sent for print formatting on March 31, 2010, with the report sent to the printer by June 1, 2010. The book, containing the 10 chapters, will be published as PICES Special Publication No. 4 titled “North Pacific Marine Ecosystem Status and Trends, 2003–2008”,

and should be available a few weeks later. The Special Publication will be accompanied by a brochure that will summarize the key findings of the report for the public.

A remarkable part of the effort to produce this report is the number of volunteers who were willing to make written contributions, to lead, organize, and write chapters, to include previously unpublished results, and to grapple with the challenges of synthesizing key messages from across regions to make sense of our changing world. For that, the editors are especially pleased. The Governing Council had called for PICES scientists to make incremental improvements over the pilot project that was PICES Special Publication No. 1 (2004), but they are getting much more from this team.

We thank Dr. James Irvine (Pacific Biological Station, Canada) who is Chairman of the Stock Assessment Working Group of the North Pacific Anadromous Fish Commission and who was invited to represent that organization at the workshop and to participate in the synthesis. Special thanks is also given to Dr. Oleg Katugin (TINRO-Centre, Russia), a member of the Advisory Panel on *Status, Outlooks, Forecasts, and Engagement* (SOFE) of the FUTURE Science Program of PICES that is responsible for the future of ecosystem status reporting in PICES, who agreed to present the Okhotsk Sea results on short notice, and who provided a nice collection of photographs from the workshop. In addition to being part of the fisheries synthesis, Jennifer Boldt (Pacific Biological Station, Canada) acted as rapporteur for the workshop and for that, the editors are very grateful.

We are also grateful to Drs. Michael Seki and Jeff Polovina from NOAA’s Pacific Islands Fisheries Science Center in Honolulu for their help with projectors. Christina Chiu at the PICES Secretariat was responsible for the seamless logistical arrangements made for the workshop and its participants.



Editors of the North Pacific Ecosystem Status Report: (left) Dr. Stewart (Skip) McKinnell (mckinnell@pices.int) has lost track of what he is, but he works for PICES; (right) Dr. Michael Dagg is Professor at the Louisiana Universities Marine Consortium (mdagg@lumcon.edu) and Chairman of the PICES Biological Oceanography Committee (BIO), and he uses a Mac.

2009 PICES Rapid Assessment Survey

by Graham Gillespie and Thomas Therriault

PICES Working Group on *Non-indigenous Aquatic Species* (WG 21) has been working to increase our understanding of marine non-indigenous species (MNIS) in the North Pacific since 2006. The taxonomy initiative is one of two key MNIS research activities within a 5-year (2007–2012) PICES project on “*Development of the prevention systems for harmful organisms’ expansion in the Pacific Rim*” supported by a voluntary contribution from the Ministry of Agriculture, Forestry and Fisheries of Japan, through the Fisheries Agency of Japan. Under the supervision of Dr. Thomas Therriault (Fisheries and Oceans Canada), this initiative has evolved to include both rapid assessment surveys and collector surveys. The first PICES Rapid Assessment Survey (RAS) was carried out in October 2008, in conjunction with the PICES Annual Meeting in Dalian, China. This article discusses the second RAS conducted in October 2009, immediately prior to the PICES Annual Meeting in Jeju, Korea. The 2009 RAS was a tremendous success thanks to excellent logistical support and local knowledge supplied by our hosts, Drs. Kyoung Soon Shin and Jung-Hoon Kang (Korea Ocean Research and Development Institute, Geoje).

A rapid assessment survey provides the opportunity to catalogue native, non-indigenous and cryptogenic species at a given place and time. Repeated surveys over time

generate important baseline information that allows researchers to, among other things, determine when new species arrive. Our surveys target commercial ports in PICES member countries, as ports have a greater probability of containing non-indigenous species. Not only do these locations serve as a recipient environment for organisms transported by commercial shipping (ballast water, ballast sediment, hull fouling), they often have high levels of secondary traffic (recreational or small craft, aquaculture transfers) and tend to be more disturbed than natural environments, a factor that could enhance invasion success. The PICES surveys focus on two major port ecosystem components, namely intertidal and subtidal habitats. Intertidal habitats are sampled using both a timed walk and quadrat/grab sampling methods, and subtidal habitats are sampled using fouling organism collectors, trapping for macrofauna (primarily fish and crabs) and a survey of the fouling communities on floating docks and their associated structures. These surveys are qualitative rather than quantitative and endeavour to capture species composition within each location surveyed, not characterize abundance of any specific species. Classification of species as native, non-native or cryptogenic occurs following species identification based on literature accounts, general rules for classification of status, and discussion by members of the RAS team.



2009 PICES Rapid Assessment Survey team.



Discussion of the 2009 PICES Rapid Assessment Survey results at the WG 21 meeting, October 23, 2009, Jeju, Korea.

In addition to the authors of this article, the 2009 PICES RAS team consisted of Darlene Smith (National Headquarters, Fisheries and Oceans Canada); Masaya Katoh (Seikai National Fisheries Research Institute, Japan), Hisashi Yokoyama (National Research Institute of Aquaculture, Japan); Jin-Woo Choi, Jung-Hoon Kang, Kyoong-Soon Shin, Seungshic Yum (Korea Ocean Research and Development Institute, Korea); Sae-Heung Kim, Jong-Rak Lee and Eun-Young Yim (Jeju Biodiversity Research Institute, Korea); Eduard Titlyanov and Tamara Titlyanova (Institute of Marine Biology of RAS, Russia); Suchana Apple Chavanich (Chulalongkorn University, Thailand); John Chapman (Oregon State University, U.S.A.) and Judith

Pederson (MIT Sea Grant Program, U.S.A.). Laboratory space, equipment, and reference material were graciously provided by the Jeju Biodiversity Research Institute (Jeju Hi-Tech Industry Development Institute, Seogwipo, Jeju, Korea).

During the summer of 2009, three collector plates were deployed at different locations within each of the following four ports: Busan, Masan, Jangmok, and Ulsan. These locations represented different levels of shipping and human-use activity that might suggest different patterns in non-indigenous species occurrence. The collector plates were subsequently processed in Jeju, the week prior to the

PICES Annual Meeting, by the assembled international team of participants. Further, since one of the goals of these surveys is to act as a conduit of knowledge, Korean RAS team members participated in hands-on field sampling in Jeju at Seogwipo Port and Sunrise Peak, Sungsan (UNESCO's World Nature Heritage Site). Seogwipo Port was typical of a multi-use commercial area, with sampling conducted in and around the port using a chartered fishing vessel. In addition, three baited traps were deployed at this location to sample more mobile fauna. The Sungsan location was selected to demonstrate sampling at an intertidal beach where a number of bivalve and algal species were found. Preliminary results of the 2009 RAS include 213 taxa from the following groups: crustaceans (58 taxa), algae (55 taxa), molluscs (54 taxa), polychaetes (37 taxa), ascidians (9 taxa), bryozoans (7 taxa), cnidarians and echinoderms (4 taxa each), porifera (3 taxa) and one taxon each of platyhelminth and fish. Most taxa were identified to the species level, although many are provisional identifications and will require further investigation. Also, some taxa could only be identified to higher taxonomic levels (genus, family or order). Currently, we are able to classify

four species as non-indigenous: the bivalve mollusc *Mytilus galloprovincialis*, the cirriped *Balanus eburnus*, the amphipod *Podocerus cristata* and the polychaete *Hydroides norvegica*. A further 17 species were classified either as cryptogenic or status uncertain so it is possible that other non-indigenous species were encountered, but identifications and classifications are pending.

The 2008 RAS in Dalian, China, identified a total of 119 taxa, three of which (all bivalve molluscs) were classified as non-indigenous (PICES Press Vol. 17, No. 1, pp. 30–32). The larger species list in 2009 may be a reflection of the taxonomic expertise available for the Korean RAS or may be due to higher diversity at examined intertidal sites. Because several identifications remain provisional, both the total number of species and the number of non-indigenous species may increase for both the Chinese and Korean surveys.

As future surveys continue to gather distributional data for a number of taxa among PICES member countries, it will be possible to better understand the extent of non-indigenous marine species in coastal waters of the North Pacific Ocean.



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Graham Gillespie (Graham.Gillespie@dfo-mpo.gc.ca) is a Research Biologist with Fisheries and Oceans Canada (DFO) at the Pacific Biological Station in Nanaimo, BC. Graham is Head of the Intertidal Bivalve and Crab Programs, conducting stock assessments for commercially important species, providing scientific advice for the SARA-listed Olympia oyster and participating in ecosystem-level research involving these groups. He also coordinates an Aquatic Invasive Species project that examines distribution, dispersal and impacts of intertidal non-indigenous species on the Pacific Coast of Canada. He is a member of PICES WG 21 on Non-indigenous Aquatic Species and WG 24 on Environmental Interactions of Marine Aquaculture.

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