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2013 PICES Science: A Note from the Science Board Chairman

According to the Strategic Plan of PICES, its mission is to advance scientific knowledge on the North Pacific Ocean and its marginal seas, and to make predictions that will improve human conditions. In 2013, we continued efforts towards implementing this mission. Our efforts broadly fall into several categories: symposia and workshops sponsored and organized by PICES, which facilitate the free exchange of ideas and information among scientists; publication of peer-reviewed literature and periodic PICES scientific reports; collaborations with other organizations and programs; developing outreach, and improving the opportunities for the next generation of scientists to be involved in PICES activities, and most importantly, in PICES' integrative science program, FUTURE (Forecasting and Understanding Trends, Uncertainty and Responses of North Pacific Marine Ecosystems).

Since PICES-2012, the Organization continued to make logistical and financial arrangements for more than 20 inter-sessional symposia, workshops and meetings convened at various locations around the North Pacific and beyond. In the first half of 2013, we supported the international symposium on "*Climate variability and change on marine resources and fisheries: Toward a South Pacific Integrated Ecosystem Studies Program (SPICES)*" in Concepción, Chile, IMBER (Integrated Marine Biogeo-chemistry and Ecosystem Research) IMBIZO III in Goa, India, and the 4th International Jellyfish Bloom Symposium in Hiroshima, Japan. In August, travel support was provided for early career scientists to attend the 8th Conference on Marine Bioinvasions in Vancouver, Canada. PICES also co-convened theme sessions with CLIVAR (Variability and predictability of the ocean-atmosphere system) and ICES (International Council for the Explorations of the Sea) at their annual conferences.

In March 2013, PICES partnered with GEOHAB, ICES and NOAA in organizing and funding the workshop on "*Harmful algal blooms in a changing world*" in Friday Harbor, WA, USA, to assess the state of knowledge on HABs and climate change, and how to move forward on these issues the next decade. The workshop findings are now being integrated in a manuscript to be published in the international peer-reviewed journal *Harmful Algae*. In May 2013, a FUTURE inter-sessional workshop on "*Global assessment of the implications of climate change on the spatial distribution of fish and fisheries*" was convened in St. Petersburg, Russia, by the joint PICES/ICES Section (or Strategic Initiative in ICES jargon) on *Climate Change Effects on Marine Ecosystems*. This workshop was built around 6 theme sessions to develop and test analytical methods for detecting changes in distribution of fish and fisheries, assessing the skill of different modelling approaches, and quantifying uncertainty in projected climate-driven changes. Papers in a special issue of the ICES *Journal of Marine Science* are expected next year.

In This Issue

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Participants of the PICES-2013 Science Board meeting (back row, from left): Atsushi Tsuda (BIO), Toru Suzuki (TCODE), Sinjae Yoo (Science Board Chairman), Hiroya Sugisaki (MONITOR), Hal Batchelder (representing AP-SOFE), Igor Shevchenko (representing Russia), (front row, from left):Thomas Therriault (AP-AICE and Science Board Chairman-elect), Hiroaki Saito (AP-COVE), Skip McKinnell (PICES Secretariat), Kyung-Il Chang (POC). Absent in photo: Chuanlin Huo (MEQ).

During the summer, PICES sponsored a couple of meetings back-to-back in Honolulu – a science team meeting for a project on "*Marine ecosystem health and human well-being*" (funded by the Ministry of Agriculture, Forestry and Fisheries of Japan) and a Section on *Human Dimensions of Marine Ecosystems* workshop on "*Social and economic indicators for status and change within North Pacific ecosystems*". Both the PICES/MAFF project and Section on *Human Dimensions* have very strong connections and interactions with FUTURE. In addition, the Working Group on *Regional Climate Modelling* (WG 29) organized a workshop dedicated to RCM activities in Busan, Korea, and the Working Group on *Jellyfish Blooms around the North Pacific Rim* (WG 26) took advantage of expertise coming to the Jellyfish Bloom Symposium to hold an inter-sessional meeting on achievements and new topics. The United Nations, through the Convention on Biological Diversity (CBD), is in a process of identifying ecologically or biologically significant areas around the world, and earlier this year, PICES was invited to participate in a CBD North Pacific regional workshop because of its experience with this topic (I talk about this more on page 4).

Regarding peer-reviewed publications in 2013, selected papers from the 2nd International Symposium on the "*Effects of climate change on the world's oceans*", held the year before in Yeosu, were published in a special issue of ICES *Journal of Marine Science* (Vol. 70, No. 5) and papers from the PICES-2011 Topic Session on "*Mechanisms of physical-biological coupling forcing biological hotspots*" were published in *Marine Ecology Progress Series* (Vol. 487). Reports and recommendations from 4 PICES Working Groups that have reached the end of their terms were published in PICES' Scientific Report series. These, and previous reports, can be accessed through PICES' website (http://pices.int/publications/scientific_reports/).

PICES scientific activities in 2013 culminated with the Annual Meeting, PICES-2013, held from October 10–20, 2013, in the beautiful harbour city of Nanaimo, Canada. The meeting was hosted by the Government of Canada, Department of Fisheries and Oceans (DFO) in coordination with the PICES Secretariat. Local arrangements are made by DFO, Science Branch, Pacific Region. We thank Ms. Susan Farlinger (Regional Director General, DFO Pacific Region) for welcoming participants on behalf of the Canadian Government. PICES-2013 covered a broad range of timely and very relevant marine science issues under the theme

Yang Liu (Best FIS-sponsored Poster award recipient) enjoying the city of Nanaimo during PICES-2013.

Opening Session at PICES-2013.

Keynote speaker, Dr. Ian Perry (Canada).

"*Communicating forecasts, uncertainty and consequences of ecosystem change*". A full-day Science Board Symposium on this topic was led by a keynote address by Dr. Ian Perry (Canada), who was a previous Chairman of Science Board. A total of 366 scientists and managers from 13 countries and 21 international and regional organizations and programs attended the meeting, composed of 13 scientific sessions, 5 workshops and 27 business meetings of the committees and expert groups, and 198 talks and 94 posters. (Most of these presentations can be found on the PICES-2013 Annual Meeting presentations webpage). Of the sessions and workshops, 5 were co-sponsored by other international organizations or programs such as ICES, IMBER, ISC (International Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean) and SOLAS (Surface Ocean – Lower Atmosphere Study).

It was my great honor and pleasure to announce that the 2013 Wooster Award was given to Dr. Vera Alexander (University of Alaska, Fairbanks, USA) for a career of sustained excellence in marine science that has spanned nearly 50 years. The 2013 PICES Ocean Monitoring Service Award (POMA) went to the A-line monitoring program for its contributions to understanding the past and future oceanography of the North Pacific (read more on this year's recipients on page 6). We also presented awards for best papers and posters, and I encourage you to visit the PICES website to see who the worthy recipients were this year.

During PICES-2013, some changes were made in the leadership of our committees and expert groups. At the end of the Annual Meeting, I stepped down as Science Board Chairman and was replaced by Thomas Therriault (Canada). Hiroaki Saito (Japan) was elected as Science Board Vice-Chairman. Angelica Peña (Canada) was elected as BIO Chairman, replacing Atsushi Tsuda (Japan). Jennifer Boldt (Canada) and Sanae Chiba (Japan) were elected as Chairman and Vice-Chairman of MONITOR, respectively, replacing Hiroya Sugisaki (Japan) and Phil Mundy (USA). Steven Bograd (USA) replaced Thomas Therriault as FUTURE's AP-AICE Chairman. I thank the outgoing Chairmen and Vice-Chairmen for their dedicated service in the past, and new Chairmen for their service in advance.

PICES' integrative science program, FUTURE, is at the center of the Organization's endeavor to fulfill its mission. FUTURE has now entered its fifth year. It has some new elements added to the traditional PICES science, such as a capacity of forecasting ecosystem changes beyond simple understanding mechanisms and processes. The human dimension is another new element that will not only strengthen the research of two-way interactions between nature and human society but also effectively convey this knowledge and predictions to society. During the past 4 years, we have planned and strived to steer the program into these unchartered waters of new PICES science. Since FUTURE's inauguration in 2009, 16 new expert groups (3 Advisory Panels, 5 Study Groups, 6 Working Groups, and 2 Sections) were formed to produce the scientific outputs that the program is expected to achieve. In 2012, the progress and gaps in the initial-phase implementation of FUTURE was critically reviewed and, based on this review, we developed a FUTURE roadmap.

Hal Batchelder describing a proposed new process of reporting the next North Pacific Ecosystem Status Report at a special plenary during PICES-2013.

In 2013, 4 new expert groups were established. This past March the Study Group on *Radionuclide Science in the North Pacific Ocean* (SG-RS) held a workshop on "*Radionuclide science and environmental quality of radiation in the North Pacific*" in Xiamen, China. The outcome of the workshop was a proposal to form a new Working Group on *Assessment of Marine Environmental Quality of Radiation around the North Pacific* (WG 30), which was approved less than 6 months later. This group is addressing the question whether changing patterns of radioactivity constitute an additional stressor to the ecosystem in the North Pacific. It had its first meeting at PICES-2013 to discuss how to assess the impacts of radionuclides on the North Pacific ecosystems and how to use radionuclides as tracers of circulation, biogeochemical cycling and ecological transfers.

Although marine pollution constitutes an important stressor category of the marine ecosystem and hence is related to the key questions of FUTURE, scientific activities on this topic have been limited for the past few years in PICES. To remedy the situation, at the recommendation of the Study Group on *Marine Pollutants* (SG-MP; 2011–2013), a new Working Group on *Emerging Topics in Marine Pollution* (WG 31) was established at PICES-2013. This group will document and profile emerging marine pollution issues in the North Pacific Ocean and compile data pertinent to pollution indicators. It is expected that WG 30 and WG 31 will greatly contribute to FUTURE and to the next editions of the PICES North Pacific Status Report. Both these groups also plan to have a strong cooperation with other international organizations and programs.

FUTURE is addressing complex questions that require comprehensive approaches to connect all the components in chains from climate change to society. These chains form a web with multiple pathways linking human systems, environmental systems, and marine ecosystems. Existing expert groups will deal with only parts of the chain, and we do not know precisely yet how to connect the parts. To resolve the issue of integration, a new Study Group on *Socio-Ecological-Environmental Systems* (SG-SEES) was proposed and approved at PICES-2013. This group will create a conceptual model by comparing hypoxia in two ecosystems: the East China Sea and the California Current. The conceptual model from SG-SEES will then be used in the development of a fully integrated quantitative model to answer the FUTURE questions.

Marine biodiversity is an important scientific topic related to ecosystem structure and function. Understanding drivers of biodiversity change (*e.g*., non-indigenous marine species, climate change, eutrophication, fishing, pollution, *etc*.) and their interactions can help inform decisions related to ecosystem-based management that balance multiple objectives. As a leader in North Pacific marine science, PICES has been asked by other international organizations and programs such as CBD and WOA (World Ocean Assessment) to provide scientific information on marine biodiversity. To serve the role of scientific advisor better, a Study Group on *Biodiversity Conservation* (SG-BC) was formed at PICES-2013. It will review the scope of key drivers of biodiversity change in the North Pacific Ocean and identify potential mechanisms to advance biodiversity-based scientific research and/or conservation related to these drivers.

Naoki Yoshie, Sachihiko Itoh and Michio Kishi enjoying a discussion during a break at a Topic Session at PICES-2013.

By 2014, FUTURE will be 5 years old. A FUTURE Open Science Meeting (OSM), taking place from April 15–18, 2014, on the Kohala Coast, Hawaii, is intended to provide an opportunity to evaluate progress of FUTURE. The OSM will consist of morning plenary sessions and concurrent theme sessions in the afternoon, with 1-day workshops preceding the symposium. On the last day, the plenary session will focus on the integration of more general topics followed by a discussion on FUTURE achievements and gaps. After the meeting, an evaluation team will gather to make a formal assessment of FUTURE progress and to identify any needed changes or adjustments to fulfill program objectives. Please check the PICES website for further information on the FUTURE OSM.

Earlier, I mentioned the workshop convened by the Section on *Human Dimensions* to develop social and economic indicators for North Pacific marine ecosystems for an upcoming North Pacific Ecosystem Status Report, PICES' flagship product. The spinoff from the Section's human dimension indicators is that this information can also be used to contribute to the UN's WOA, which is a regular process for global reporting and an assessment of the state of the marine environment. Together with the findings of the Study Group on *Biodiversity Conservation*, the Section on *Human Dimensions* will enhance PICES' contribution to international collaboration on these global issues.

During the past decade, PICES has expanded cooperation with other international scientific organizations and programs of regional and global scale. This was evident at PICES-2013 in which there was new or ongoing discussions on collaboration with APN (Asia-Pacific Network), CBD, ICES, IMBER, IOC (International Oceanographic Commission of UNESCO), and its Sub-commission for the Western Pacific (WESTPAC), IIOE-II (International Indian Ocean Expedition II), ISC, SAHFOS (Sir Alister Hardy Foundation for Ocean Science), SCOR (Scientific Committee on Oceanic Research), and SOLAS. Another partnership was brought to a higher level this year when NPAFC (North Pacific Anadromous Fish Commission) and PICES formed

Participants of the PICES-2013 Governing Council meeting.

a joint Study Group on *Scientific Cooperation in the North Pacific Ocean*. PICES and NPAFC have been working together on problems of mutual interest for the past 15 years with good results, and this Study Group has been established to develop an official framework of enhanced collaboration between the two organizations to achieve better and/or more rapid understanding of natural and anthropogenic variability in marine ecosystems.

Capacity building has been another high priority activity of PICES. To this end, the Organization has regularly held schools on marine sciences: 4 PICES-run summer schools have been organized since 2006, with a summer school on "*Ocean observing systems and ecosystem monitoring*" just being completed in August 2013 in Newport, USA. Thirty-three early career scientists from a pool of 90 applicants attended the 5-day event, and judging from comments made by the participants at the end of the course, it was a resounding success. The 5th PICES summer school on "*Ecological modeling for marine resources management and research*" will be held August 26–29, 2014, Seoul, Korea. During the 5-day course, lectures and exercises will be provided on end-to-end ecosystem models and food-web based fisheries management models. Besides our own summer schools, PICES is also a strong supporter of schools organized by large-scale international ocean research projects, such as SOLAS' 6th International Summer School held in Xiamen, China, this past summer. Here, PICES provided travel funds for early career scientists from the PICES member countries of Japan, Russia and the U.S. to attend. Another component of PICES capacity building is to share methodologies and information by organizing methodology workshops or training courses in developing countries in the Pacific Rim. After the success of the first NOWPAP/PICES/WESTPAC training course on "*Remote sensing data analysis*" in 2011, PICES and NOWPAP partnered again to hold another training course by the same name in Qingdao, China (October 21–25, 2013). In addition, two successful capacity-building workshops were co-sponsored in Vietnam and Indonesia under the PICES/MAFF project on "*Marine ecosystem health and human well-being*". PICES strategy for capacity building also includes travel grants for students and early career scientists to attend PICES Annual Meetings and any symposia co-sponsored or organized by PICES. A total of 41 individuals were provided funds to attend PICES-2013.

Since PICES was formed in 1992 to promote and coordinate marine scientific research in the North Pacific Ocean, the Organization has made significant contributions to this mission. It has grown tremendously in not only membership, but in scope and challenges it has taken on in the fields of science, policy and education. The year 2016 will mark the 25th anniversary of PICES, and a planning committee is now in place and has met at PICES-2013 to discuss tasks and brainstorm for more ideas. The objectives for the anniversary are to celebrate achievements and search for ways to raise the profile of PICES with the public, including communication through various formats utilizing social media, as well as through national activities. I encourage you to contact the PICES Secretariat if you have additional interesting suggestions to help celebrate this occasion.

Our next Annual Meeting, PICES-2014, will be held from October 17–27, 2014, in Yeosu, Korea, under the theme "*Toward a better understanding of the North Pacific: Reflecting on the past and steering for the future*". Many interesting sessions and workshops covering a wide range of topics are planned.

Finally, I wish to thank all the members of the PICES community for their support during my term as the Science Board Chairman and wish them all the happiness in 2014 and beyond.

Sinjae Yoo
Science Board Chairman

2013 PICES Awards

The presentation ceremony for two prestigious PICES awards took place on October 14, 2013, during the Opening Session at the 2013 PICES Annual Meeting in Nanaimo, British Columbia, Canada.

Wooster Award

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. He was not only a distinguished scientist, but also an ambassador of international scientific cooperation. Though Professor Wooster passed away in October 2008, his spirit will live in our minds through this award. Award description, nomination process and selection criteria are posted on the PICES website. Prior recipients of the Wooster Award were Michael Mullin (USA; 2001), Yutaka Nagata (Japan; 2002), William Pearcy (USA; 2003), Paul LeBlond (Canada; 2004), Daniel Ware (Canada; 2005), Makoto Kashiwai (Japan; 2006), Kenneth Denman (Canada; 2007), Charles Miller (USA; 2008), Kuh Kim (Korea; 2009), Jeffrey Polovina (USA; 2010), Bernard Megrey (USA; 2011), and Richard Beamish (Canada; 2012).

The 2013 award presentation ceremony was conducted by Drs. Laura Richards (Chairman of PICES) and Sinjae Yoo (Chairman of Science Board). Dr. Yoo introduced the award and announced that the 2013 award was being given to Prof. Vera Alexander (University of Alaska, Fairbanks, USA) for a career of sustained excellence in marine science that has spanned nearly 50 years. He read the following Science Board citation (reading of the citation was accompanied by a slide show dedicated to Dr. Alexander):

The Wooster Award is the highest recognition of individual scientific achievement offered by PICES. Its name honors the first Chairman of PICES, Prof. Warren Wooster. The award is given to an individual who has made significant contributions to North Pacific marine science, especially to understanding and predicting how humans and climate affect marine ecosystems. In making its decision, the PICES Science Board looks for sustained excellence in research, teaching, and administration of marine science. It is my great pleasure to announce that Prof. Vera Alexander of the University of Alaska, Fairbanks (UAF) is the recipient of the 2013 Wooster Award for a career of sustained excellence in marine science that has spanned nearly 50 years.

Vera was born in Budapest, Hungary, but left with her family to England just before the start of World War II. There she developed a love for music and became an accomplished pianist. Early in life, she also developed an interest in agriculture and a love for the outdoors. Her family moved to the U.S. east coast, but Vera kept going west to attend the University of Wisconsin where she earned a bachelor degree in 1955. In 1965, she became the first woman to receive a Ph.D. at the University of Alaska. She became an associate professor at the new Institute of Marine Science on the Fairbanks campus.

Vera was a scientific pioneer. She was among the first to use the N-15 isotope to study nitrogen fixation in lakes. At the time, everyone thought that bacteria were the primary source of fixed nitrogen, but Vera found that most of it was fixed in lakes by blue green algae. Since this ground-breaking effort, this same process has been found in other environments including tundra terrestrial ecosystems, where lichens fix nitrogen.

Vera is also known worldwide for her pioneering research on the role of sea ice in the Bering Sea, by discovering that the ice was a critical factor determining spring productivity in the arctic region. The importance of Vera's work on Arctic phytoplankton and sea ice algae cannot be overstated. Many of her studies, such as heterotrophy of sea ice algae, or developing appropriate techniques to measure ice algal activity, were firsts in marine science. She and her colleagues, helped to lay a foundation for the current U.S. Bering Sea Ecosystem Program that is further developing our understanding of biological processes in polar seas. Vera has published more than 70 papers in the refereed literature, most of which are recognized for scientific excellence with many having more than 50 citations.

Vera is known internationally and deeply appreciated for her administration of many regional, national, and international marine science programs. In 1980, she became the director of the Institute of Marine Science where she was instrumental in bringing fisheries scientists and oceanographers together. When the School of Fisheries and Ocean Sciences was formed at the University of Alaska in 1987, Vera became its first dean and served in that role for nearly 20 years.

A crowning achievement in Vera's career was the construction and launch of the 261-foot research vessel (R/V) Sikuliaq, one of the most advanced research vessels in the world. The Sikuliaq, owned by the U.S. National

Science Foundation and operated by the University of Alaska Fairbanks, is the first ice-strengthened research vessel in the U.S. academic fleet. She and Bob Elsner were involved with the planning and development of this ship for several decades. Vera's vision and involvement was recognized when she was invited to christen the ship at its launching in 2012. Vera and Bob's initials have been welded into a steel plate that is affixed to its keel.

In the course of her illustrious career, Vera Alexander has received numerous honors, including election as Fellow of the American Association for the Advancement of Science, to the Arctic Institute of North America, the Explorers Club, and was given the Walter and Ermalee Hickel Lifetime Achievement Award from the Alaska Marine Leadership Council. Vera was honored recently by the naming of the Vera Alexander Learning Center, which is the most technologically advanced classroom on the UAF campus.

Her service to science spans many organizations, including 16 years as a commissioner on the United States Marine Mammal Commission, 10 years on the Science Panel of the North Pacific Research Board, and 12 years on the International Scientific Steering Committee (SSC) of the Census of Marine Life (COML). She also received an honorary Doctorate of Laws degree from Hokkaido University in recognition of her work in promoting international scientific cooperation.

Vera is a founder of PICES where she served as U.S. Delegate from 1992–2002, before becoming Vice-Chairman from 1998–2002, and Chairman from 2002–2006. Her dedication and contributions to PICES are deeply appreciated by all of us.

Ladies and Gentlemen, please join me in congratulating Dr. Vera Alexander as the 2013 recipient of the Wooster Award.

Prof. Vera Alexander with Dr. Laura Richards, PICES Chairman (right), and Dr. Sinjae Yoo, PICES Science Board Chairman (left), after receiving the 2013 Wooster Award.

A commemorative plaque was presented to Dr. Alexander (a permanent plaque identifying all Wooster Award recipients resides at the PICES Secretariat), who accepted the award with the following remarks of thanks:

I was completely surprised and astonished to receive this prize and yet nothing could have pleased me more. PICES has been an incredibly important part of my life, and in developing the Organization under the wise leadership of Warren Wooster, I learned so much. Preparing for PICES seemed to take a long time, but once it was signed, the forward movement was amazing. Others, too numerous to mention, played important roles as well, but I particularly want to mention Dick Beamish and Bill Aron for introducing me to the world of fisheries science and international policy most effectively. I owe them and PICES a major debt. It would be negligent not to mention Alex Bychkov and his excellent staff; they are highly effective and a pleasure to work with. It is good to find that PICES is prospering and continuing to do good and timely work. I am humbled in receiving the Wooster Award, but also extremely grateful and happy for this recognition. Thank you very much.

PICES Ocean Monitoring Service Award

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 and so inconspicuous 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 to acknowledge organizations, groups or outstanding individuals who have contributed significantly to the advancement of marine science in the North Pacific through long-term ocean monitoring and data management. Prior recipients of the award were the training ship T/S *Oshoro-maru* (Japan) in 2008, Dr. Bernard Megrey and Mr. Allen Macklin (NOAA, USA), leaders of the PICES Metadata Federation Project, in 2009, the Station P/Line-P (Canada) Monitoring Program in 2010, the Network of Serial Oceanographic Observations (Korea) in 2011, and the California Cooperative Fisheries Investigations (CalCOFI) in 2012.

Drs. Richards and Yoo conducted the POMA presentation ceremony. Dr. Yoo introduced the award and announced that the 2013 award was being given to the A-line Monitoring Program for its contributions to understanding the past and future oceanography of the North Pacific and read the following Science Board citation (reading of the citation was accompanied by a slide show dedicated to A-line Monitoring Program):

The Oyashio is a cold western boundary current flowing southward from the Kurile Islands to Hokkaido, Japan. "Oya" in Japanese means "parents" or "source" and "shio" means "current". Thus, Oyashio means "a current *that provides rich marine products". This area is known as a good fishery ground for Japanese sardine, walleye pollock and other species. Because of its high productivity, Oyashio has fascinated biological oceanographers, fisheries scientists, and physical oceanographers. Not so long ago, there was relatively little information about its physical properties, ecosystem structure and mechanisms for maintaining its high productivity. It was clear that a continuous ocean monitoring system was needed to begin to understand fisheries oceanography in the Oyashio area.*

Twenty-six years ago in 1987, the first of many A-line observations was made by scientists at the Hokkaido National Fisheries Research Institute, led by Dr. Makoto Kashiwai (the second Science Board Chairman of PICES). The 3-year project on "Oyashio water" focused on its physical oceanography. The "A" in A-line is taken from the first letter of Akkeshi Bay, near the first station of the A-line. This project ended in 1990, but the enthusiasm of a new group of scientists expanded A-line monitoring to include physical, chemical and biological properties of the Oyashio ecosystem and the search for key factors associated with its high productivity. In 2002, the Tohoku National Fisheries Research Institute joined the effort and has been conducting 5–7 cruises per year up to the present. During that time, the A-line monitoring program has made outstanding achievements related to understanding the Oyashio and its ecosystem.

An important characteristic of the A-line monitoring program is the close cooperation among scientists of different disciplines. It inspired the development of ecosystem models by the MODEL Task Team in PICES. The NEMURO model and its daughter models are now used in marine sciences all over the world. The A-line was also the site of iron fertilization experiments coordinated by the PICES Advisory Panel on Iron Fertilization Experiment in the Subarctic Pacific Ocean. They found that iron controlled the productivity of the North Pacific and found east-west differences in iron concentration and iron species composition. Repeated monitoring in the A-line region discovered that the Sea of Okhotsk is an important source of iron in the western subarctic Pacific. Long-term observations have helped to clarify relationships between the physical environment and living marine resources, and revealed the mechanisms for long-term variation of ocean ecosystems of the western North Pacific in relation to global warming and/or Pacific Decadal Oscillation.

The A-line Monitoring Program has fostered oceanography and fisheries science in the western North Pacific, with many papers presented annually at PICES Annual Meetings and symposia and workshops sponsored by PICES. A-line monitoring will continue to provide important data to understand the future ecosystem change related to the global change and contribute to the development of ocean science of the North Pacific.

PICES Science Board is honouring the A-line Monitoring Program with the 2013 PICES Ocean Monitoring Service Award for its contributions to understanding the past and future oceanography of the North Pacific. Congratulations!

A commemorative plaque (a permanent plaque identifying all POMA recipients resides at the PICES Secretariat) and a certificate were presented to Dr. Hiroshi Kuroda (Hokkaido National Fisheries Research Institute, Fisheries Research Agency, Japan), who accepted the award with the following remarks of appreciation:

Thank you very much for this award. I am the newest participant of the A-line monitoring, but I do not have a strong constitution against seasickness. Whenever I feel seasick on a ship, I am always mindful of the conditions that crew and researchers must work under. I respect and am very proud of all of the participants and contributors, particularly, captains, officers and crew of Research Vessels Hokko-maru and Wakataka-maru. This award will encourage us – all the participants and contributors. I would like to thank PICES deeply.

Dr. Laura Richards, PICES Chairman (left photo), and Dr. Sinjae Yoo, PICES Science Board Chairman (right photo), present POMA commemorative plaque and a POMA certificate to Dr. Hiroshi Kuroda (Hokkaido NFRI, FRA, Japan).

Workshop on "*Comparison of Size-based and Species-based Ecosystem Models*"

by Shin-ichi Ito, Skip McKinnell, Jeffrey Polovina, Anne Hollowed and Myron Peck

Participants of the afternoon discussion in the workshop on "Comparison of size-based and species-based ecosystem models" at PICES-2013.

Size-based and species-based approaches are often used within ecosystem models, and these two types of models carry different assumptions and are designed to address somewhat different questions. In recent years considerable development of size-based models has occurred within the ICES community, while the PICES community has typically focused on species-specific models for its applications. The objective of this workshop was to bring together the two communities of modelers to: (1) advance our understanding of the advantages and limitations of these two modeling approaches, especially in the context of modeling climate impacts on ecosystems, (2) make direct comparisons of the predictions of ecosystem structure and dynamics, both top-down and bottom-up, stemming from these two model types when applied to the same regional ecosystem, where possible under climate change forcing, and (3) discuss the benefits and feasibility of developing hybrid, size-based and species-specific models.

Since there was a U.S. government partial shutdown during the first half of October, scientists from NOAA, including workshop co-convenors Jeffrey Polovina and Anne Hollowed, could not attend the workshop. Another co-convenor, Myron Peck, was also unable to come to Nanaimo. Skip McKinnell kindly accepted to act as a co-convenor with Shin-ichi Ito. About 40 people attended the workshop, and eight presentations were made.

An invited talk by Villy Christensen (University of British Columbia, Canada) reviewed the brief history of Ecopath with Ecosim modeling (EwE) and introduced the newest version of the Ecospace model, which includes temporal and spatial dynamics bridging environmental factors to marine ecosystems through the food web. James Watson (Princeton University, USA) showed an example of a global simulation of fish biomass distribution using a simple size-based food web model coupled to simulations of global ocean physics and biogeochemistry, revealing the importance of active movement to estimates of changes in fish distribution. The second invited speaker, Julia Blanchard (University of Sheffield, UK), joined via the internet and demonstrated several examples of model comparisons between size- and species-based food web models (there are many different types of food web and multispecies models from species- to size-based models, and some of them are a mixture of both types). She emphasized the importance of model comparison to improve our process-based understanding. The third invited speaker, Julia Baum (University of Victoria, Canada), showed that trophic pyramids and size spectra are, in fact, interchangeable representations of the same information and highlighted the size spectrum as a central concept in ecosystem ecology that can be used to understand baseline expectations of community structure. Marc Hufnagl (University of Hamburg, Germany) made a presentation on

Table 1 Participants of afternoon discussion.

Name	Affiliation
Julia Baum	Canada
Alida Bundy	Canada
Villy Christensen	Canada
Andrew Edwards	Canada
Cheryl Harrison	USA
Marc Hufnagl	Germany
Shin-ichi Ito	Japan
Sukyung Kang	Korea
Skip McKinnell	PICES Secretariat
Colleen Petrik	USA
James Robinson	Canada
Yunne-Jai Shin	France, South Africa
James Watson	USA

behalf of Myron Peck regarding the influence of size spectrum slope of prey sizes on fish early life stages. Shin-ichi Ito presented for Nis Sand Jacobsen (DTU, Denmark) and colleagues on the comparison of ecosystem models under different fisheries managements. The results showed the importance of multi-model approaches for fisheries management, especially for mixed fisheries. Guimei Liu (National Marine Environmental Forecasting Center, China) showed an example of a species-specific model for jellyfish in the Northwestern Pacific. Three papers from NOAA employees had to be cancelled.

The afternoon session consisted of a group discussion focused on the three objectives of the workshop. Thirteen participants contributed to this discussion (Table 1).

(1) Advantages and limitations of size-base and species-based modeling approaches, especially in the context of modeling climate impacts on ecosystems

First, it was recognized that purely body size-based or species-based models are the extremes of a continuum of approaches that contain both dimensions. Many different structures and assumptions are used in those models. Therefore, it was difficult to simply list advantages and limitations of both types of models although several points were noted (Tables 2 and 3). Andrew Edwards (Pacific Biological Station, Canada) presented methods to estimate size spectrum slope and showed the risk of simply fitting straight lines to log-log histograms. Likelihood methods were recommended. Adding to the advantages and limitations, the following issues were pointed out:

Table 2 Advantages and limitations of size-based model.

Advantages	Limitations
Coverage of ecosystem is greater since size-based models can represent continuous distribution of biota from small phytoplankton to large top predator fish.	Core of many size-based models is metabolic theory (allometric scaling) and cannot resolve detailed biological processes.
Species interactions are emergent (large species prey upon small ones).	Interactions are defined by differences and overlap in body size and specific, strong interactions between species may not be included.
Climate change impacts are possible to incorporate.	Climate change impacts on primary productivity is imitated by changing the intercept and/or slope of the size spectrum line.
Useful for global assessment of climate change impacts on marine ecosystems since size-based models are generic and able to be applied without local species composition.	Representation of regional ecosystems may be limited. Adaptation of species may be difficult to reveal.

Table 3 Advantages and limitations of species-specific model.

Advantages	Limitations
Suited to focused interests in certain species.	Species interactions pre-defined by species/model group pairs and species that do not interact will not interact in a model.
Species interactions determined by functional response settings.	Size-based processes (large predate on small) cannot be resolved except where sub-species groups are included.
Climate impacts are possible to incorporate. Adaptation effects may be possible to be incorporated with high computational cost.	Changes in primary production are represented by changes in functional phytoplankton groups. Size and space are implicit in species-based models with diet information.
Useful for global assessment of specific species regarding spatial distribution and biomass change.	Representation of global ecosystems may be impossible.

- There is a continuum of models between species- based and size-based ones. Distinguishing of model is difficult since recent model developments tend to incorporate both dimensions.
- Embracing trait-based models of which size is only one dimension.
- Sampling bias at large/small size affects size spectra.
- Do inverted trophic pyramids exist?
- Changing primary productivity changes size-spectrum and the extent depends on migration characteristics.
- Spatial resolutions of marine ecosystem models have been increased. Unclear whether advection of size spectrum is meaningful in high-resolution models.
- Need to model how climate change and anthropogenic pressures affect species interactions to a greater extent than food web effects.
- Climate change affects species interactions. Would size-based models be a better reflection of the changes?

(2) Comparisons of the predictions of ecosystem structure and dynamics from size-base and species-based models

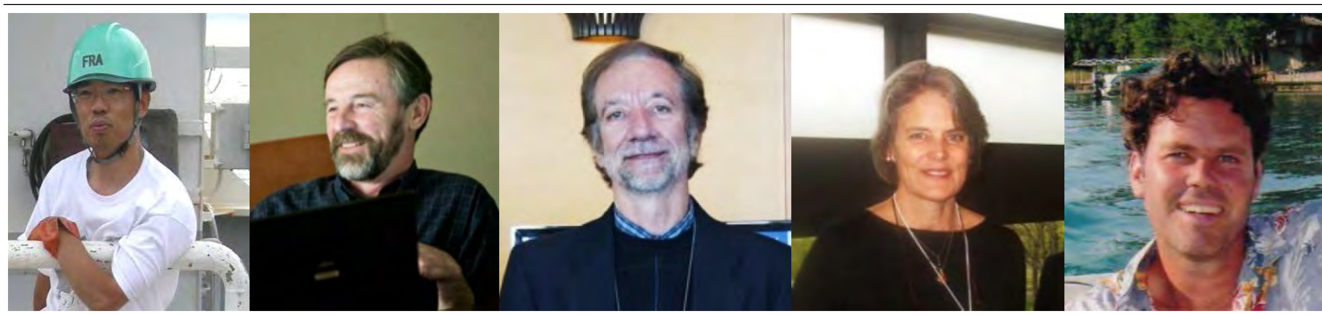
A lot of effort has been devoted to comparisons of marine ecosystem models. The presentation of Julia Blanchard made a theoretical comparison between size-based and species-specific models. It also compared population and community responses to fisheries using multispecies size spectrum models in which growth and predation mortality processes are different. The presentation of Nis Sand Jacobson compared the responses of fish species to fisheries using EwE and size- and trait-based models. Through these presentations, the audience learned how difficult comparisons can be. The following points were noted:

- Comparisons need multiple ecosystem models and multiple marine ecosystems.
- Comparisons should focus on specific questions and/or scenarios (*e.g.*, Steller sea lions – what caused the decline?).
- Comparisons need initial tunings of models to test the climate impacts.
- Theoretical comparisons are needed before application to specific questions since it is possible to get similar results from different models for very different reasons. Need to understand these differences before applying them to policy questions.
- Density-dependence is one of the most important factors for species-specific models and exploration is needed on how this process is implemented in each model.

(3) Benefits and feasibility of developing hybrid size-based and species-specific models

There are a variety of marine ecosystem models and continuum of models between species-based and size-based ones. Some of them are hybrid size-based and species-specific models. Depending on the scientific focus, it is feasible to apply different type of models.

At the end of the workshop, participants agreed to continue work on comparison of size-based and species-based ecosystem models through workshops at the FUTURE Open Science Meeting (April 14–18, 2014, Hawaii).



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Workshop on "*Identifying Mechanisms Linking Physical Climate and Ecosystem Change: Observed Indices, Hypothesized Processes, and "Data Dreams" for the Future*"

by Ryan R. Rykaczewski and Emanuele Di Lorenzo

Climate variability and change are now recognized as significant factors influencing population fluctuations of living marine resources. However, distilling complex climate–ecosystem interactions into key, testable hypotheses remains a challenge. Living components of marine ecosystems, particularly upper-trophic-level populations, commonly display variability at low temporal frequencies (*e.g.*, decadal and multi-decadal). Understanding such low-frequency variability is facilitated by a combination of historical observations and mechanistic models that represent physical–biological interactions. Time series of sufficient length may permit multiple observations of the relatively infrequent changes in the system, and models that represent influential interactions allow simulation of poorly resolved, low-frequency events. Increased understanding of the key physical–biological processes through which climate influences marine ecosystems can improve observational and modeling approaches and will promote incorporation of physical data into management strategies. Simplified process models may prove more effective for these efforts than full-complexity models, which are typically associated with multiple sources of uncertainty. The development of such reduced complexity climate-driven ecosystem models relies on: (1) identifying mechanisms controlling the response of the marine ecosystem to climate forcing, (2) isolating the climate forcing functions that are relevant to the specific ecosystem that is studied, and (3) linking these climate forcing functions to the dynamics of large- and regional-scale climate variability (Fig. 1).

This desire to better identify and represent key climate–ecosystem interactions motivated the GLOBEC/PICES/ICES

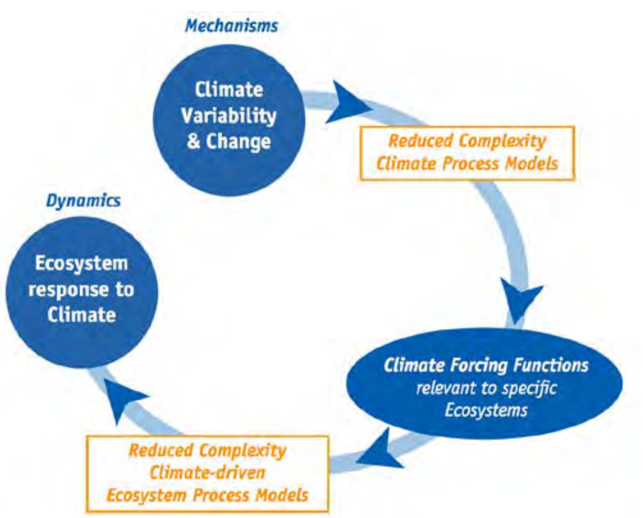

Fig. 1 Conceptual diagram illustrating the development of climate-driven ecosystem process models.

Workshop on "*Forecasting ecosystem indicators with process-based models*" (ECOFOR). The workshop was organized by the PICES Working Group on *North Pacific Climate Variability and Change* (WG 27) and was held at Friday Harbor Laboratories (Washington State, USA) in September 2012. The goal of the ECOFOR workshop was to begin a more systematic application of previous knowledge to identify key processes enabling modeling of the mechanisms underlying physical–biological relationships in the North Pacific and North Atlantic. Physical and biological oceanographers, ecologists, climate scientists, and a mathematician were included among the PICES and ICES participants (see PICES Press Vol. 21, No. 1). Two major results from this workshop were: (1) recognition of the community's continuing enthusiasm for the exchange of concepts between physical and biological ocean scientists, and (2) realization that although immense progress has been made over the past several years, understanding of key mechanisms underlying ecosystem variability in both North Atlantic and Pacific basins remains in a stage of development. Succinct description of physical–biological interactions has often been limited by the paucity of relevant observations of sufficient length and resolution, and so many mechanistic descriptions persist as early hypotheses.

Given these issues and the ongoing interest identified at the ECOFOR workshop, members of WG 27 convened a theme session at the 2013 ICES Annual Science Conference and a workshop at the 2013 PICES Annual Meeting (ICES session M: and PICES W2). The goal of these events was to promote and expand discussion regarding modeling physical forcing of ecosystem variability. The ICES theme session and PICES workshop shared the title: "*Identifying mechanisms linking physical climate and ecosystem change: Observed indices, hypothesized processes, and "data dreams" for the future*." Workshop convenors encouraged contributions which sought to identify and model key processes explaining mechanisms underlying the correlative relationships in physical–biological datasets. Convenors also hoped to solicit ideas and new hypotheses concerning mechanisms of physical–biological interactions that can be tested by establishing novel long-term observational strategies or by developing creative modeling datasets.

The quantity of abstract submissions and attendance at the PICES workshop exceeded our expectations. A full day was allocated for 14 oral presentations (including four invited speakers) and a poster. Of note was the extensive range of scales and approaches, indicative of the broad interest across the PICES and ICES communities. The four invited speakers offered examples of the scales over which the mechanisms of climate–ecosystem interactions are examined. At the relatively small spatial and temporal scale, invited speaker Dr. Hans Pörtner (Germany) discussed recent findings regarding organismal capacity to respond to multiple stressors in a climate context. He introduced the concept of oxygen- and capacity-dependent thermal tolerance: while thermal stressors appear to be the dominant factor influencing biogeographical ranges, phenology, and species composition, this thermal tolerance may be narrowed by oxygen and CO_2 stress. Dr. Pörtner highlighted the need to understand the molecular adjustments in species' eco-physiological responses to climate-related stressors, as these are the fundamental scales that structure direct organism responses to changes in climate-related variables.

On the other end of the spatial spectrum, invited speaker Dr. Jürgen Alheit (Germany) discussed evidence of basin-scale climate forcing (related to the Atlantic Multi-decadal Oscillation) of small pelagic fish in the northeast Atlantic. He noted that variability in commercially harvested fish populations of both the North Pacific and North Atlantic may be associated with expansion and contraction of the subpolar gyres, advocating for further investigation of gyre size as a potential integrative indicator of large-scale ecosystem changes.

Between these basin-scale and organismal-scale perspectives, the workshop's two other invited speakers presented case studies demonstrating mechanisms of climate–ecosystem relationships at mesoscale to regional scales. Dr. Bryan Black (USA) presented results of a study detailing the sensitivity of northeastern Pacific ecosystem productivity (both in the marine and in the adjacent terrestrial environments) to atmospheric conditions; specifically wintertime upwelling events. In addition to contemporary fisheries, seabird, and atmospheric observations, this project utilized tree-ring records, rockfish otoliths, and geoduck shells to examine interannual climate–ecosystem interactions over the last six centuries (Fig. 2). Dr. Carolina Parada (Chile) discussed a dynamical model-based investigation of the potential impact of mesoscale and submesoscale hydrographic features on the distribution and biophysical conditions experienced by larval and juvenile walleye pollock in the Gulf of Alaska. She also emphasized the uncertainties associated with modeling pollock survival, as data concerning temporal changes in the predator field are few, currently limiting the ability to accurately estimate recruitment variability.

A number of speakers also utilized more conceptual and numerical methods to explore the mechanisms of climate–ecosystem interactions. Select examples of this approach were the presentations by Drs. Emanuele Di Lorenzo and Kenneth Denman. Dr. Di Lorenzo (USA) numerically simulated biological responses to climate variability and demonstrated the tendency of populations to fluctuate in phase with a global scale climate pattern, even when this pattern has a relatively minor influence on the factors that directly affect marine populations. Dr. Denman (Canada) presented results of simulations examining the responses of a population's phenotypic composition to variability and trends in climate factors. A synthesis of some key findings from the PICES workshop and ICES theme session is highlighted in Box 1.

A common challenge acknowledged at the conclusion of the workshop concerns the difficulty in describing the mechanisms through which variability in lower-trophic-level populations influences populations of higher-trophic-levels. Comprehensive model description of multi-dimensional interactions among populations and the changing physics of their environment is impractical, and thus the desire to concisely represent key relationships with simplified

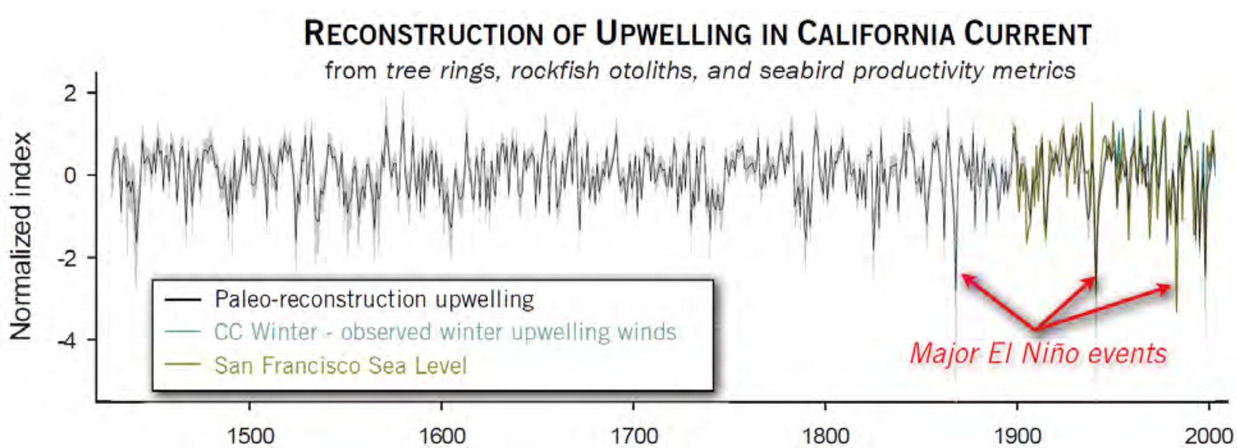

Fig. 2 A 600-year reconstruction of winter climate in the central California Current derived from tree-ring data. CC winter, the target of the reconstruction, is the leading principal component of winter (Jan–Mar) Northern Oscillation Index (a measure of the North Pacific High), winter upwelling index averaged across 36°N and 39°N, and winter sea level at San Francisco. Gray shading indicates 95% confidence intervals. Note that the reconstruction is dominated by high-frequency variability and that the four most extreme negative values all occurred during major El Niño events (i.e., 1868, 1941, 1983, and 1998). Dr. Black's presentation, as well as those of the other workshop speakers, is available on the PICES website at http://www.pices.int/publications/presentations/PICES-2013/2013-W2/2013-W2.aspx.

Box 1. Synthesis of the main findings of the PICES workshop and ICES theme session

1. Sensitivity of ecosystem to physical drivers changes with season
During different months of the season, different physical drivers become important in driving ecosystem variability. Therefore, using regional indices that track the seasonal sensitivity of the ecosystem leads to better predictions than using climate indices. In future studies it is critical to examine whether IPCC class models can resolve the dynamics of the regional forcing functions.

2. Lower-trophic levels variability tracks regional and local physical forcing
Ecosystem properties of lower-trophic levels (*e.g.*, nutrient fluxes and primary productivity) are typically sensitive to few environmental drivers and often track indices of climate variability that are regionally or locally defined. These regionally defined indices allow capture of the local scale environmental variability as well as the impacts of large-scale climate variability.

3. Higher-trophic levels integrate multiple forcings and track large-scale climate modes
Ecosystem functions of higher-trophic levels (*e.g.*, fishes) are typically sensitive to multiple stressors. Hence, higher-trophic levels have the ability to integrate multiple sources of environmental variability and exhibit the tendency to align their variability with that of the large-scale climate modes, which capture the shared, low-frequency variance among the different environmental forcings.

4. Changes in large-scale and regional scale circulation play a dominant role in driving ecosystem variability
Changes in large-scale and regional scale circulation play a dominant role in driving ecosystem variability both at the lower and higher trophic levels. Resolving the circulation dynamics with regional climate models is key to allow a proper understanding of how coastal ecosystems respond to climate forcing. It will be important in the future to develop adequate data archives of ocean currents and advection pathways that can be used offline by ecosystem scientists to test hypotheses regarding ecosystem responses to environmental oceanic forcing. These data archives will likely be assembled using the output of regional scale model hindcasts. It was also pointed out the resolving eddies at the regional scale is critical, but introduces a stochastic component in the variability associated with the degree of intrinsic nature of the eddy-scale circulation. Future eddy-resolving models will need to perform an ensemble hindcast in order to separate the fraction of variance that is deterministically forced vs. the internal variance.

5. Spatial dimension is key for understanding the links between physical variability and ecosystem response
As we develop reduced-complexity models of the marine ecosystem responses to climate forcing, it will be critical to incorporate the spatial dimension (*e.g*., associated with species distributions). This topic has already emerged from the Section on *Climate Change Impacts on Marine Ecosystem* (S-CCME) and is currently an important topic of research and discussion. Although several talks showed examples of how the spatial dimension plays an important role, no systematic approach was presented to incorporate the spatial dimension in reduced-complexity models. During the discussion, a Linear Inverse Model methodology was suggested as one approach to model the spatial dimension of fish distribution in the context of a changing climate.

(Continued on page 42)

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Dr. Emanuele (Manu) Di Lorenzo (edl@gatech.edu) is a Professor of Ocean and Climate Dynamics in the School of Earth and Atmospheric Sciences, Georgia Institute of Technology (USA). His research interests and experience span a wide range of topics from physical oceanography to ocean climate and marine ecosystems. More specific focus is on dynamics of basin and regional ocean circulation, inverse modeling, Pacific low-frequency variability, and impacts of large-scale climate variability on marine ecosystem dynamics (http://www.oces.us). In PICES, Manu co-chairs the Working Group on North Pacific Climate Variability and Change, leads the Study Group on Social-Ecological-Environmental Systems (SG-SEES), and is a member of the FUTURE Advisory Panel on Climate, Oceanographic Variability and Ecosystems (AP-COVE). He also serves on the US Comparative Analysis of Marine Ecosystem (CAMEO) Science Steering Committee.

Navigating Change: Well-being, Values and the Management of Marine Social-Ecological Systems

by Grant Murray, Linda D'Anna, Patricia MacDonald and Michele Patterson

Introduction

Like other PICES member countries, Canada has a strong interest in ensuring sustainable seafood economies that both preserve important ecological functions and support the livelihoods and communities of Canadians on all three of our coasts. Unfortunately, Canada has not been immune from declines in some seafood species or the socio-cultural and economic drivers and impacts of these problems on Canadians.

In response, integrated management is mandated under Canada's Oceans Act (1996) and is described in detail in Canada's Oceans Strategy (2002). While a promising direction in terms of addressing these linked social-ecological system issues, realizing an ecosystem-based approach to management requires that there be: a) good information, data and analysis and b) willingness and capacity for stakeholders to work collaboratively toward mutually beneficial ecological, social, economic and cultural outcomes.

Compared to natural science information and data, however, there has been less socio-economic information collected and analyzed to inform management processes.[1] Moreover, much of the information that does exist for use in resource management planning is about economic activity and economic values. While useful, these data are limited in that they do not represent the full range of values (*e.g*., those that are 'socio-cultural' in nature) that influence the setting of management objectives or the behaviors that drive social-ecological system change. A focus on economic activity and values paints an incomplete picture of the impact of ocean activities (and management interventions) on human well-being. To address these gaps, we have developed a research program to centre on the holistic concepts of well-being and values.

For us, the term value has a number of meanings, from the theoretical to the practical. In a resource management context, for example, this term is used in a variety of different ways, ranging from describing desired end states or qualities, to the assigned economic value (or price) placed on harvested natural resources, non-market values like the functional value the oceans play in mitigating climate change, or requests to respect and incorporate the 'traditional values' of First Nations into decision-making.[2,3] While appealing in conceptual terms, there has been a relative dearth of applied, empirically-based research about individual and community values in the seafood sector.[1,4]

Well-being is also a broad term, but for us it refers to a holistic, multidimensional aspect of human welfare that has material, relational and cognitive/psychological features. Assessing well-being is made challenging, however, due to its subjective nature, social and cultural construction, and because it is context dependent. Nonetheless, some models and frameworks have been developed to assess and measure it, including for fisheries.[5-6]

In the two case studies below, we present examples of two research projects that have engaged in empirical research in these critical areas.

Case study 1: Understanding values across the seafood sector

Seafood is significant in coastal communities in British Columba. The province produces about $1.5 billion in seafood a year, and the industry creates more than 19,000 full and part-time jobs – many of them in coastal communities. However, the seafood 'sector' does not function as an integrated whole but rather, represents a range of sub-sectors involved in the production and consumption of seafood. For example, in this study we considered the seafood sector to include recreational fishing, recreational fishing services, First Nations food and commercial fishing, fin fish aquaculture, shellfish aquaculture, seafood processing, seafood distributing, and cooking and serving seafood (restaurants/catering). These complex sectoral categories both shape and reflect an equally complex range of sometimes competing value sets associated with seafood production and consumption.

Based on the recognition that values are context dependent, we chose to focus on a single community for this initial study. We selected Campbell River, on Vancouver Island, British Columbia, because many of the seafood sub-sectors of interest are well developed in the area. Campbell River has long been known as the "Salmon Capital of the World" based on its recreational and commercial fishing sectors and, more recently, the salmon and shellfish aquaculture sectors have developed and, along with fishing, they support a number of processing plants. There are several retail fish markets and numerous seafood restaurants in the community.

One of the innovations of this study was the adoption of the Q method[7] to identify values. The Q method uses the words of those involved with an issue to tap into the full range of perspectives on it. Specifically, we conducted ten

Photo 1 "The people here are very proud of the ocean and they love being by the water. They use it recreationally. Families are at the ocean all day, playing on the beach and barbecuing and people are wind surfing and boating. It is a huge boat culture." Statement by interview participant; photo of Campbell River marina by Daniel Day.

in-depth interviews with participants in the sector and reviewed the non-market values literature and a variety of secondary sources. This initial phase identified a complex range of themes related to values, including: accessibility, adaptability of the ocean and the community, balanced use of the ocean, collaboration, conservation, fairness/equity, inclusiveness/input, inter-connections, healthy/clean ocean, loyalty, nostalgia, objectivity/science in decisions, physical experience of the ocean, productive ocean, prosperity, resilience of the ocean and the community, regulation, recreation, rights to the ocean, security of jobs and food, spiritual/cultural role, local versus global sharing, stewardship, sustenance, sustainability, teaching/learning, and tradition.

From this phase we then selected 40 statements made by the interviewees to represent the full range of value themes raised. For example, the cultural role of seafood in coastal communities was indicated in the statement, "*Salmon is recognized as an iconic seafood. It is a cultural icon for both the First Nations and non-First Nations; it connects the sea and the land like no other species. We must look after it*". A second phrase relating to the importance of 'boating culture' is included as a caption in Photo 1. In the second phase of the study, we asked 42 individuals, representing all sub-sectors, to consider their priorities and rank the set of 40 statements by arranging the statements into 9 categories ranging between categories of "most like the way I think" to "least like the way I think".

Using a combination of factor and qualitative analyses, we identified five factors, representing five groupings of values (groupings of the statements from the pool of 40) which can be thought of as five idealized types. Table 1 shows a listing of each grouping, beginning with an overarching succinct title to characterize the grouping as a whole, followed by a list of five phrases representing the core value encapsulated in each of the five statements that were ranked "most like the way I think" within each group.

The nature of what is valued is notable. For example, the 'collaborative pragmatism' and 'objectivity and innovation' factors contain statements that emphasize the procedural or process values of collaboration and objectivity, respectively. The other three groupings emphasize substantive outcomes such as prosperity or a healthy fishery.

We also identified the value statements around which our sample of individuals had the most consensus and those value statements on which they had the most divergence. Generally speaking, there was consensus around the importance of using precaution and teaching people about the ocean, stewardship of the ocean for future generations, conservation of salmon as a community builder, and the adaptability of the eco-system. There was the most contention around using aquaculture to enhance seafood production and protecting First Nation rights to access.

Interestingly, the different value groupings do not align exclusively with the seafood sub-sectors. For example, the individuals involved in aquaculture did not align with only one value grouping (since they did not all load onto just one of the five factors). Indeed, individuals from aquaculture loaded on four out of the five factors.

Table 1 Value groupings in the seafood sector of Campbell River, British Columbia.

Collaborative Pragmatism	Local Stewardship	Objectivity & Innovation	Balanced Tradition	Balanced Prosperity
Collaboration*	Interconnection ocean/community*	Objectivity through science	Interconnection fishery/community	Prosperity*
Objectivity through science	First Nations rights and access*	Enhance production through aquaculture	Cultural role of salmon	Enhance production through aquaculture
Trust in regulations*	Pre-caution/Learning	Pre-caution/Learning	Recreation*	Security through aquaculture
Balanced use	Stewardship	Global sharing	Balanced use	Balanced use
Stewardship	Local decisions	Sustainable aquaculture*	Experience of nature/wild	Experience of nature/wild

* indicates that the ranking of that statement (in that factor) was significantly different than the overall mean ranking of that statement @ $p < 0.05$ in the data.

Case study 2: Shellfish aquaculture and well-being

As wild fisheries have plateaued, aquaculture has become an increasingly important source of protein and economic opportunity for populations around the world. As the industry continues to modernize, expand, and intensify, however, it will become increasingly important to understand how aquaculture affects the well-being of the social-ecological systems (SESs) in which it is embedded. Like any industry, aquaculture will have both positive and negative effects – costs and benefits – on the surrounding environment and communities.

Baynes Sound, on the east coast of Vancouver Island, is the site of 129 shellfish licenses which collectively produce half of all the shellfish cultured in the province: over 3,700 tonnes per year. Farms have existed in this area for decades, but there has been a more recent shift to deep water leases and a more widespread use of engines and technology. The farms are surrounded by more than 6,500 residents in several small communities.

Our study was conducted in these communities utilizing a mixed-methods approach to identify and measure the perceived ways that the shellfish aquaculture industry promotes and/or erodes community well-being as assessed by local residents. We began by conducting targeted semi-structured interviews with a variety of individuals including property owners who live upland of shellfish farms, residents involved with environmental and civic groups, resource managers/government agents, shellfish farm leaseholders, and owners of shellfish processing houses. A portion of the interviewees also engaged in participant-employed photography ('photovoice' – see Photo 2) which enabled these individuals to record their views on a theme visually and discuss their photos and views during an interview.

Photo 2 Shellfish aquaculture in Baynes Sound. Photo by anonymous interviewee who participated in the photovoice project.

Our findings demonstrate that the relationship between aquaculture and well-being is multi-dimensional, and includes subjectively interpreted dimensions of environment, economy, and experience. Positive and negative aspects of each dimension are shown in Table 2.

These dimensions are complex and inter-related. For example, the environmental changes related to shellfish aquaculture activities can directly affect objective aspects of ecological and economic productivity, but perceived changes in the natural environment also contribute to people's subjective assessments of well-being as residents subjectively consider the meanings and effects of those changes based on norms, individual values, and beliefs. Local economic activity and stimulation were priorities for residents but, to foster subjective well-being, many residents felt that economic activity should be locally owned, employ local people, be sustainable, provide sustainable jobs, and

Table 2 Effects of shellfish aquaculture on well-being in Baynes Sound across environmental, economic and experiential dimensions.

Dimensions	Positive components	Negative components
Environment	Industry as advocate Biodiversity enhancement Water filtration	Beach modification Predator netting Destruction of predators Bottom changes Species interactions Plastic pollution Carrying capacity
Economy	Tax-base Income Sustainable jobs	Non-local ownership Job quality Provenance of workers
Experience	Sense of place Identity Way of life Local history Local environment Local pride Community participation	Beauty/naturalness Debris Hazards and safety Noise Smell Alienation/separation

stimulate local vitality through connections to other local businesses. Perceptions about the ability of the shellfish aquaculture industry to meet these requirements varied, and many residents expressed a feeling they did not want the character of the area to be altered. Finally, we found that residents expressed ways that the effects of shellfish aquaculture can enhance or erode well-being through pathways that are neither environmental nor economic. The experience dimension encompasses those effects that alter residents' expectations of their lived experience, but may not lead to identifiable ecological or economic change.

In a second phase of this study, we conducted a mail survey (developed from the qualitative interview data) to assess the breadth and depth of perceptions about these dimensions within the Baynes Sound communities. Preliminary analysis of these data suggests several key findings. First is that within each dimension attitudes are variable, highlighting the fact that the way local residents view the impacts of aquaculture is variable. Second, several key variables were associated with this variability in expressed attitudes. Specifically, geography (namely residency on the smaller of the two islands in the sound), strong ecological worldview (as measured by New Ecological Paradigm score), and infrequent shellfish consumption were correlated with negative perceptions of the effects of shellfish aquaculture on well-being.

Conclusions

The results highlighted in both of these case studies have clear implications for oceans governance and management. For example, while divergent value sets are often present in governance processes, they can serve to impede those processes when: 1) the emphasis is on difference rather than commonality and 2) there is no mechanism to identify and incorporate the full range of those value sets into decision-making. The first case study demonstrates that the Q method may be one way to capture, compare, and incorporate ocean and seafood values into decisions. By eliciting a broad set of value statements, highlighting how values may group together, identifying common ground and highlighting points of disagreement, processes like the one described in this case study could provide participants with a common vocabulary that cuts across existing constituencies.

The second case study demonstrates that a multi-dimensional understanding of well-being moves assessments of effects of changes beyond trade-offs between jobs *versus* the environment, providing a more holistic way to understand local preferences for social-ecological conditions and how these conditions may be enhanced or diminished by coastal and marine activities. Aquaculture and other changes that modify SESs and the flow of ecosystem services are experienced and valued variably across communities, highlighting the need to be attentive to the local contextual realities that shape attitudes and objectives at very local scales.

Emerging integrated marine ecosystem-based management (EBM) planning processes for Canada's Pacific Ocean offer a place-based, collaborative approach to natural resource management that aims to restore and protect the health, function and resilience of entire ecosystems for the benefit of all organisms, while at the same time leading to social, cultural and economic benefits. For these processes to be successful, however, it demands a deep understanding of underlying values and preferences of individuals and communities, as well as how the impacts of activities such as aquaculture can be considered in a holistic and therefore, more meaningful and resonant way. Our hope is that research of the type presented here will contribute significantly to developing more effective and collaborative management objective setting processes, reducing conflict, and resulting in better resource management outcomes.

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Dr. Grant Murray (grant.murray@viu.ca) was appointed Canada Research Chair in Coastal Resource Management at Vancouver Island University in 2006. With graduate training in marine ecology and natural resource sociology, his interdisciplinary research involves the combination of elements from both natural and social sciences, and has focused on historical and current marine resource usage patterns in Mexico, the United States and Canada. His research interests include: 1) interdisciplinary marine environmental history using local ecological knowledge (LEK) in combination with archival sources and scientific information; 2) the relationship between local knowledge, marine resource management and social-ecological outcomes; 3) governance and aquaculture; 4) the cumulative effects of regulatory change on commercial fishing communities; 5) the environmental and social impacts of tourism; and 6) the governance of marine and coastal protected areas.

Dr. Linda D'Anna (linda.d'anna@viu.ca) is an ecologist who uses interdisciplinary approaches to investigate the interface among ecology, economy, and culture and its impact on ecological management and restoration efforts in coastal and estuarine systems. Linda's work explores how the socio-cultural components of coastal systems impact and are in turn impacted by the biological ones by focusing on the interconnectedness of these social-ecological systems – an interconnectedness that encompasses not only geographical, ecological, and physical contexts, but cultural and social ones as well. Her goal is to inform ecosystem-based management and process-based ecological restoration efforts that secure coastal resilience and wellbeing.

Dr. Pat MacDonald (pat.macdonald@viu.ca) holds a PhD in general management and an MBA from the Ivey School of Business at Western, a MA in Conflict Analysis and Management (Royal Roads), and a BComm (Queen's). Pat is interested in organizations' ability to generate strategic renewal and learning out of conflict. Recently she has examined the conditions that enable collaborative activity and learning between individuals, groups and organizations that have different views on salmon farming on Vancouver Island. She has also studied the strategic impact of conflict at the industry level in a comparative case study of the forestry and aquaculture industries in British Columbia. Pat has also consulted independently, helping a range of private, non-profit and government organizations develop strategies, implement major changes and manage inter-personal and inter-group conflict. She is a Chartered Mediator (CMed), a Project Management Professional (PMP), and a Certified Management Consultant (CMC).

Michele Patterson (michele.patterson@viu.ca) leads the VIU Institute for Coastal Research Aquatic Foods Initiative – a program that seeks to foster development of an innovative and sustainable aquatic food sector in BC; and broaden VIU's involvement in the sector through our extensive seafood portfolio including teaching, research, community engagement and infrastructure capacity. She is also the ICR's Program Manager. Prior to coming to VIU she spent 10 years with WWF-Canada, developing broadly supported, science-based conservation solutions to support sustainable coastal communities in BC as both Director, BC Conservation and concluding as Acting VP, WWF-Pacific Region. Michele has been involved in resource management, community economic development and conservation in British Columbia for over 20 years. She has expertise in: rural and aboriginal community issues; external and government relations, program management, and conservation policy development, planning and analysis. Michele has an MA degree from Royal Roads University's Environment and Management program (2006, Victoria, BC); and is currently a PhD Candidate (Geography) at the University of Victoria.

The 8th International Conference on Marine Bioinvasions

by Thomas Therriault and Lisa Drake

From August 20–22, 2013, the 8th International Conference on Marine Bioinvasions—the first held in Canada—was convened in Vancouver, British Columbia. Approximately 125 researchers, policy makers, and managers from 13 countries in North America, South America, Europe, Australia/New Zealand, and Asia arrived in Vancouver to exchange ideas and discuss the latest findings and progress in the global effort to understand and reduce the delivery, establishment, and spread of marine invasive species. This conference's theme, "*Biological Invasions in Changing Waters: Envelopes, Estuaries, and Evolution*", solicited papers on a variety of topics, including the role of some invasive species as ecosystem engineers, the intersection between invasive species and climate change, and the increasing use of molecular tools in invasive species studies. In addition, a poster session was held on the first evening that allowed presenters and attendees to mingle and learn about the latest findings in a relaxed atmosphere that included pizza and drinks (always helpful for breaking the ice!). A social gathering on the second night allowed continued discussion over snacks and drinks at the beautiful University of British Columbia gardens. An important part of this conference is the opportunity to informally discuss presentations, meet new colleagues, and forge new contacts. To this end, coffee breaks and meals hosted on site allowed these happy interactions to take place in a relaxed and inviting setting. On the last day conference delegates were free to explore the famed Beaty Biodiversity Museum on campus and each evening participants were able to sightsee or tour around Vancouver.

The conference co-chairs (and co-authors of this article), Thomas Therriault (Fisheries and Oceans Canada) and Lisa Drake (Naval Research Laboratory, USA), were supported by a diverse, international Scientific Steering Committee (SSC) and an extremely productive Local Organizing Committee (LOC) headed by Cathryn Clarke Murray (World Wildlife Fund/University of British Columbia). In addition to the efforts by the SSC and its advisors, the LOC, and three student interns, the conference received generous financial support from the North Pacific Marine Science Organization (PICES), the Second Canadian Aquatic Invasive Species Network (CAISN II), the National Oceanic and Atmospheric Administration (NOAA), the World Wildlife Fund (WWF), and the University of British Columbia (UBC). The conference was held at the main campus of UBC in Vancouver which allowed easy access to the botanical gardens and the Beaty Biodiversity Museum.

Dr. Thomas Therriault with the PICES-supported early career scientists at the 8th International Conference on Marine Bioinvasion.

The three invited plenary speakers began each day with timely and novel approaches to issues of invasive species research. Emma Johnston (University of New South Wales, Sydney, Australia) opened the conference by discussing how marine ecosystems are under pressure from a wide variety of stressors, including invasive species, and that research needs to consider how invasive species interact with these other stressors, particularly the cumulative effects which are much less predictable. James Carlton (Williams College – Mystic Seaport, USA) provided a moving and thought-provoking plenary about the potential introduction of invasive species associated with Japanese tsunami debris from the catastrophic magnitude 9.0 earthquake that hit off the coast of Japan in March 2011. Lastly, Thomas Therriault (Fisheries and Oceans Canada, Nanaimo) provided an overview of CAISN II and highlighted advancements on better understanding European green crab invasion dynamics in British Columbia. All presentations were well received and provided a starting point for continued discussion during coffee breaks, meals and especially over drinks. Plenary talks were followed by two concurrent sessions on each day and included topic sessions on: management of invaders, factors affecting invasion success, invasion vectors, invasion niche, invasion impacts, applying molecular tools, fish invasions, tunicate invasions, and crab invasions.

The input and participation of early career scientists historically has been an important aspect of the Marine Bioinvasions Conferences, both due to the contributions of early career scientists and the benefits to their professional development by participating in such events. Indeed, this conference was no different. Thanks to funding from PICES, it was possible to provide travel support to 14 of the 34 graduate students and postdoctoral fellows who applied. PICES offered travel support to two undergraduate students (Stephanie Hall and Katherine Rolheiser), eight graduate students (Johanna Bradie, Farra Chan, Elizabeth Sheets, Darragh Clancy, Brian Turner, Max Castorani, Carolyn Tepolt, and Brian Cheng), and four postdoctoral fellows (Emily Brown, Amy Fowler, Christine McLaughlin, and Amanda Kelley). Many of these award recipients were captured in a group photo.

In summary, the plenary talks, along with all of the presentations—approximately 110 papers and posters—engendered lively discussions during the sessions, the breaks, and the social events. The topics of the presentations were impressive: new ideas and approaches to invasion biology, clever field studies to address emerging hypotheses, and research results used to inform national and international policy. This clearly illustrates how the field of invasion biology has advanced since the first conference in 1999, owing largely to the researchers and policy makers who attend these conferences!

Planning has begun for the 9th International Marine Bioinvasions Conference tentatively scheduled for January 2016 in Sydney, Australia, and the 10th International Marine Bioinvasions Conference tentatively scheduled for 2018 in Argentina, so keep an eye out for further details in future issues of PICES Press.

Dr. Thomas Therriault (Thomas.Therriault@dfo-mpo.gc.ca) is a Research Scientist with Fisheries and Oceans Canada (DFO) at the Pacific Biological Station in Nanaimo, British Columbia. Tom is working on a number of aquatic invasive species research questions both within DFO and through the second Canadian Aquatic Invasive Species Network (CAISN II). He was the Principal Investigator for the Taxonomy Initiative of PICES Working Group 21 on Non-indigenous Aquatic Species that includes rapid assessment surveys for non-indigenous species. Within PICES, Tom now serves as Chairman of Science Board *(see p. 43 for more details).*

Dr. Lisa Drake is a Physical Scientist at the U.S. Naval Research Laboratory in Key West, Florida. She is a biological oceanographer and leads a team of biological and physical scientists, engineers, and a statistician who develop procedures and methods used in testing ballast water management systems. Specifically, the biology group is developing robust, automated analyses to determine protist and zooplankton viability.

Second Regional Climate Modeling Workshop

by Kyung-Il Chang, Enrique Curchitser, Chan Joo Jang and Kelvin Richards

Participants of the second Regional Climate Modeling Workshop (September 10–12, 2013, Busan, Korea).

A second Regional Climate Modeling Workshop (RCM-II) took place from September 10–12, 2013, in Busan, Korea. The workshop was co-organized by PICES, Seoul National University and the Korean Ministry of Oceans and Fisheries. Drs. Kyung-Il Chang (Seoul National University, Korea), Enrique Curchitser (Rutgers University, USA), Chan Joo Jang (Korea Institute of Ocean Science and Technology, Korea) and Kelvin Richards (International Pacific Research Center, USA) served as co-convenors. The first workshop (RCM-I) was held in 2011, in Seoul, Korea.

Workshop participants were given a warm welcome to the beautiful seaside city of Busan by Mr. Song-Hack Lim, Director for Marine Environment Policy Division of the Ministry of Oceans and Fisheries. In his remarks, Mr. Lim drew attention to the work of the Intergovernmental Panel on Climate Change (IPCC) and the concern for global society that IPCC reports have generated during the last 25 years. The Korean peninsula has experienced significant increases in temperature and changes in marine biology in its adjacent seas. Fishes from the subtropical oceans, for example, are replacing many of the native species of fish in the southern sea of Korea near Jeju Island. Mr. Lim pointed out that rapid physical and ecological changes in regional seas are a great concern and an ability to develop accurate projections of future climate change is of utmost importance for the Korean government, and encouraged participants to engage in vigorous discussions that will lead to more accurate regional climate models. Following Mr. Lim, Dr. Skip McKinnell (PICES Deputy Executive Secretary), introduced the activities of PICES Working Group 29 on *Regional Climate Modeling* (2011–2014) and described how international workshops like RCM-II are contributing to the goals of this expert group.

Workshop presentations were grouped on a thematic basis beginning with *Mesoscale and Sub-mesoscale Motions* on the first day, then *Regional Climate Projections* on the second day, and finishing with *Climate Variability in the North Pacific* on the final day. The full program of the workshop and extended abstracts can be downloaded from WG 29's webpage.

Invited speakers at the workshop supported by PICES included Drs. Shoshiro Minobe (Hokkaido University, Japan) and Michael Foreman (Institute of Ocean Sciences, Canada). Dr. Minobe presented on "*Regional influence of basin-scale wind stress variability via jet-trapped Rossby waves in the western North Pacific*". His main point was that jet-trapped Rossby waves are newly discovered features that are not yet captured by regional climate models whose zonal domain and spatial and temporal resolutions are insufficient to realize the jet. Model spatial resolution must be increased, perhaps by an order of magnitude. One consequence of missing this feature (in the Kuroshio Extension) is that jet-trapped waves create a different sea level anomaly pattern around Japan compared to linear long Rossby waves. Dr. Foreman spoke on "*Regional ocean climate projections for the British Columbia continental shelf*" and showed how regionally downscaled climate models were being used to support regional climate projections for the coast of British Columbia, Canada.

On the last day, a discussion session was moderated by Drs. Kelvin Richards and Enrique Curchitser. Questions stimulated by the workshop included: How useful are idealized process models? At what spatial resolution do results converge? How important are sub-mesoscale processes in a global sense? Is it possible to simply parameterize the impact of the sub-mesoscale? How much can be learned from one-way nesting? How to quantify the impact of global warming? What is the way forward – Limited area *versus* basin scale models?

The relative importance of sub-mesoscale processes sparked considerable interest and discussion. Dr. Jason Holt (National Oceanography Centre, UK) believed that they must be parameterized in global models and that super-parameterization might be a route to go. Dr. Richards suggested embedding downscaled models within global models. Dr. Paulo Calil (Universidade Federal do Rio Grande, Instituto de Oceanografia, Brazil) noted that when trying to understand the carbon cycle, for example, the parameterization must be based on physical understanding, and he emphasized a need to understand the influence of small-scale structures. Drs. Christopher Edwards (University California Santa Cruz, USA) and Kelvin Richards indicated that our ability to parameterize processes in large-scale models is limited because the processes are too complicated. That led to a question whether we can be clever enough to parameterize all of the important sub-mesoscale processes. "Probably not" was the response. Process studies though are useful to understand the sub-mesoscale approach. A question was also raised if sub-mesoscale processes need to be resolved in regional models and, if yes, then what resolution is needed? It was noted that: the response must consider distinguishing shelf seas from the open ocean (Dr. Holt), the decision probably depends on the context (Dr. Minobe), and we are not at a point yet to quantify the overall impact of sub-mesoscale processes and need to assess their importance (Dr. Richards). Dr. Annalisa Brocco (Georgia Institute of Technology USA) expected that the next IPCC assessment will use higher resolution without adding greater complexity. Dr. Richards reminded participants of Dr. Clara Deser's paper suggesting that 40 ensemble members are needed so that, at the present time, it might not be possible to afford higher resolution although it could be useful to have higher resolution for southern ocean winds, for example.

On discussing the need for RCM-III, there was a suggestion that it could be important to attract atmospheric and land surface modelers to the workshop. Recognizing that Korea was the host of RCM-I and RCM-II and may also be a host of RCM-III, Dr. Foreman asked about modeling issues of greater interest to Korea? Dr. Chang re-iterated what Mr. Lim had said in his welcome address – that sea level rise and ecosystem change are the two issues of greatest interest to the Korean government. He suggested that RCM-III might focus on physical/biological coupling, although noted that no one in Korea is doing ocean/atmosphere coupling. Dr. Minobe proposed the idea of a workshop or session on regional climate modeling that might include the scientists working in the Atlantic, possibly in conjunction with the 3rd International Symposium on "*Effects of climate change on the world's oceans*" (March 23–27, 2015, Santos, Brazil).

Dr. McKinnell closed the workshop with some encouraging words on the need for, and value of, regional climate models. It is not uncommon to find that GCMs are not capturing variability at the scales that are of interest to scientists working at regional scales.




Dr. Kyung-Il Chang (kichang@snu.ac.kr) is an Associate Professor at the Seoul National University (SNU, Korea), working on various aspects of physical oceanography of the East Sea: deep circulation and currents, hydrography and currents in Korea Strait, and interaction of near-inertial waves with mesoscale eddies. In PICES, he has been a member of the Physical Oceanography Committee (POC) since 2006 and a member of the CREAMS/PICES Advisory Panel since 2009, and he is currently serving his second term as Chairman of POC.

Dr. Enrique Curchitser (enrique@marine.rutgers.edu) is an Associate Professor at Rutgers University (USA). His main research interests are at the intersection of climate and ecosystems. His current projects range from downscaled coupled bio-physical modeling of the California Current and Bering Sea, the impact of climate change on coral bleaching in the Coral Triangle and the role of the Gulf Stream in the climate and social systems of the northeast U.S. Within PICES, he is a member of POC and Working Group 27 on Climate Variability and Change in the North Pacific, and co-chairs Working Group 29 on Regional Climate Modeling.

Dr. Chan Joo Jang (cjjang@kordi.re.kr) is a Research Scientist at the Korea Institute of Ocean Science and Technology (KIOST). His research interests include climate change analysis and modeling, observation and modeling for ocean turbulence mixing, and physical-biogeochemical couple models. In PICES, he co-chairs WG 29 on Regional Climate Modeling, and is a member of POC and WG 27.

Dr. Kelvin Richards (rkelvin@hawaii.edu) is a Professor at the Department of Oceanography and International Pacific Research Center, University of Hawai'i at Manoa. His research interests include ocean processes and dynamics, ocean/atmosphere interactions, and ecosystem dynamics. In the early 2000s he chaired the CLIVAR Pacific Panel and helped organize two PICES/CLIVAR workshops.

PICES 2013 Summer School on "*Ocean Observing Systems and Ecosystem Monitoring*"

by Jack Barth and Craig Risien

A 5-day PICES 2013 Summer School on "*Ocean Observing Systems and Ecosystem Monitoring*" was held from August 19–23, 2013, at Oregon State University's (OSU) Hatfield Marine Science Center, Newport, Oregon, U.S.A. The goals of the summer school were to 1) learn about in-water ocean observing, 2) work with multi-disciplinary sensors and analyzers in the laboratory, 3) make interdisciplinary measurements during an oceanographic cruise, 4) process and analyze in-water data, 5) answer some interdisciplinary questions about local ocean and estuarine dynamics, and 6) meet new people and have fun.

Thirty-three early career scientists representing all the PICES member countries attended the Summer School (Photo 1). Included in this number were students from Argentina, Australia, India, and the Philippines. Professor Jack Barth (OSU, MONITOR member) was the Principal Organizer and was assisted by the School Coordinator, Mr. Craig Risien (OSU). Instructors included Barth and Risien, as well as Francis Chan (OSU), Burke Hales (OSU), Waldo Wakefield (U.S. National Oceanic and Atmospheric Administration), Steven Rumrill (Oregon Department of Fish and Wildlife), Alicia Helms (South Slough National Estuarine Research Reserve), Cheryl Brown (U.S. Environmental Protection Agency), and R. Kipp Shearman (OSU). Much of the laboratory and field work was led by OSU Teaching Assistants Ata Suanda, Piero Mazzini and Colleen Wall.

The Summer School consisted of a series of classroom lectures, laboratory demonstrations of inter-disciplinary ocean sensors, an introduction to ocean observing platforms, and fieldwork on a research vessel to deploy ocean observing equipment at sea. We covered a range of sensors and equipment used to measure physical, biological and chemical properties of the ocean. Particular emphasis was placed on the measurement of temperature, salinity, dissolved oxygen and the partial pressure of carbon dioxide ($p\mathrm{CO_2}$). Students received practical experience with the programming, calibration, deployment, recovery, data file formats, and QA/QC protocols for time-series data. Each student took part in a half-day oceanographic cruise aboard OSU's R/V *Elakha*, conducting sampling along the estuary adjacent to the Marine Center. Students also gained an understanding of the ecological processes that contribute to marine ecosystem metabolism and how to estimate the relative importance of physical and biological contributions.

In preparation for the Summer School, the participants were asked to read about a dozen papers from a list that included detailed descriptions of analytical techniques for measuring oxygen and carbonate species, and a review of physical oceanographic sensors and their use on various platforms, including Argo floats and gliders.

The Summer School started with an introductory lecture about ocean and estuarine observing delivered by Dr. Barth.

Photo 1 Participants in the PICES 2013 Summer School on "Ocean Observing Systems and Ecosystem Monitoring" (August 19–23, 2013, Newport, Oregon. Photo by David Reinert (OSU).

He highlighted the importance of knowing the time and space scales of the phenomena of interest in order to design an effective ocean observing system. Dr. Barth also covered the many types of in-water oceanographic instruments and measurement platforms, and the challenges to their use such as keeping them in calibration, bio-fouling, energy demands, *etc*. After an introduction to the oceanography and biogeochemistry of Pacific Northwest waters, his lecture concluded with a description of the near real-time Ocean Observatories Initiative array being installed off Oregon and Washington. A series of lectures then followed, describing the scientific goals and relevant in-water sensors for studying physical oceanography (Dr. Shearman), ocean chemistry (Dr. Hales), ecosystem monitoring and metabolism (Dr. Chan) and fisheries oceanography (Dr. Wakefield).

After learning about physical, biological and chemical sampling techniques in the class lectures, the students broke up into groups of about eight and cycled through half-day laboratory sessions where they obtained "hands on" experience with various oceanographic sensors. In the physical oceanography laboratory, they learned how to operate a conductivity-temperature-depth (CTD) profiler, how to keep the individual sensors in calibration, and how to process data obtained with the CTD at sea. Students also learned how Acoustic Doppler Current Profilers (ADCP) operate, how to calibrate the internal compass inside the ADCP so that the raw velocities can be accurately converted to east-west and north-south currents, and how to interpret velocity time series. The physical oceanography session finished with a demonstration of how autonomous underwater gliders work and how CTD data can be obtained with this new oceanographic platform.

In the biological laboratory, students learned about measuring dissolved oxygen and using it to understand respiration and net community metabolism. They found out about both Clark electrode-type and fluorescence quenching-type dissolved oxygen sensors. Students learned about and completed Winkler titrations for measuring dissolved oxygen concentrations in samples obtained during the Summer School cruises. In the chemistry laboratory, students studied carbonate species in seawater and how to measure them accurately, and how to use an instrument to measure both the partial pressure of carbon dioxide ($p\mathrm{CO_2}$) and the total carbon dioxide ($\mathrm{TCO_2}$) from seawater samples and how to keep that instrument in calibration using reference samples (Photo 2). A similar system to this is presently being used to estimate ocean acidification in waters entering Oregon oyster hatcheries.

One of the highlights of the Summer School was the chance for students to participate in an oceanographic cruise to carry out a sampling program using the instruments and sensors they learned about in the classroom and laboratories. The students were split up into four groups and each group embarked on the R/V *Elakha* for a half-day cruise on the Yaquina Bay estuary. The cruises were designed to sample changes over two days, hence multiple tidal cycles, and to make measurements spanning from near the ocean upstream to the more freshwater-dominated end of the estuary.

Photo 2 PICES Summer School instructor Burke Hales (OSU) supervises PICES students, from left to right, Jianbo Luo (China), Renyan Liu (China), Ellen Tyler (USA), Chuning Wang (China), Tetsuichiro Funamoto (Japan), and Bo-ram Shim (Korea) as they operate a combined $p\mathrm{CO_2}/\mathrm{TCO_2}$ analysis system. Students analyzed samples they collected from various stations in Yaquina Bay while onboard the R/V Elakha in order to better understand the complex biogeochemistry of this estuary. Photo by Steve Rumrill (ODFW).

The students used the R/V *Elakha*'s flow-through surface seawater instruments for measuring salinity, temperature and chlorophyll fluorescence. They deployed a profiling CTD at several stations to reveal along-estuary gradients in salinity and evidence for vigorous tidal mixing (Photo 3).

Photo 3 Hiromu Ishiyama (Japan) and Sung Yong Kim (Korea) deploy a CTD rosette from the R/V Elakha. Photo by Jack Barth (OSU).

Students studied how to take uncontaminated water samples from a rosette bottom system and to prepare them for measuring dissolved oxygen, $p\mathrm{CO_2}$ and nutrients (Photo 4). They were thrilled to learn that water samples for $p\mathrm{CO_2}$ really are collected using beer bottles and a beer bottle capping device! On one of the half-day cruises, the students helped collect animals in the bay using a beam trawl towed on the sea floor in order to see the associations of various species with the along-estuary gradients in water properties (Photo 5).

Photo 4 PICES Summer School students sampling for dissolved oxygen onboard the R/V Elakha. Dubrava Krievskaya (Russia) adds chemical reagents to a dissolved oxygen sample taken with the ship's rosette with assistance of, from left to right, Sung Yong Kim (Korea), Anna Malek (USA) and Christine Cass (USA). Photo by Jack Barth (OSU).

Photo 5 PICES Summer School instructor Waldo Wakefield (NOAA) assists students, from left to right, Ellen Tyler (USA), Chuning Wang (China), Tetsuichiro Funamoto (Japan), Jianbo Luo (China) and Christina Frieder (USA) sort a beam trawl sample onboard the R/V Elakha. This particular sample taken from Yaquina Bay included a number of juvenile Dungeness crab. Photo by David Reinert (OSU).

In addition to the ship-based measurements, students learned how to deploy and recover an oceanographic mooring that sampled water velocity using an ADCP and water properties (temperature, salinity, dissolved oxygen) at the sea floor and at the sea surface. All of these data and water samples were used in the laboratory analyses and in learning about the Newport ocean-estuary system.

Because many of the Summer School students are interested in fisheries oceanography, Dr. Waldo Wakefield provided two very interesting tours of local fisheries research activities. The first was a tour of a Hatfield Marine Science Center laboratory where the effects of hypoxia and temperature on the growth of juvenile English sole and Dungeness crab are being studied. This work, led by OSU graduate student, Morgan Bancroft, involves the use of 21 fish tanks simulating a range of temperatures and dissolved oxygen levels found during the spring and summer months in Oregon coastal waters. The second tour was of the F/V *Excalibur*, docked in Newport and being prepared for a NOAA survey of groundfish along the U.S. west coast (Photo 6). Students were able to see both how fish are sampled and enumerated, and how ruggedized oceanographic instruments are used in the fish trawls.

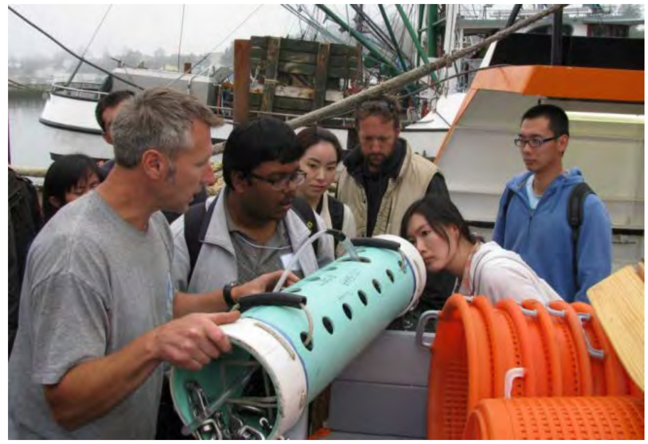


Photo 6 Victor Simon (NOAA Marine Biologist) onboard the chartered NOAA F/V Excalibur shows Irene Alabia (Philippines), Zhankun Wang (China), Sourav Maity (India), Hanna Na (Korea), Henry Potter (USA), Bo-ram Shim (Korea) and Chuning Wang (China) one of the ruggedized CTD instruments that are attached to the survey bottom trawl for profiling conductivity, temperature, depth, dissolved oxygen, turbidity, and fluorescence. Photo by Jack Barth (OSU).

The Summer School featured a lecture and tutorial about the global Argo float program delivered by Dr. Howard Freeland. After describing this amazing global program and showing off an Argo float, he demonstrated how to easily access the Argo data so that the students can use it in their own research. We also enjoyed an evening lecture by Dr. Robert Cowen, the new Director of the Hatfield Marine Science Center, who talked about his very exciting optical line scanner for making very detailed *in situ* images of zooplankton and small fish.

On the evening before the final day of the course, the students were challenged to synthesize what they had learned and measured in the field and laboratory to answer some fundamental questions about Newport's ocean-estuary system:

- What is the along-estuary *spatial variability* in physical, biological and chemical properties and what are the driving forces that create these variations?
- What is the *temporal variability* in physical, biological and chemical properties and what are the processes that create these variations across the observed range of time scales?
- What are the relative roles of the coastal ocean and local environmental factors in driving dissolved oxygen dynamics in the estuary, and which dominates at each of the stations we sampled along the estuary?

- Are there departures from conservative mixing predictions as revealed by generating plots of total carbon dioxide, alkalinity, nutrients, partial pressure of carbon dioxide and pH versus salinity from stations along the estuary?

One question was assigned to each group and the students rose to the challenge by doing their homework that evening and then presenting summaries on the final morning of the Summer School. The summaries reflected the students' greater understanding of interdisciplinary ocean observing and were a delight to hear.

The Summer School participants enjoyed meeting and collaborating with other young scientists from around the world. The working groups of about eight enabled close relationships to develop among participants. Discussion and camaraderie continued beyond the classroom and laboratory, with several evenings filled by informal gatherings and friendship. As one student put it, "the opportunity to interact with international students has been not only an excellent occasion to exchange views on each other's work, but also a perfect time to create new relations for future collaborations."

Photo 7 A way to say "Thank you for the wonderful experience" from our next generation of oceanographers. Photo by Steven Rumrill (ODFW).

To cap off the Summer School, we took a field trip along the Oregon coast, including walking in the frigid upwelled ocean waters, gazing out across the Pacific from high cliffs as banks of fog drifted by, and watching whales spout just offshore. Judging by student comments, the Summer School was a success: "It was an incredible experience and I am very grateful that I was chosen to participate in it;" "Nicely planned and efficiently managed; entire knowledge and expertise I received is really relevant to my field;" "The week was overall wonderful. The thought put into every detail was apparent (from science to food to field trips);" "Thank you for a wonderful experience." (Photo 7).

We appreciate the assistance of the PICES Secretariat and the Summer School Steering/Selection Committee who helped identify the 33 Summer School attendees from among a pool of 90 applicants. Main funding was from the U.S. National Science Foundation, with travel support from various U.S. and international programs, including the Ocean Observatories Initiative (OOI), the North Pacific Research Board (NPRB), the Integrated Marine Biogeochemistry and Ecosystem Research (IMBER) project, the Surface Ocean – Lower Atmosphere Study (SOLAS) project, and the Scientific Committee on Oceanic Research (SCOR). In addition, Oregon State University's College of Earth, Ocean, and Atmospheric Sciences (CEOAS) and Hatfield Marine Science Center provided substantial local support.

Dr. Jack Barth (barth@coas.oregonstate.edu) is a Professor of Oceanography and Associate Dean for Research in the College of Earth, Ocean, and Atmospheric Sciences (CEOAS) at Oregon State University. His research seeks to understand the spatially and temporally variable ocean circulation, water mass structure and ecosystem response in coastal waters including a focus on low-oxygen zones off Oregon. Within PICES, Dr. Barth is a member of the Technical Committee on Monitoring (MONITOR).

Mr. Craig Risien (crisien@coas.oregonstate.edu) is a Senior Faculty Research Assistant in the College of Earth, Ocean, and Atmospheric Sciences (CEOAS) at Oregon State University. He has conducted research using satellite-derived winds in relation to oceanographic features and is now actively involved in several ocean observing efforts off Oregon including the Northwest Association of Networked Ocean Observing Systems (NANOOS) and the Ocean Observatories Initiative (OOI).

NOWPAP–PICES Joint Training Course on "*Remote Sensing Data Analysis*"

by Genki Terauchi and Young-Je Park

From October 21–25, 2013, the joint training course on "*Remote sensing data analysis*" was held at the Ocean University of China (OUC), Qingdao, China, by the Special Monitoring and Coastal Environmental Assessment Regional Activity Centre (CEARAC) of the Northwest Pacific Action Plan (NOWPAP) and the North Pacific Marine Science Organization (PICES), supported by the International Ocean Colour Coordinating Group (IOCCG), the China National Environmental Monitoring Center (CNEMC), as well as OUC. The goal of the training course was to provide postgraduate students, young professional researchers and coastal manages (including local government officials) in the Northwest Pacific Region and its adjacent area with opportunities to obtain useful skills and knowledge of remote sensing techniques and its application in marine environmental research.

This training course series started in 2007 as part of the capacity building activity of CEARAC, and since has been organized in one of the NOWPAP member states (Japan in 2007, Korea in 2008 and Russia in 2011). Through the help of CEARAC Focal Points in China, the fourth training course took place at OUC. The CEARAC Secretariat, along with the members of the Organizing Committee, Dr. Young-Je Park (Korea Institute of Ocean Science and Technology, Korea; representing PICES), Dr. Roland Doerffer (GKSS Research Center, Germany; representing IOCCG), Ms. Lihuan He (CNEMC, China), Dr. Ling Sun (Meteorological Administration, China; representing NOWPAP WG 4) and Dr. Chaofang Zhao (OUC, China) prepared the course program and selected 23 trainees from 75 applicants from the NOWPAP member states, other Asian countries, Canada, Africa, Europe and the Middle East. The sponsoring organizations covered the costs of the course, so the training was provided free of charge. Also, 5 trainees were chosen for financial support so their transportation and accommodation expenses were paid.

After welcome addresses by Ms. Lihuan He (Director, Ecological Monitoring Department, CNEMC) and Dr. Xueen Chen (Deputy Director, International Cooperation and Exchange Office, OUC), Dr. Doerffer initiated the first day with an introduction to satellite oceanography and recent progress in ocean color remote sensing. His short film, "*The science of ocean color*", helped the trainees to better understand the lecture, including issues of uncertainties of ocean remote sensing. Then, Dr. Zhihua Mao (Second Institute of Oceanography, China) introduced on-going and future ocean observation satellite missions in China, new algorithms for atmospheric correction, and remote sensing applications such as red tide monitoring. At the end of the day, Dr. Mati Kahru (Scripps Institution of Oceanography, UCSD, USA) gave a lecture on WIM software and its challenges to utilize NASA ocean color data sets, and Dr. Doerffer introduced BEAM software and MERIS ocean color data sets.

The second day started with a lecture by Dr. Young-Je Park who introduced applications of ocean color remote sensing data, including oceanographic and operational uses, and gave an overview on the spatio-temporal variability of the bio-optical properties in the Northwest Pacific based on decade-long satellite observations. He then described the Korean Geostationary Ocean Color Mission, GOCI and GOCI-II, including its applications, data distribution and software, and encouraged the use of GOCI for marine environment monitoring to take advantage of its hourly observations. In the afternoon, Dr. Kahru gave the trainees opportunity to learn time series analysis of satellite data with WIM software. Sea ice data sets provided by NASA were chosen as an example, and the participants studied how to detect long-term changes of sea ice distribution in the Arctic. They then learned how to detect changes in time series of ocean color data obtained from the NASA ocean color webpage.

Photo 1 Dr. Joji Ishizaka lecturing on the third day of the training course.

Dr. Joji Ishizaka (Hydrospheric Atmospheric Research Center, Nagoya University, Japan) started the third day with a lecture on primary production (Photo 1). A brief explanation on primary production was given and evaluation of satellite-based ocean color models in coastal and pelagic region across the globe was presented. The trainees learned how to estimate primary production with ocean color satellite data. Dr. Ishizaka then introduced a chlorophyll-*a* estimation algorithm for turbid water produced under Yellow Sea Large Marine Ecosystem Regional Ocean Color Algorithm Development and discussed seasonal and interannual variations of chlorophyll-*a* concentration in the East China Sea and Yellow Sea and their possible linkages with eutrophication and other ecosystem changes such as macro algae blooms, occurrence of red tides and abundance of giant jellyfish. Then, Dr. Kahru emphasized the importance of validating satellite-derived information and provided materials for hands-on exercises (Photo 2). The trainees learned how to validate satellite-derived chlorophyll-*a* with *in-situ* measured values using WIM software, and how to compare satellite derived chlorophyll-*a* values among different sensors for detecting long-term changes using a series of ocean color sensors.

Photo 2 Dr. Mati Kahru during hands on practice.

On Day 4, Dr. Leonid Mitnik (V.I. Il'ichev Pacific Oceanological Institute, FEB RAS, Vladivostok, Russia) gave a lecture on utilization of Landsat images for monitoring of the marine environment. He encouraged the use of Landsat images that have been available for more than 30 years since Landsat-1 was launched in 1972, and explained various uses of these images to detect oceanic phenomena such as sea surface currents, temperature, eddies, river plumes, algae blooms, and oil spills. Dr. Doerffer then introduced future Sentinel missions of the European Space Agency: Sentinel-2 for land applications and Sentinel-3 for ocean applications. An Ocean and Land Color Instrument (OLCI) will be onboard Sentinel-3 as a follow-on sensor of the MERIS instrument on board Envisat, and it is expected that long-term changes of the marine environment will be monitored by OLCI. In the afternoon, he conducted a hands-on excise on correction, verification and validation of MERIS data using sample data sets on BEAM software.

On the final day, two lectures on oil spill monitoring were given by Dr. Mitnik and Dr. Chaofang Zhao. Dr. Mitnik reviewed theories of remote sensing of oil spills and sea slicks, and demonstrated satellite images on oil spills detected by synthetic aperture radar, optical sensors and laser fluorosensors. Dr. Zhao presented oil spill distribution maps of the Yellow Sea and East China Sea and introduced efforts to detect oil spills using remote sensing techniques and a Lidar system at the Ocean Remote Sensing Institute (OUC), showing fluorescence characteristics of different oil types. In the afternoon, all participants were given chances to ask the lecturers questions and to work by themselves to further follow the hands-on exercises conducted during the course. Dr. Fang Liu (Director of Marine Monitoring Department, CNEMC) then presented certificates to all trainees and congratulated them on their completion of the course. In the evening, all participants got to enjoy a farewell party hosted by CEARAC.

In the seven years since the first training course was held on remote sensing data analysis for marine environment conservation in the Northwest Pacific region, significant progress has been made in the field of satellite oceanography. Now, with more than a 15-year record of ocean color data of the global earth, we can detect mid-term changes in the marine environment. Furthermore, hourly observation of the sea surface has became possible with the success of the Korean GOCI mission that, for the first time in the history, carries an ocean color sensor on a geostationary satellite. The Northwest Pacific region is becoming the most active region in the field of satellite oceanography, and CEARAC continues to work in this field to develop tools for environmental planning and management.

This 5-day course provided all the trainees an opportunity not only to obtain and/or improve their knowledge on the marine environment and ocean remote sensing, but also to communicate and develop friendships and partnerships with people of the same interest.

Last, we would like to express our special thanks to Dr. Chaofang Zhao and his team for their tremendous efforts and help provided before and during the training course. With their warm hospitality, we all enjoyed the intensive 5 days in the beautiful marine city of Qingdao!

Mr. Genki Terauchi (terauchi@npec.or.jp) is a Senior Researcher at the Special Monitoring and Coastal Environmental Assessment Regional Activity Centre of the Northwest Pacific Action Plan (NOWPAP) in Japan. His research interests include the assessment of eutrophication status with ocean color remote sensing data and mapping seagrass species with hyperspectral sensors.

Dr. Young-Je Park (youngjepark@kiost.ac) is Director of the Korea Ocean Satellite Center (KOSC), Korea Institute of Ocean Science and Technology (KIOST), where he is leading the Geostationary Ocean Color (GOCI) Mission. His research area includes calibration and validation, algorithm development, applications of GOCI data.

6th Surface Ocean – Lower Atmosphere Study (SOLAS) Summer School

by Emilie Brévière

From the initial proposal to develop the Summer School during the first SOLAS conference in Damp, Germany, in early 2000, it has been the sincere wish of the SOLAS Scientific Steering Committee and the organizers that the next generation of SOLAS scientists be intellectually prepared to conduct exemplary science in a rapidly changing world. SOLAS believes that by providing excellent training, it adequately prepares future proficient scientists to contribute to the understanding of global change and its significant environmental and societal challenges. The SOLAS Summer School is a 2-week advanced international capacity-building program for early career scientists. The SOLAS Summer Schools are an integral part of the project SOLAS. As per today, 427 young scientists have been trained to understand the nature of air–sea interactions, including biogeochemical and physical processes and feedbacks.

Following on the success of all five previous schools, the 6th SOLAS Summer School took place from August 23 to September 2, 2013, in Xiamen, Fujian Province, P.R. China, directed by Véronique Garçon (CNES/LEGOS, France) and Minhan Dai (Xiamen University). The school brought together (Photo 1) 69 early career scientists from 24 countries, mostly PhD-level students, and 15 world-leading scientists, from a variety of fields, for a combination of plenary lectures and hands-on practical workshops in small groups on not only core SOLAS science but also on soft skills, such as scientific communication. Its comprehensive schedule provides the next generation of scientists opportunities to interact and network with their peers. One third of the students came from PICES member countries, and PICES kindly fully supported three of them to attend the school.

The first part of the school included a mixture of lectures on basic SOLAS topics and poster sessions, the second part consisted of hands-on practicals in small groups, and the last part was a mixture of lectures on more advanced SOLAS topics and 5-minute oral presentations by students in plenary.

Photo 1 The participants, lecturers and instructors of the 6th SOLAS Summer School (August 23 to September 2, 2013, Xiamen, P.R. China).

Photo 2 Students exchanging research results during an evening poster session.

On the first 3 days, every student presented a poster displaying his/her research at the evening poster sessions (Photo 2). These sessions allow students to learn about each other's research topics from the very first days of the school and, therefore, to facilitate scientific interactions amongst participants. A committee composed of lecturers selected the four posters to receive the best poster award. We congratulate Shlomit Sharoni (Israel), Hilary Palevsky (USA), Young-Shin Kwon (Korea) and Meri Eichner (Germany) for their excellent poster contribution.

Photo 3 Maurice Levasseur giving his plenary lecture on marine ecology to a captivated audience.

Over the duration of the school, the 1-hour lectures presented an insightful depth of the full breadth of SOLAS science, including an introduction to SOLAS (Véronique Garçon); the carbon and iron cycles (Laurent Bopp and Phil Boyd); greenhouse and trace gases and their relationship to climate change and its variability (Laurent Bopp, Peter Liss and Alberto Piola); atmospheric chemistry and modeling (Roland von Glasow); air–water gas exchange (David Ho); ocean physics and coastal processes (Alberto Piola and KK Liu); remote sensing and time-series observations (I-I. Lin, Phil Boyd and Eric Saltzman); marine ecology, aerosols, genomics and macronutrients (Maurice Levasseur (Photo 3), Eric Saltzman, Phyllis Lam and Phil Boyd); solar radiation in the ocean (David Kieber); and biogeochemical modeling and its changes over long time-scales (Véronique Garçon and Meixun Zhao). As well as the lectures, special sessions were adopted to deal with issues that arise when working within the world of science. These included sessions on ethics in science (Eric Saltzman), scientists and the press (Phil Boyd) and changing Earth (Kitack Lee).

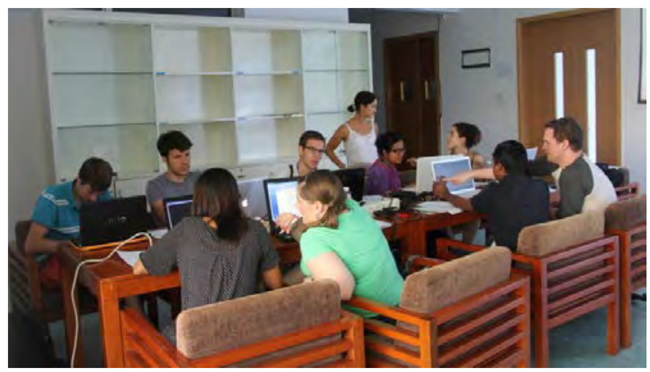


Photo 4 Phyllis Lam and 'her' students during the marine molecular ecology hands-on practicals.

Photo 5 Mingxi Yang running the gas exchange hands-on practical.

Half way through the school, the students took part in hands-on practicals in small groups where they were introduced to techniques used within the field (Photos 4 and 5). Ran by lecturers, this encompassed atmospheric and carbon cycle modeling, marine molecular ecology, gas exchange, laboratory and cruise work on the University of Xiamen Research Vessel *Ocean II* in the Jiulong River Estuary (Photo 6).

Photo 6 Students collecting water samples from the CTD Niskin bottles (top) and a net deployed to sample phytoplankton and zooplankton (bottom) during the cruise hands-on practicals on board the R/V Ocean II in the Jiulong River Estuary.

Communication workshops were also conducted in which the students were given guidance and constructively criticized on maximizing opportunities of presenting their research, writing and designing posters and papers. Before the school the students were assigned to prepare and bring to the school their own 5-minute oral presentations. Every student then gave a presentation, using power point, in plenary sessions during the second half of the school. This exercise, taking place right after the mandatory practical workshop on scientific communication, allowed the students the opportunity to immediately draw on their newly acquired skills to present their improved work to the rest of the school. A committee composed of lecturers selected three oral presentations for best presentation awards: Eva Mayol (Spain), Natalie Freeman (USA) and Neil Clark (UK). The students themselves also selected three of their peers to receive a best presentation award: Jana Schneider (Germany), Raissa Philibert (South Africa) and Shlomit Sharoni (Israel). Congratulations to all six of them!

All the participants made the most of the available free time by discovering and enjoying the Chinese culture of the Fujian Province.

We would like to acknowledge the generosity of the numerous sponsors of the 6^{th} SOLAS Summer School, such as PICES, Asia-Pacific Network for Global Change Research, Scientific Committee on Oceanic Research, State Key Laboratory of Marine Environmental Science, National Natural Science Foundation of China, Natural Environment Research Council, Xiamen University, Centre National d'Etudes Spatiales, Ocean Carbon and Biogeochemistry and many more.

Every edition of the SOLAS Summer School is a smashing success as demonstrated by the high and stable number of applications received every time (up to 230) and the excellent results out of the anonymous evaluation forms that all participants, students and lecturers, filled in last hours before departure. Finally, the 7^{th} SOLAS Summer School will most likely take place in 2016; exact dates and location are still under investigation. Follow us at www.solas-int.org.

Photo credit: 6^{th} SOLAS Summer School Local Organizer.

Dr. Emilie Brévière (ebreviere@geomar.de) received a French engineering diploma in chemistry and chemical engineering (2001) from the Ecole Nationale Supérieure de Chimie de Mulhouse, France and a Ph.D. in Oceanography (2005) from the University Pierre et Marie Curie, Paris, France. She is a marine biogeochemist with a research interest focussing on CO_2 fluxes in the Southern Ocean. Since 2005, she works as science manager for Global Environmental Change programmes. She is currently the SOLAS International Project Office Executive Officer based at GEOMAR Helmholtz Centre for Ocean Research in Kiel, Germany; she coordinates international SOLAS activities.

News of the Northeast Pacific Ocean

by William Crawford

For a few months in late summer 2013, the west coast waters from Oregon to Alaska warmed by several degrees, bringing unusual marine life to the continental margin. This warm interval came after almost seven years of mainly cool sea surface temperature.

An unusually warm near-surface temperature within Canadian waters was observed in September off southwest Vancouver Island, as measured during the La Perouse survey by Fisheries and Oceans Canada (DFO). Figure 1 presents the temperature distribution, along with a map of station locations and a graph of individual profiles of ocean temperature. The individual profiles of temperature reveal waters as warm as 18°C. The zooplankton sampled during this cruise were dominated by gelatinous animals such as salps and doliolids. There were many *Corolla spectabilis* visible, swimming at the surface. These were last seen off the west coast in warm-water summers of 2005 and 1997. Cold water copepods and chaetognaths were almost completely absent from the samples in September 2013 until sampling reached northern Vancouver Island where the community structure returned to 'normal'. During another DFO survey in late summer, Pacific saury (*Cololabis saira*) were noted west of Vancouver Island. These fish have been caught in fisheries surveys in the past, but the numbers were higher in 2013. In addition, more albacore tuna (*Thunnus alalunga)* and juvenile sablefish (*Anoplopoma fimbria*) were observed near the coast than in previous summers. These three species of fish are associated with warmer waters than are normal for the Canadian west coast.

The warm episode in late summer 2013 contrasts with the prevailing conditions of the past few years. Since 2006, the ocean surface temperature along the North American west coast has been cooler than average, except for a brief interval during the 2009–2010 El Niño. The cool waters extend from the eastern Bering Sea south to the tip of Baja California, and are associated with a shift in the major atmospheric pressure systems of the Northeast Pacific. The close links between changes in air pressure and ocean temperature are surprisingly robust for this region and are described below.

Climatologists generally use a recent 30-year period to represent average atmospheric conditions, with the years 1981 to 2010 forming the most recent epoch. Average sea surface air pressure (SSP) and temperature (SST) are presented in Fig. 2 for this 30-year period. H and L in Fig. 2a denote the North Pacific High Pressure System and the Aleutian Low Pressure System, respectively. The former expands in area and increases in pressure in summer, whereas the latter expands in area and decreases in air pressure in winter. This seasonal change brings dry summers and wet winters to the North American west coast from Oregon to British Columbia.

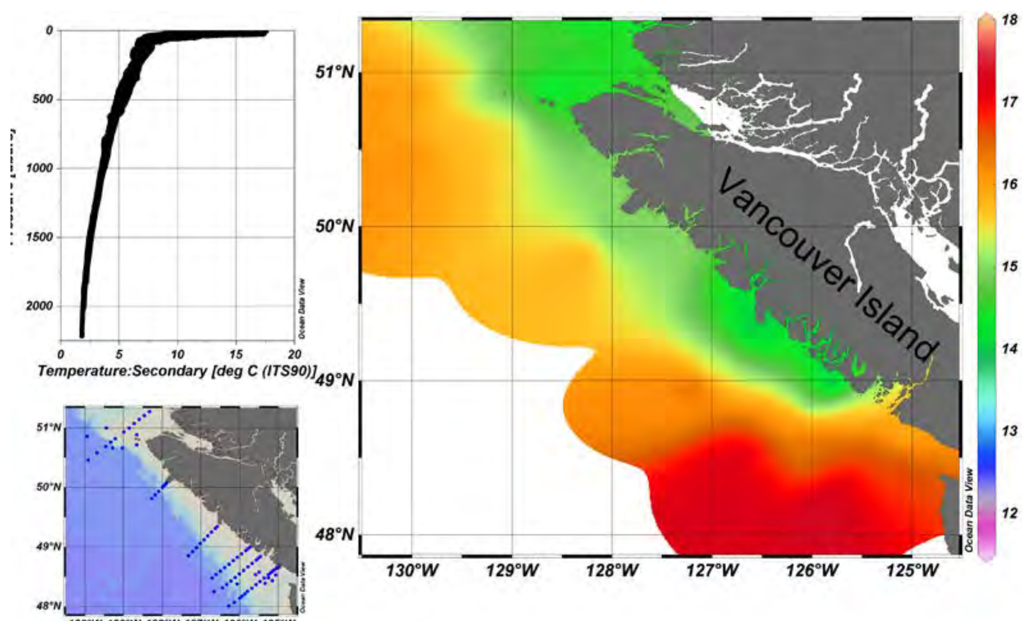


Fig. 1 Ocean conditions in September 2013 off the west coast of Canada. At right is a contour map of ocean temperature measured at the top of CTD profiles whose locations are shown at bottom left. Temperature profiles of sampling stations are presented at top left. Figure provided by Douglas Yelland, Fisheries and Oceans Canada.

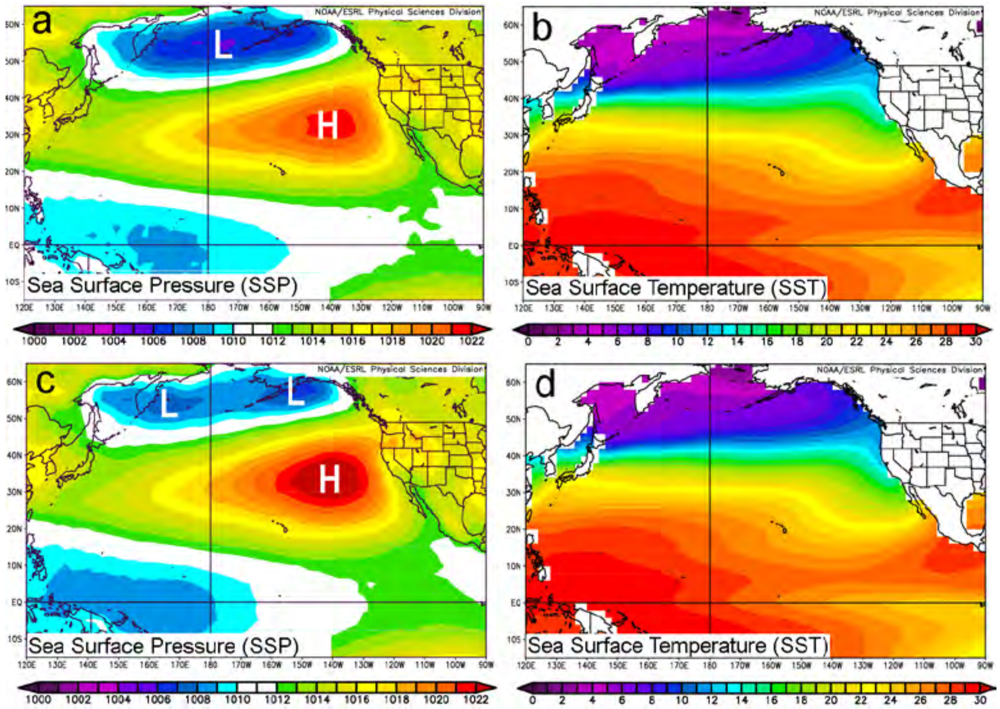


Fig. 2 (a) Sea surface air pressure (SSP, millibars) and (b) sea surface temperature (SST, degrees Celsius) for the North Pacific averaged over all months from January 1981 to December 2010. (c) Sea surface air pressure (SSP) and (d) sea surface temperature (SST) for the North Pacific averaged over all months from August 2006 to July 2013, except for the 1-year period of August 2009 to July 2010 during an El Niño event. Image provided by the NOAA/ESRL Physical Sciences Division, Boulder Colorado from their website at http://www.esrl.noaa.gov/psd/.

Since 2006, the average air pressure distribution over the Northeast Pacific Ocean has shifted relative to average conditions, with a stronger North Pacific High (NPH) and weaker Aleutian Low (AL) after 2006. Comparison of Figs. 2a and 2c shows higher air pressure in the core of the NPH in 2006 to 2013. A bigger change can be seen in the AL, whose centre is weaker and shifted to the east in Fig 2c compared to Fig. 2a. Although SST changed along with the shifting sea surface pressure, the changes are not at first noticeable between Figs. 2b and 2d. A careful comparison reveals decreased SST along parts of the North American coast in 2006 to 2013, but the drop in temperature of a degree or so is difficult to observe when the full range is about 25°C.

The relationship between shifting SSP and SST is more easily seen in their anomalies, although changes can be difficult to understand at first. Figure 3 presents sea surface pressure anomaly (SSPA in Fig. 3a) and sea surface temperature anomaly (SSTA in Fig. 3b) for the same years as for Figs. 2c and 2d. There was an anomalously positive SSPA centred over the Aleutian Islands and extending far to the south in the Gulf of Alaska in 2006 to 2013, as shown in Fig. 3a. In contrast, SSPA was negative over most of North America. The presence of these two opposite-sign anomalies created an east–west gradient in air pressure that set up an anomalous wind that blew along the direction of the black arrow in Fig. 3a, generally from the north. (Anomalous wind from the north could actually

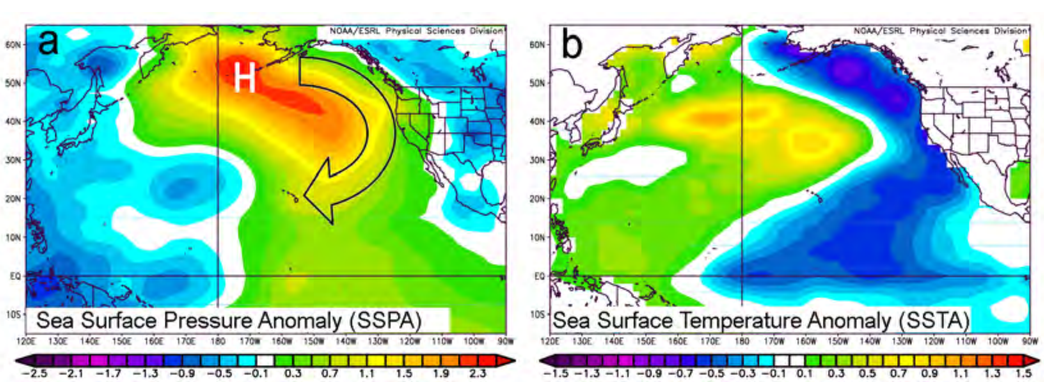


Fig. 3 (a) Sea surface air pressure anomaly (SSPA, millibars) and (b) sea surface temperature anomaly (SSTA, degrees Celsius) for the North Pacific Ocean, averaged over all months from August 2006 to July 2013, except for the 1-year period of August 2009 to July 2010 during an El Niño event. The black arrow in (a) represents anomalous winds due to the anomalous SSPA. The Equator and 180ºW lines are show in black. Image provided by the NOAA/ESRL Physical Sciences Division, Boulder Colorado from their website at http://www.esrl.noaa.gov/psd/.

be due to weaker wind from the south. It is this interpretation that often confuses.) The arrow in Fig. 3a extends all along the eastern side of the positive SSPA, representing a cold wind anomaly in the direction of upwelling along the west coast of North America. The combination of cool wind and increased coastal upwelling (or weaker downwelling) drove the negative SSTA observed in the eastern Gulf of Alaska in Fig. 3b. In addition, the broad centre of the high SSPA of Fig. 3a is a region of enhanced Ekman convergence, which led to positive SSTA for this region in Fig. 3b.

This pattern of Fig. 3 was interrupted from August to October 2013, when a shift in air pressure and wind brought high ocean temperature to west coast waters, and also to adjacent waters offshore. This event is represented in Fig. 4. The yellow arrow in Fig. 4a shows the direction of the wind anomaly, blowing counterclockwise around the low pressure anomaly, carrying warm air from the south, and blowing along the coast in direction to force coastal downwelling. Both factors lead to positive SSTA in waters of the Gulf of Alaska, as shown in Fig. 4b, between the centre of the negative SSPA and the coast. This air pressure pattern persisted for only a few months, but it was able to reverse the pattern of positive and negative SSTA of Fig. 3d that persisted until July 2013. Although the SSTA image of Fig. 4b lags the SSPA image by several weeks, the actual lag of temperature anomaly relative to pressure anomaly can vary considerably, depending on the strength of the pressure field and accompanying winds, and distance to the continental margin.

The sudden warming along the coast was captured by the daily sampling program of Fisheries and Oceans Canada at its coastal stations. Time series of surface temperature are shown in Fig. 5 for Langara Island and Amphitrite Point along the Canadian west coast. These locations are plotted in Fig. 4b, with Amphitrite Point located on the west coast of Vancouver Island and Langara Island to the north.

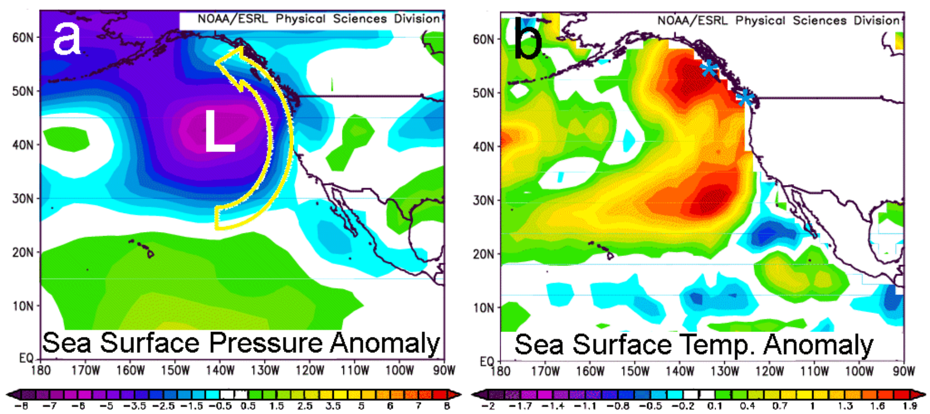


Fig. 4 (a) Sea surface air pressure anomaly (SSPA, millibars) averaged from August 21 to September 12, 2013. (b) Sea surface temperature anomaly (SSTA, degrees Celsius) for the Northeast Pacific Ocean, averaged from September 5 to September 26, 2013. The yellow arrow in (a) represents anomalous wind due to the SSPA. The reference period for the anomaly is January 1981 to December 2010. Blue stars in (b) show positions of lighthouse stations where temperature is sampled daily. Image provided by the NOAA/ESRL Physical Sciences Division, Boulder Colorado from their website at http://www.esrl.noaa.gov/psd/.

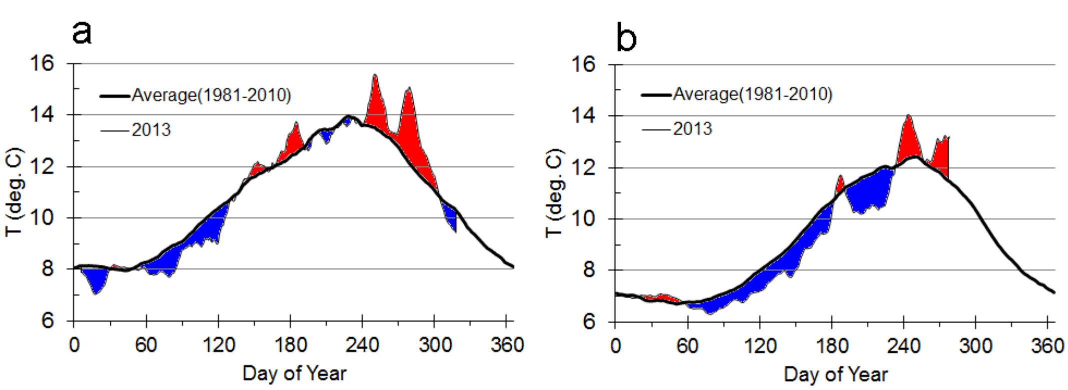


Fig. 5 Time series of sea surface temperature measured at shore at (a) Amphitrite Point and (b) Langara Island. The thick line is the average temperature for 1981 to 2010. The thin line is the temperature measured in 2013. Red and blue shading shows the magnitude of positive and negative temperature anomalies. Both time series have been passed through an 11-day low-pass running-mean filter. Day 240 is August 28 and day 300 is October 27. Water samples have been collected and recorded daily at these stations for almost 80 years, mainly by lighthouse keepers. Additional information and data are found at http://www.pac.dfo-mpo.gc.ca/science/oceans/data-donnees/lighthouses-phares/index-eng.html.

(Continued on page 39)

The Bering Sea: Current Status and Recent Trends

by Lisa Eisner

Climate and oceanography

The spring and summer of 2013 included rather typical weather for the eastern Bering Sea shelf. The mean sea level pressure during this period was slightly greater than normal (Fig. 1), which represented a continuation of the pattern observed during the previous 6 months. The SLP (sea level pressure) pattern supported weak (~1 m/s) wind anomalies in an anti-cyclonic (clockwise) sense over the Bering Sea.

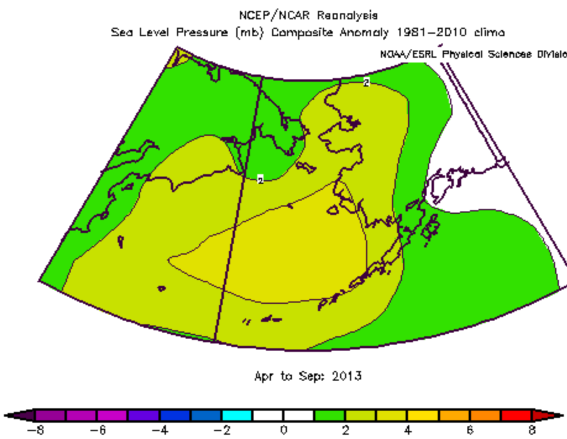


Fig. 1 NOAA SLP (mb) composite anomaly for April–September 2013 (deviations from 1981–2010 climatology). Figure courtesy of N. Bond.

The relatively heavy sea ice from the previous winter appears to have had effects on the weather of the eastern Bering Sea into the spring of 2013. Daily air temperatures at St. Paul Island (Fig. 2) were generally lower than normal during April and May of 2013, and there were two record daily minimums set in each month. This effect did not persist, with the summer of 2013 featuring temperatures near normal in an overall sense, and a couple of daily measurements in July reaching all-time highs. Relatively warm weather continued over the Bering Sea and mainland Alaska into the first half of November 2013, which is apt to delay the development of sea ice in the northern Bering Sea for the winter ahead.

Western Bering Sea: Russian TINRO-Center fisheries oceanography surveys

The research vessels, "Professor Kaganovskiy" and "TINRO", conducted surface trawl surveys in summer (June–July) and fall (September–October) in the western Bering Sea in 2002–2013. A goal of these surveys is to provide abundance estimates to improve forecasts for pink salmon (*Oncorhynchus gorbuscha)* fisheries.

In the summer of 2013, total biomass and abundance of nekton species was estimated at 174 thousand tons (th t) (Fig. 3). Most of the biomass was Pacific salmon (104 th t, 83% of the total fish biomass). Maturing chum salmon was the dominant species (62% of the total salmon biomass), although abundance was lower than that in previous years, likely due to a delay in migration to the western Bering Sea. Biomass and abundance of pink salmon were very low (40–45 million individuals (mln ind)) for the first time in the last decade among odd years. Commercial catches corroborated these decreases of pink salmon abundance in the eastern Kamchatka region in 2013. Abundance of juvenile pink salmon in fall 2012 was also tenfold lower (95 mln ind) compared to previous generations (Fig. 4).

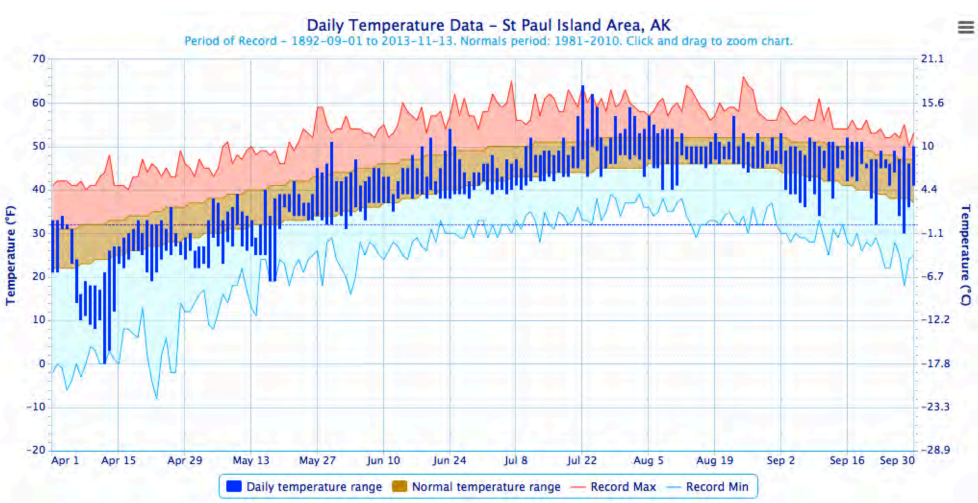


Fig. 2 Daily air temperature (°F) at St. Paul Island April–September 2013. The reddish and aqua lines at the top and bottom, respectively, refer to the all-time high and low temperatures for each date; the tan lines in the center refer to the average daily high and low temperatures for each date. The period of record is 1892 to present. Figure courtesy of N. Bond.

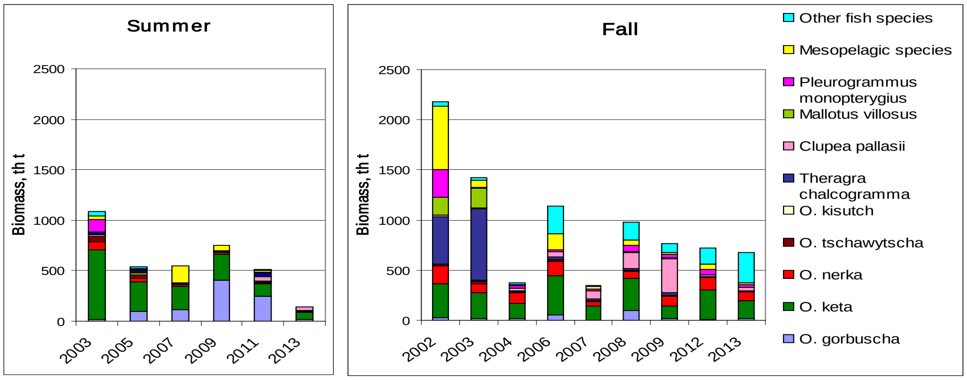


Fig. 3 *Nekton biomass (thousand tons) the upper layer (0–50 m) in the western Bering Sea in fall 2002–2013. Note: no observations in 2004 and 2013 in the Anadyr Bay. Figure courtesy of O. Temnykh.*

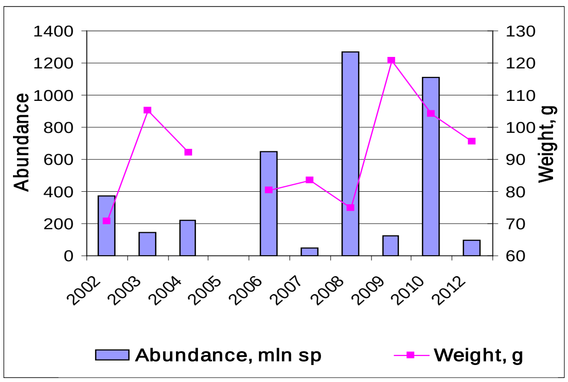


Fig. 4 *Interannual variability of juvenile pink salmon abundance (millions of individuals) and biomass in the western Bering Sea in fall 2003–2012. Note: in 2004, abundance of pink salmon was underestimated due to early migration to the ocean. Figure courtesy of O. Temnykh.*

In fall 2013, the total salmon biomass and abundance were estimated at 291 th t and 452 mln ind. Pacific salmon dominated in terms of biomass among nekton species (comprising 43% of the total fish biomass and 37% of the total nekton biomass, Fig. 3). For immature salmon, only chinook salmon showed a clear decrease since 2007 (Fig. 5). Abundance of chum and sockeye salmon was low in 2007–2010, but increased in 2012–2013. Changes in abundance and distribution of these immature salmon in the western Bering Sea were studied in relation to hydrological and forage conditions (Zavolokin and Khen 2012). The decrease in abundance coincided with a temporary weakening of inflow from the Pacific Ocean to the northwestern Bering Sea. In 2012, water inflow in the western Bering Sea increased, and salmon biomass tended to increase as well. This result shows the importance of oceanic waters for immature salmon survival in the Bering Sea.

Northeastern Bering Sea: Fisheries oceanography surveys

The northeastern Bering Sea portion of the Arctic Ecosystem Integrated Survey (EIS), funded in part by the Coastal Impacts Assistance Program, Arctic Yukon Kuskokwim Sustainable Salmon Initiative, and U.S. Bureau of Ocean Energy Management, was completed in September 2013 aboard the F/V "Bristol Explorer". The northeastern Bering Sea is a principal rearing area for western Alaska juvenile chinook salmon stocks, so research in this region is essential for understanding variations in chinook salmon abundance and associated environmental forcing factors.

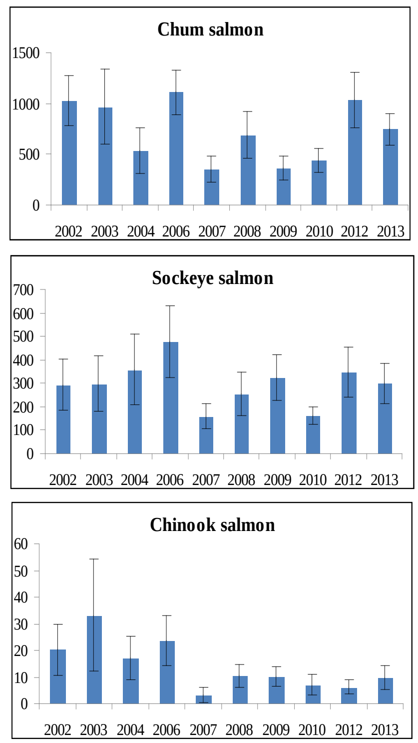


Fig. 5 *Abundance (ind/km^2), with standard error bars, of immature Pacific salmon in the deep-water regions of the western Bering Sea in fall of 2002–2012.*

Juvenile chinook salmon catch during 2013 (n = 523) was the largest catch in the this region since the inception of northeastern Bering Sea surface trawl surveys in 2002, and was significantly larger than in 2012 (n = 90) (Fig. 6). Age-0 Pacific herring catch in the northeastern Bering Sea during 2013 (n = 186,445) was also significantly higher than in previous surveys and the only year where catch has exceeded 50,000.

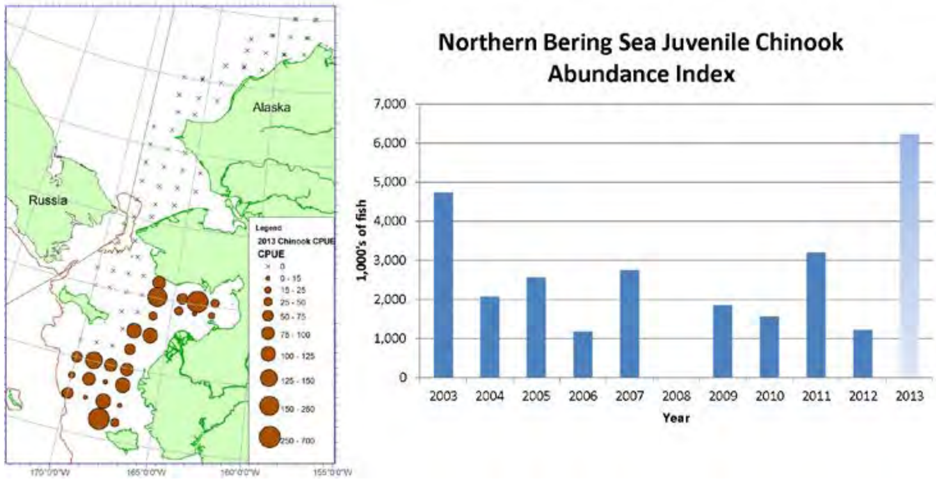


Fig. 6 Juvenile chinook salmon distribution for 2013 in catch per unit effort (CPUE), left, and abundance index for 2003–2013, right. Note: the 2013 abundance index is preliminary. Figure courtesy of J. Murphy.

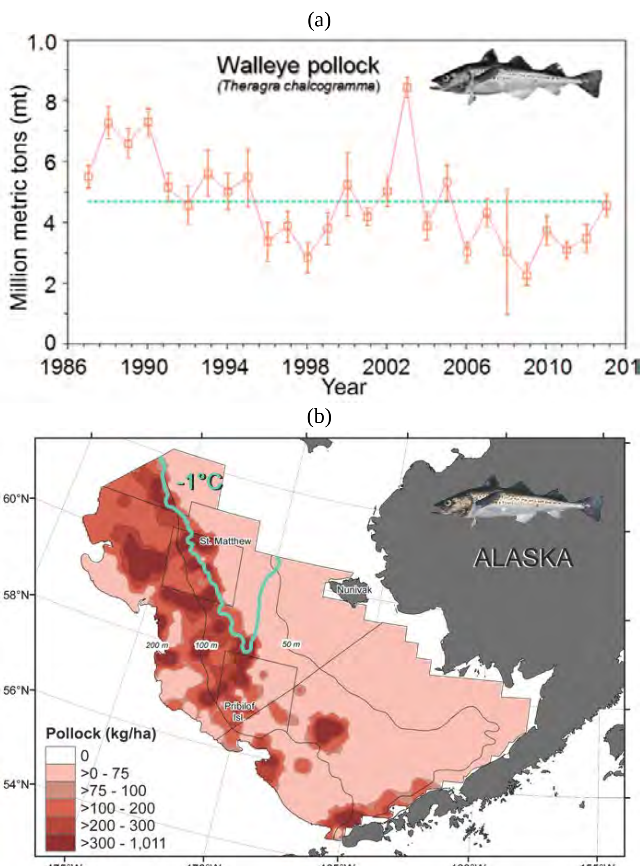


Fig. 7 (a) Walleye pollock biomass, with standard error bars, in NOAA AFSC bottom trawl surveys in the eastern Bering Sea for 1986–2013 and (b) walleye pollock distribution and location of –1°C bottom water during 2013 NOAA AFSC bottom trawl surveys. Figures courtesy of R. Lauth.

Eastern Bering Sea: Bottom trawl surveys

In June–July 2013, the NOAA Alaska Fisheries Science Center (AFSC) conducted its 32nd annual eastern Bering Sea shelf bottom trawl survey. The survey biomass of walleye pollock (*Gadus chalcogrammus*) increased by 31% compared to 2012 (Fig. 7a), primarily due to the high abundance of 5-year-olds from a strong 2008 year class. Pollock were in highest abundance on the northwestern outer middle shelf where bottom temperatures were above –1°C (Fig. 7b). The survey biomass of Pacific cod (*Gadus macrocephalus*) dropped by 11%, but was still above the long-term survey average.

Pribilof marine science camp 2013

The 7th annual marine science camp, "*Rhythms and Research*", was held July 2013 on St. Paul Island, with participation by 21 students aged 10–18 from St. Paul and St. George Islands (Fig. 8). Classroom work featured daily journal entries (writing and drawings), marine biodiversity classes, and guest speakers on parasites in northern fur seals (Univ. Colorado), blue king crab biology (Michelle Ridgway), Pacific halibut surveys (International Pacific Halibut Commission and Central Bering Sea Fisherman's Association.), wildlife and environmental monitoring (Saint Paul Tribal Government), marine mammals of Alaska (Kate Wynne, Univ. Alaska Sea Grant), and the history of the Pribilof Islands. Ocean art, music and performance were also important parts of the curriculum. Students participated in daily field excursions to local habitats and offshore waters and lab work on marine ecology and zooplankton ecology.

Field studies included a halibut prey study (with stomachs provided by Pribilof Island halibut fishermen), a Pribilof Island blue king crab habitat study, and a hair crab bait preference experiment. The results of the halibut prey study indicated that there was a 100% overlap to a similar study conducted in 1996–1997. Students also discovered that halibut could eat king crab, one of their original hypotheses, although they were present in only 2 of the 87 stomachs.

Fig. 8 Various activities during the 7th annual marine science camp, "Rhythms and Research" (July 2013, St. Paul Island, USA).

For the first time, students who had participated in previous science camps became assistant instructors and research assistants. "*This cadre of young ocean scientists has the technical savvy, teaching skills and knowledge of the Pribilof Domain. They understand and exhibit positive teamwork instincts, and supported the up and coming younger ocean explorers that joined camp for the first time this year.*" For further information, contact mishridgway@gmail.com or ocean education tab at http://www.alaskadeepocean.org (photos courtesy of M. Ridgway).

Upcoming science meetings

Meetings in 2014 of interest to scientists working in the Bering Sea include:

- Alaska Marine Science Symposium, January 21–25, 2014, Anchorage, USA;
- Bering Sea Open Science Meeting and Ocean Sciences Meeting, February 22–28, 2014, Honolulu, USA.;
- 29th Lowell Wakefield Fisheries Symposium on "*Fisheries Bycatch: Global issues and creative solutions*", May 13–16, 2014, Anchorage, USA;
- PICES Annual Meeting, October 17–26, 2014, Yeosu, Korea.

Acknowledgements: Many thanks to the following scientists who helped create this report: Drs. Nicholas Bond (NOAA PMEL), Robert Lauth (NOAA AFSC), Olga Temnykh (TINRO-Center), James Murphy (NOAA AFSC) and Michelle Ridgway (Alaska Deep Ocean Science Institute).

Dr. Lisa Eisner (lisa.eisner@noaa.gov) is a Biological/Fisheries Oceanographer at the Alaska Fisheries Science Center of NOAA-Fisheries in Juneau, Alaska and Seattle, Washington. Her research focuses on oceanographic processes that influence phytoplankton and zooplankton dynamics and fisheries in the eastern Bering Sea. She has been the lead oceanographer for the U.S. component of the BASIS program (Bering Aleutian Salmon International Surveys). She is a scientific steering committee member of NOAA's Fisheries and the Environment program (FATE) and a co-PI on current (and past) eastern Bering Sea and Chukchi Sea research programs.

(Continued from page 35)

The warmest days were on September 6 and August 30 at Amphitrite and Langara, respectively, and were by far the warmest periods of the year. The second warm period followed by 28 days at both stations. Although each event lasted only a few weeks, and the two warm events lasted for just over two months, observers on Canadian research vessels saw a significant influx of warm-water species as noted earlier. It is impressive that shifts in air pressure can lead quickly to changes in sea surface temperature. This reliable temperature response is likely to be more common in eastern boundary regions, where prevailing currents are much weaker than on the western sides of oceans, and along the continental shelf where coastal upwelling and downwelling lag the changes in wind direction by a day or so.

Acknowledgements: Information on the marine species sightings were provided by Moira Galbraith, Hugh Maclean, Douglas Yelland, Tyler Zubkowski, and John Morris of Fisheries and Oceans Canada. Peter Chandler manages the Shore Station Sampling Program of Fisheries and Oceans Canada and provided observations at Langara Island and Amphitrite Point.

Dr. William (Bill) Crawford (bill.crawford@dfo-mpo.gc.ca) is an emeritus research scientist with Fisheries and Oceans Canada (DFO) at the Institute of Ocean Sciences in Sidney, British Columbia, having retired from DFO after 36 years of service. He is fascinated with changes in ocean climate and its impact on ecosystems of the northeast Pacific Ocean.

The State of the Western North Pacific in the First Half of 2013

by Shiro Ishizaki

Sea surface temperature

Figure 1 shows monthly mean sea surface temperature (SST) anomalies in the western North Pacific from January to June 2013, computed with respect to JMA's (Japan Meteorological Agency) 1981–2000 climatology. Monthly mean SSTs are calculated from JMA's MGDSST (Merged satellite and *in-situ* data Global Daily SST), which is based on NOAA/AVHRR data, MetOp/AVHRR data, GCOM-W1/AMSR2 data, Coliolis/WINDSAT data and *in-situ* observations for the period since 1985.

Time-series of 10-day mean SST anomalies are presented in Figure 2 for the 9 regions indicated in the panel at the bottom. From January to March, SSTs were above normal in the seas around 30ºN, 180ºE. From April to June, positive anomalies dominated in the seas from the area east of the Philippines to the area around the Mariana Islands. During the entire period, positive anomalies prevailed in the South China Sea. Negative anomalies observed in regions 1 and 3 from January to May turned positive in June. In June, positive anomalies exceeding +1ºC were found in the seas south of Okinawa. From May to June, negative anomalies were seen in the seas along 30ºN south of Japan.

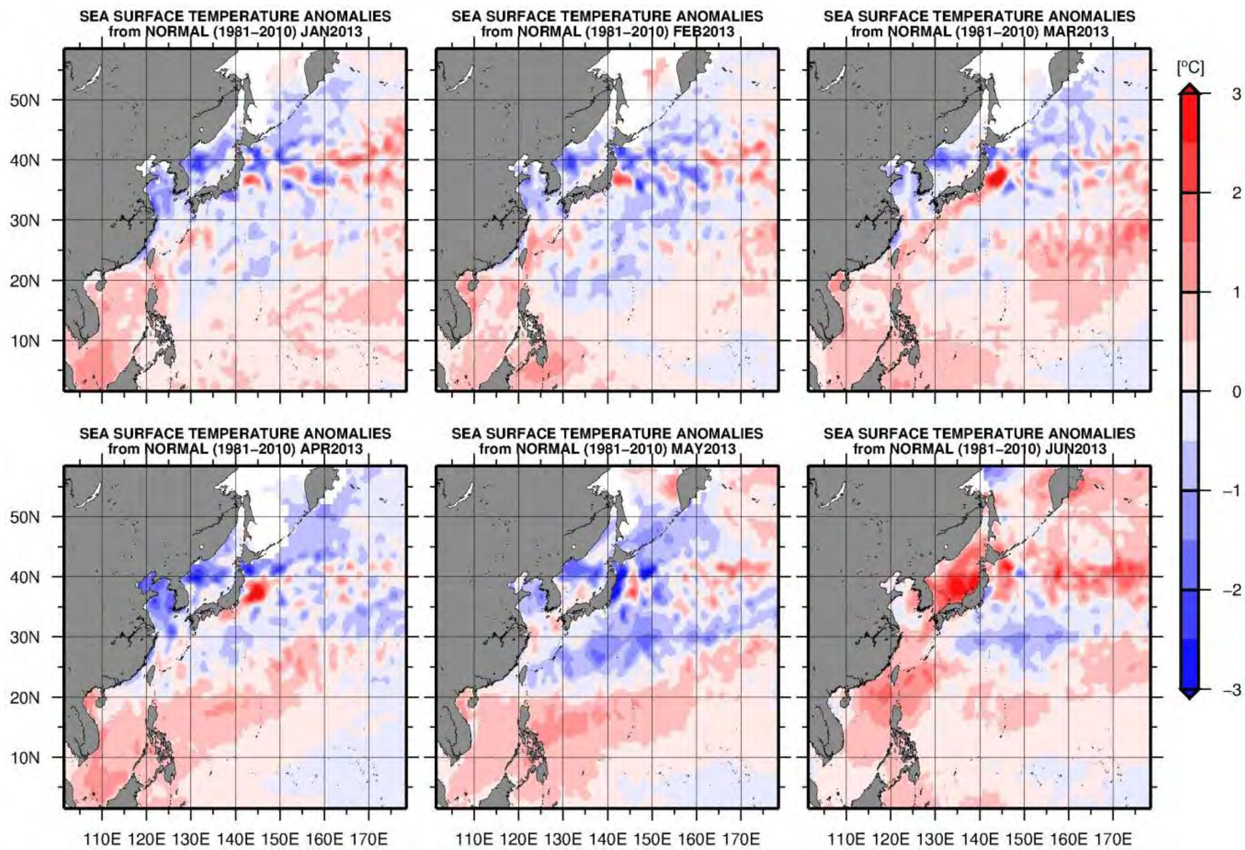


Fig. 1 Monthly mean sea surface temperature anomalies (ºC) from January to June 2013. Anomalies are deviations from JMA's 1981–2010 climatology.

Shiro Ishizaki (s_ishizaki@met.kishou.go.jp) is a Scientific Officer of the Office of Marine Prediction at the Japan Meteorological Agency. 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.

We would like to express our deep appreciation to Shiro for consistently providing two articles per year on the state of the NW Pacific since 2006.

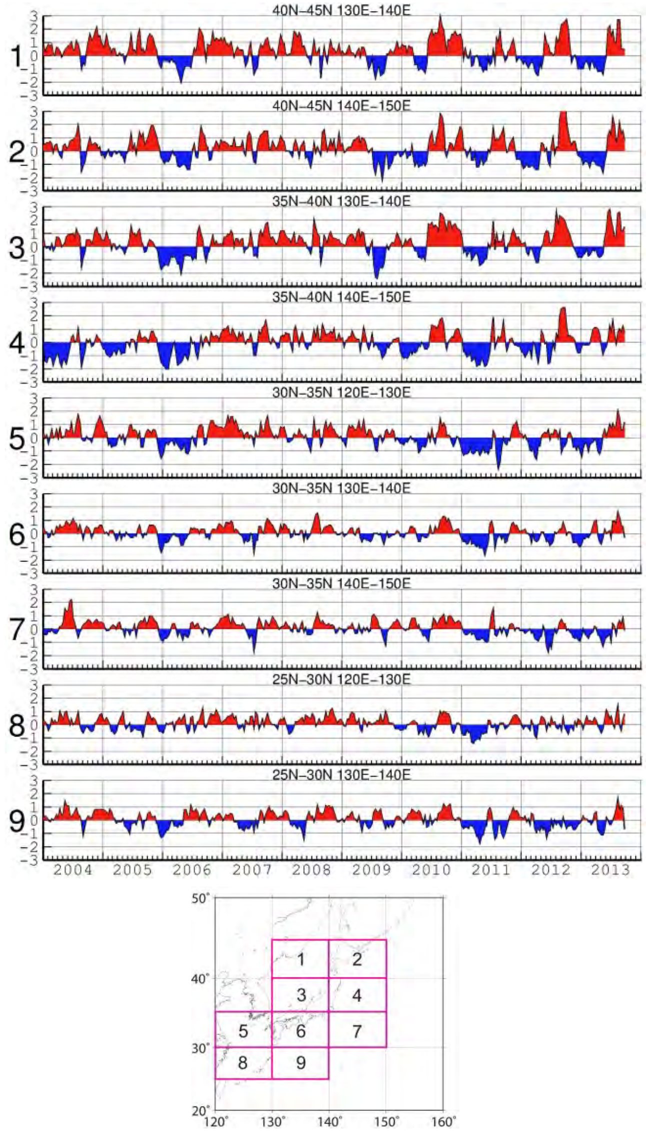


Fig. 2 Time-series representation of 10-day mean sea surface temperature anomalies (ºC) averaged for the sub-areas shown in the panel at the bottom. Anomalies are deviations from JMA's 1981–2010 climatology.

Kuroshio and Oyashio

A time-series outlining the location of the Kuroshio path from January to June 2013, at intervals of 10 days, is presented in Figure 3. During the entire period, the current took a non-large-meandering path off the southern coast of Honshu Island, between 135ºE and 140ºE. East of 135ºE, several small perturbations propagated eastward along the Kuroshio. Corresponding to the passage of each perturbation, the latitude of the current's axis over the Izu Ridge (around 140ºE) moved north and south. The latitude of the axis at the Izu Ridge (about 140ºE) was about 34ºN (around Miyake Island) from January to April. From May to June, the Kuroshio flowed south of Hachijo Island (33ºN, 140ºE).

Figure 4 shows monthly mean subsurface temperatures at a depth of 100 m in the waters east of Japan for March 2013 generated using the numerical ocean data assimilation system (MOVE/MRI.COM-WNP). The Oyashio cold water (defined as areas with temperatures lower than 5ºC in Fig. 4) normally extends southward in spring and returns northward from summer until autumn, as indicated by the green line in Figure 5. The coastal branch of the Oyashio cold water extended southward from January to March before retreating northward from March to April. Its position was almost normal during the entire period (Fig. 5).

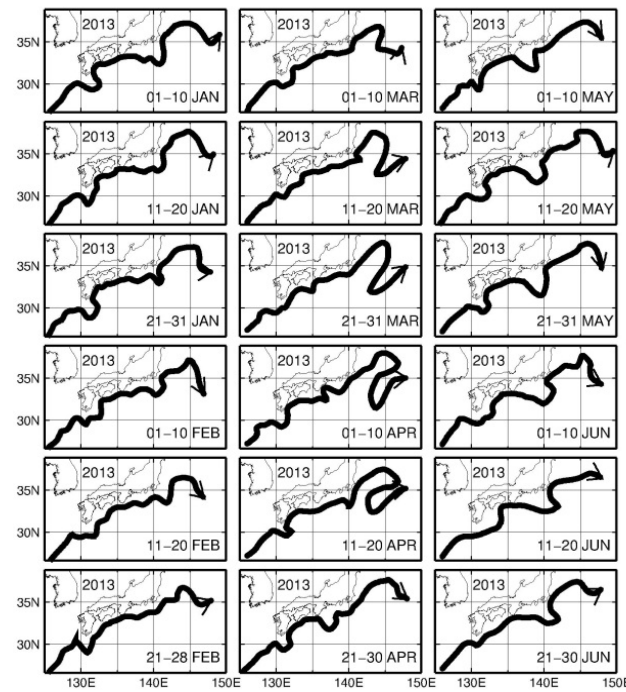


Fig. 3 Location of the Kuroshio path from January to June 2013.

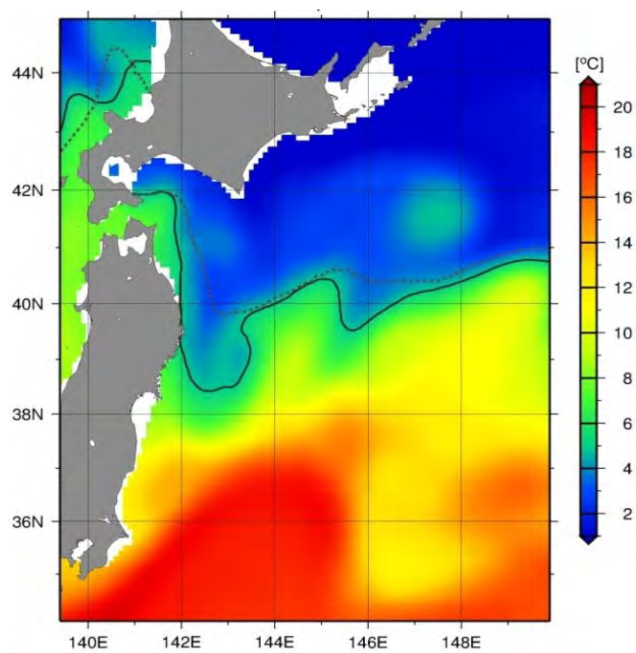


Fig. 4 Subsurface temperatures (ºC) at a depth of 100 m east of Japan for March 2013. The solid line shows the 5ºC isotherm, while the dotted line denotes that of the monthly climatology (26-year average values from 1985 to 2010).

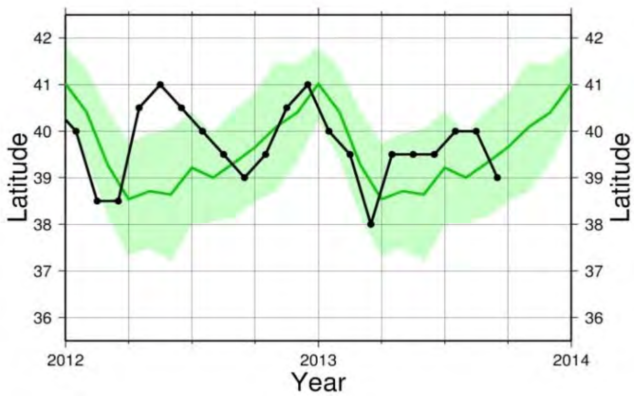


Fig. 5 *The monthly southernmost position of the coastal branch of the Oyashio cold water from January 2012 to July 2013 (black line), and 26-year average values (green line) with a range of one standard deviation (green shading) from 1985 to 2010.*

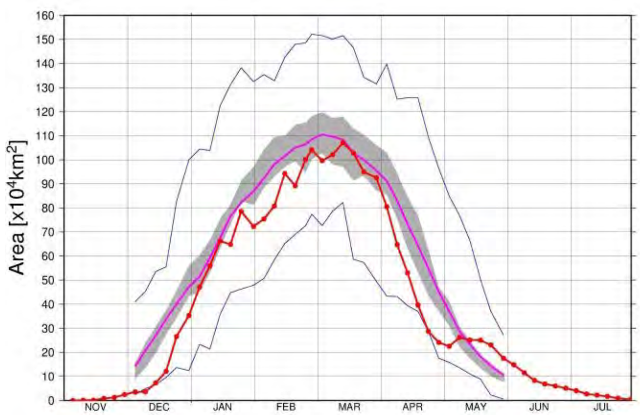


Fig. 6 *Time-series of the sea ice extent in the Sea of Okhotsk from November 2012 to July 2013 (red line: 2012–2013 analysis; pink line: JMA's 1981–2010 climatology; blue lines: maximum /minimum sea ice extent since 1971; gray area: normal range).*

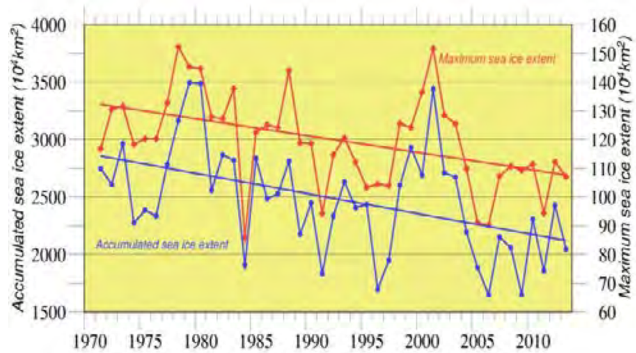


Fig. 7 *Interannual variations in the maximum sea ice extent (red line) and the accumulated sea ice extent (blue line) in the Sea of Okhotsk from 1971 to 2013. The term accumulated sea ice extent refers to the sum of all 5-day sea ice extent values from December to May.*

Sea ice in the Sea of Okhotsk

The sea ice extent in the Sea of Okhotsk was near or less than normal from December 2012 to April 2013, and became greater than normal due to slow melting of ice in May (Fig. 6). It reached its seasonal maximum of 107.13×10^4 km^2 (less than the normal of 116.92×10^4 km^2) on March 15, 2013.

Figure 7 presents interannual variations in the maximum sea ice extent and accumulated sea ice extent in the Sea of Okhotsk for the period from 1971 to 2013. Although both parameters show large variations, there are long-term decreasing trends of 175 [71–279] $\times 10^4$ km^2 per decade (the numbers in square brackets indicate the two-sided 95% confidence interval) in the accumulated sea ice extent, and of 5.8 [2.2–9.5] $\times 10^4$ km^2 (equivalent to 3.7% of the Sea of Okhotsk's total area) per decade in the maximum extent.

(Continued from page 14)

process models is warranted. However, such efforts must recognize that important ecological responses to anthropogenic climate change (*e.g*., species invasions and replacements) may not be represented accurately in simplified process models. Either explicit acknowledgment of these ecological issues as caveats of the approach or attempts to include such issues in future process models of long-term ecosystem changes should be considered in future discussions.

Further recommendations from the workshop include future workshops that might narrow the focus of discussion while maintaining the exchange of information between physical and biological oceanographers. The advertised scope of the workshop attracted participants from diverse groups within the PICES and ICES communities and brought together experts in physical and biological oceanography and fisheries management. However, the wide-ranging subjects of the presentations and limited time available constrained the further distillation of available hypotheses into a key subset of mechanisms describing climate impacts of marine ecosystems. The entrainment of increasingly diverse and numerous participants acted to broaden, rather than focus, our discussions. The workshop provided a forum for the presentation of mechanisms relating climate and higher trophic levels at a wide range of scales, but we are still faced with the challenge of applying a more systematic approach to represent these underlying relationships using models of reduced complexity. One proposed strategy for future workshops may be to divide participants into smaller groups for more focused discussions emphasizing climate–ecosystem variability at a specific scale (*e.g.*, mesoscale, regional, or global scale; interannual to centennial scale) or via general mechanistic categories (*e.g.*, trophic interactions, ecophysiology, genotypic and phenotypic responses, or species distributions). However, collaboration among physical and biological ocean scientists and recognition of interacting spatial and temporal scales must be maintained.

New Chairmen in PICES

Science Board

At PICES-2012, Dr. Thomas Therriault (Canada) became Chairman-elect of Science Board, and following PICES-2013 in Nanaimo, Canada, he took over the position of Science Board Chairman. PICES appreciates Dr. Sinjae Yoo's dedicated service to the Science Board since 2008 as Vice-Chairman, Chairman-elect, and Chairman. Dr. Hiroaki Saito (Japan) assumes the position of Science Board Vice-Chairman.

Dr. Thomas (Tom) Therriault is a Research Scientist with Fisheries and Oceans Canada (DFO) at the Pacific Biological Station in Nanaimo, British Columbia, Canada. Tom received his Honours B.Sc. in Biology in 1993 from Wilfrid Laurier University, his M.Sc. in Biology in 1996 from Memorial University of Newfoundland, and his Ph.D. in Ecology in 2000 from McMaster University. He was a NSERC (Natural Sciences and Engineering Research Council of Canada) Postdoctoral Fellow at the University of Windsor Great Lakes Institute for Environmental Research and Department of Biological Sciences before joining DFO in 2002. Tom also is an adjunct professor at both the University of Windsor and the University of Prince Edward Island.

Tom has broad research interests that were evident even during his graduate studies. His M.Sc. research was quite applied as he developed predictive models to relate changes in mercury concentrations in fish to changes in reservoir size following impoundment. His Ph.D. research developed a strong theoretical slant and focused on better understanding environmental and temporal determinants of community structure and variability using rock pool communities in Jamaica as natural mesocosms to test his theories. Finally, as a postdoctoral fellow his research became more applied again, but this time using various molecular analyses to resolve invasion dynamics in both the Laurentian Great Lakes of North America and the Volga River system of western Russia. Since joining DFO, Tom has maintained a variety of research interests and projects. Initially he focused on the role of small pelagic fish like herring and eulachon in the ecosystem and developed ecosystem-based juvenile herring surveys for stocks in northern British Columbia as a means to better understand recruitment variability. More recently, Tom has been working on a variety of conservation biology issues, most notably aquatic invasive species where he maintains a diverse and active program that includes research, monitoring, risk assessment, and rapid response planning. This program includes several graduate students funded through Canada's Second Aquatic Invasive Species Network (CAISN II) which involves collaborations between DFO and academia.

In fact, it was invasive species issues that first brought Tom to PICES when Working Group 21 on *Non-indigenous Marine Species* was formed way back in 2005. With funding from the Government of Japan, he developed a series of rapid assessment training and outreach workshops to aid developing countries advance their own non-indigenous species projects. In addition, there were several Rapid Assessment Surveys for non-indigenous species held in conjunction with the PICES Annual Meeting from 2008 to 2011. Tom also has been on the Scientific Steering Committee for the past three International Conferences on Marine Bioinvasions, most recently serving as the conference Co-Chairman for the Vancouver event in August 2013, in which PICES has been a major sponsor. Tom became involved in PICES' FUTURE program as the Chairman for the Advisory Panel on *Anthropogenic Influences on Coastal Ecosystems*, and in this capacity attended his first Science Board meeting inter-sessionally in Sendai, Japan, in 2010. Tom served on the PICES-ICES Study Group on *Developing a Framework for Scientific Cooperation in Northern Hemisphere Marine Science* and is a member of a similar Study Group on *Scientific Cooperation in the North Pacific Ocean* in collaboration with the North Pacific Anadromous Fish Commission (NPAFC). Tom was elected Science Board Vice-Chairman and subsequently Science Board Chairman-elect before taking over the job following PICES-2013 in Nanaimo. Since joining Science Board, Tom has enjoyed being active in a wide variety of issues facing North Pacific marine ecosystems.

When not travelling for DFO (or PICES), often locked in windowless meeting rooms, Tom enjoys spending time with his wife and kids – whether on a family vacation, a camping trip on Vancouver Island, or simply "hanging out" watching movies or playing video games. In the winter Tom likes to curl at the local club, and in the summer he can be found exploring beaches or tinkering around the house.

Dr. Hiroaki Saito was born in Fukushima, Japan. In his childhood, paddy fields, apple groves and rivers jumping with fish were 5 to 10 minutes by bicycle from his home. He enjoyed catching fish, crayfish, butterflies, and above all, beetles. During holidays, he often went to the country where his grandparents lived. Exploring the forests alone for feather-full nests, ambushing migrating golden-ringed dragonflies with an insect net, or encountering pale-green rat snakes were the most exciting events for him.

During his third year at the Tohoku University, Hiroaki listened to a course of lectures on oceanography from Prof. Satoshi Nishizawa. Hiroaki was so attracted to the unique atmosphere of authentic culturati created by Prof. Nishizawa, and to the novel, tough approach of his lectures that he changed his mind about being a business person and decided to study biological oceanography. In Nishizawa's laboratory, Hiroaki was a youngest member among many post-docs and graduate students and learned a sincere objectivity to science through discussion and debate with senior members.

After receiving his B.Sc. and Ph.D. in Agriculture from the Tohoku University, Hiroaki started his scientific career at the Fisheries Research Agency's Hokkaido National Fisheries Research Institute in Kushiro, working for the resource management of squid for 3 years, and then at the Biological Oceanography Section as a research scientist to study mainly the biology and ecology of copepods and their roles in fish population dynamics. After his Hokkaido period, interrupted for a year by a 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 the FRA's Tohoku National Fisheries Research Institute (TNFRI) in Shiogama, where he is now leading the Ecosystem Dynamics Group.

Hiroaki's background is zooplankton biology and ecology, but his interests are broad, ranging from viruses to whales, to understand the processes and variation mechanisms of the marine ecosystem and biogeochemical cycles. Hiroaki is one of the establishing members of the A-line monitoring programme and has been serving this line for over 20 years. He is proud that this programme received the 2013 PICES Ocean Monitoring Service Award (POMA).

During this decade, Hiroaki has led or is leading several multi-disciplinary projects such as DEEP (Deep Sea Ecosystem Exploitation Programme, 2002–2007), SUPRFISH (Studies on Prediction and Application of Fish Species Alternation, 2007–2012), and SKED (Study of Kuroshio Ecosystem Dynamics for Sustainable Fisheries 2011–2021). All these projects are designed to understand ecosystem dynamics and promote the wise use of ecosystem services. He was also a core member of a series of mesoscale 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 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*, Working Group on *Iron Supply and its Impact on Biogeochemistry and Ecosystems in the North Pacific Ocean*, Study Group on *Future Integrative Scientific Program(s)* and the FUTURE Science Plan Writing Team, and co-led the FUTURE Implementation Plan Writing Team. He now chairs the FUTURE Advisory Panel on *Climate, Oceanographic Variability and Ecosystems* and is an active member of the Biological Oceanography Committee.

Hiroaki has been also 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.

On March 11, 2011, a devastating earthquake (magnitude 9.0) occurred off the coast of Tohoku triggering a powerful tsunami that attacked the Tohoku region. The tsunami also knocked out the Fukushima Daiichi atomic power plant, which resulted in a large area in Fukushima and surrounding waters to be contaminated by released radioactivity. Some of Hiroaki's relatives were forced to abandon their houses. The incident influenced Hiroaki a lot, and he is now more serious than ever on the role of science and scientists for society and human well-being. Hiroaki is looking forward to serving as a Vice-Chairman of Science Board since he believes to answer the questions of FUTURE is one of society's urgent requests to scientists in the Anthropocene.

Biological Oceanography Committee

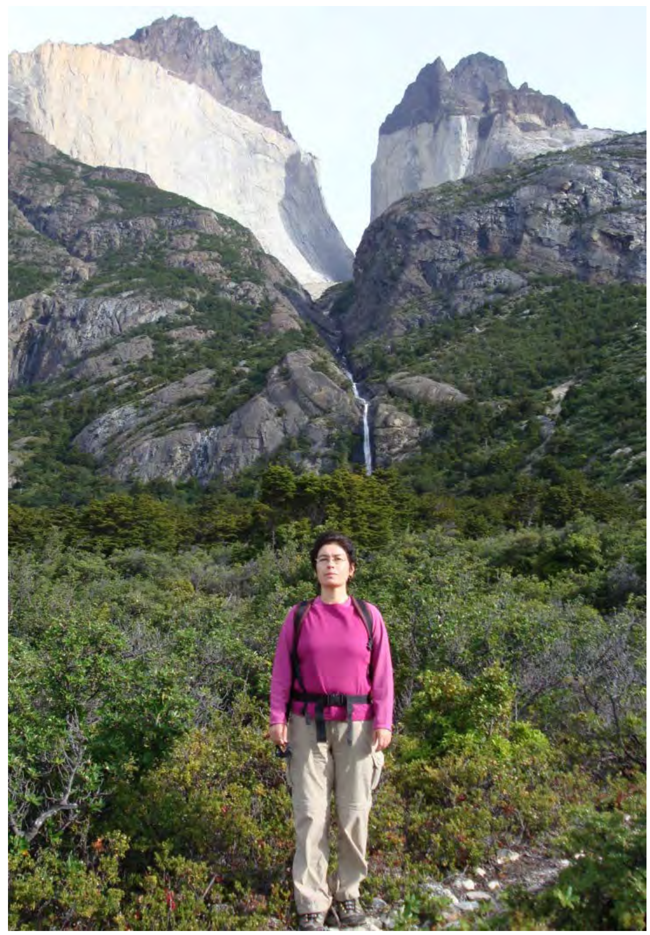
Dr. Angelica Peña (Canada) has been a member of the Biological Oceanographic Committee (BIO) since 2003. She was elected as BIO Chairman at PICES-2013. PICES thanks Dr. Atsushi Tsuda (Japan) for his dedicated service as Chairman of BIO from 2011 to 2013. Atsushi will continue to contribute to the activities of the Committee as Vice-Chairman. PICES also acknowledges Dr. Michael Dagg's service as BIO Vice-Chairman from 2010 to 2013.

Dr. Angelica Peña is a Research Scientist at the Institute of Ocean Sciences, Fisheries and Oceans Canada. She received her B.Sc. from the University of Concepción, Chile, and her M.Sc. and Ph.D. degrees in Oceanography from Dalhousie University, Canada.

Angelica was born and raised in the southernmost city of Chile, Punta Arenas. She did her undergraduate work at the University of Concepción. In 1986, she moved to the east coast of Canada to carry out her graduate work in Oceanography at Dalhousie University and has lived in Canada since then. Angelica did her graduate research on phytoplankton ecology and nitrogen utilization in the high-nutrient low-chlorophyll region of the equatorial Pacific. She used a plankton ecosystem model for her thesis and has been interested in using models to study physical–biological interactions. After completing her degree in 1994, Angelica worked as a postdoctoral fellow at the Institute of Ocean Sciences in Sidney, British Columbia, where she later became a research scientist. Since then, she has been working on various aspects of phytoplankton ecology and biogeochemical cycles. In particular, she uses field observations and models to study the dynamic relationships that exist between the planktonic ecosystem and its environment, and its response to climate change. She has been involved in research projects on the effect of iron fertilization in the Northeast subarctic Pacific, phytoplankton dynamics and biogeochemical cycles in the coastal waters of British Columbia, and analysis of decadal variability of nutrients and oxygen. Her current research includes coastal biophysical modeling, climate change modeling and analyses, and monitoring of phytoplankton community composition using pigment analysis.

Angelica began her association with PICES by attending the 1996 PICES Annual Meeting in Nanaimo. Since then she has been an active member participating in the organization of several workshops and sessions as a co-convener, contributing to PICES Summer Schools, and serving as a guest editor of two PICES special issues in *Progress in Oceanography*. Angelica has been a member of BIO for the past 12 years and is member of Working Group 29 on *Regional Climate Models*.

Outside of science, Angelica loves hiking, biking and practising yoga. She also likes travelling, visiting new places and eating good food.



Dr. Atsushi Tsuda is a Professor at the Atmosphere and Ocean Research Institute, University of Tokyo, Japan. He received his B.Sc. in Fisheries from Hokkaido University and his Ph.D. in Agriculture from the University of Tokyo.

Atsushi was born and raised in Tokyo. In his childhood, he often went to the Tokyo Bay for fishing with his parents, and developed a respect for the ocean and marine life. During his undergraduate years, Atsushi met friendly and hardworking graduate students from the Laboratory of Plankton at Hokkaido University – and the direction of his future research was decided.

Atsushi started his graduate course at the Ocean Research Institute, University of Tokyo, working on copepod ecology, especially grazing. After completion of his thesis, he moved to the Biological Oceanographic Section of the Hokkaido National Fisheries Research Institute as a research scientist in 1996. At the Institute, Atsushi served with Dr. Hiroaki Saito and colleagues on the A-line monitoring programme for 7 years. In Hokkaido, he studied mainly the biology and ecology of copepods, focusing on the *Neocalanus* species and their role in fish population dynamics. Atsushi then became involved, along with Drs. Shigenobu Takeda, Maurice Lavasseur and Mark Wells, in iron fertilization experiments in the subarctic Pacific (SEEDS-I, SERIES, and SEEDS-II) which were recommended by the PICES Advisory Panel on *Iron Fertilization Experiment in the Subarctic Pacific Ocean* (AP-IFEP).

Atsushi began his association with PICES by attending the 1996 PICES Annual Meeting. Later, he became a member of AP-IFEP and BIO. He was very excited to serve as Chairman (2011–2013), and now as a Vice-Chairman of BIO, as the goals of this committee largely overlap with his scientific interests. However, after the Great East Japan Earthquake in 2011, Atsushi aggressively studied ecosystem recovery processes of the tsunami-damaged areas and worked on the radioactive materials released from the Fukushima nuclear power plant as a core member of the Oceanographic Society of Japan, and worked for the university as an Adviser to the President. Atsushi is now experiencing the busiest years in his life.

Atsushi is an enthusiastic fly fisherman and bird watcher. He always carries a pair of binoculars during PICES Annual Meetings. His lifelong list of birds includes 995 species and his Japanese list includes 427 species. The latest addition to his lifelong list is the Hooted Merganser he observed in Nanaimo.

Technical Committee on Monitoring

Dr. Jennifer Boldt (Canada) and Dr. Sanae Chiba (Japan) have been members of MONITOR since 2010. At PICES-2013, Dr. Boldt was elected as MONITOR Chairman, replacing Dr. Hiroya Sugisaki, who held the position for two terms, and Dr. Chiba was elected Vice-Chair of MONITOR, replacing Dr. Phillip Mundy. PICES thanks Dr. Sugiski and Dr. Mundy for their dedicated service as Chairman and Vice-Chairman of MONITOR. They will continue serving as members of MONITOR.

Dr. Jennifer Boldt is a Research Scientist with Fisheries and Oceans Canada (DFO) at the Pacific Biological Station (PBS) in Nanaimo, British Columbia, Canada. Originally from the Canadian prairies, she got her undergraduate degree in Zoology from the University of Calgary. Jennifer was interested in marine biology from an early age and, after taking classes at the Bamfield Marine Station, British Columbia, and working at PBS for one summer, she decided to pursue marine biology as a career. Jennifer worked for a few years at seasonal jobs for the Pacific States Marine Fisheries Commission and the Oregon Department of Fish and Wildlife before completing her M.Sc. and Ph.D. at the School of Fisheries and Ocean Sciences (SFOS), University of Alaska Fairbanks (in Juneau, Alaska). Her research focussed on juvenile Pacific herring, walleye pollock, and pink salmon ecology. After graduate work, Jennifer was fortunate to continue a post-doctoral position at the SFOS. Marriage took Jennifer to Seattle, Washington, where she continued her SFOS post-doctoral work in collaboration with the High Seas Salmon Program at the University of Washington (UW). In 2003, she accepted a post-doctoral position and later a Research

Scientist position with the Joint Institute for the Study of the Atmosphere and Ocean (JISAO), UW, in collaboration with the Alaska Fisheries Science Center, National Marine Fisheries Service. Her responsibilities included an annual update of the Ecosystem Considerations section of the groundfish stock assessment. In 2009, Jennifer accepted an opportunity to work at PBS in the Conservation Biology Section. Her research interests include fish ecology, and ecosystem monitoring and indicators. In PICES, she has been a member of the MONITOR Committee for 2 years and is a member of Working Group 28 on *Development of Ecosystem Indicators to Characterize Ecosystem Responses to Multiple Stressors*.

In her spare time, Jennifer enjoys many outdoor activities from snowboarding to gardening, as well as playing hockey, and is aspiring to play the violin in a manner that does not agitate her border collie.

Dr. Sanae Chiba is a Senior Scientist of the Marine Ecosystem Research Team at the Japan Agency for Marine-Earth Science and Technology (JAMSTEC). Born in a coastal town of Zushi-city in central Japan and, being familiar with marine animals and flora, Sanae naturally wished to be a marine biologist when she was a little kid. Yet, that dream was gradually pushed away during her teenage years as she became interested in other things, as many girls do.

After graduating from a liberal arts college, Sanae started her first career in administration at JAMSTEC, where she eventually made up her mind to leave this job and go back to school to fulfil her early desire. Sanae received a Bachelor degree from the College of the Atlantic, located in beautiful Acadia National Park, Maine, USA. At the college, she enjoyed a work study program with the school's marine mammal research group and joined their research on baleen whales in the Gulf of Maine. Sanae then returned to Japan for postgraduate study at the Tokyo University of Fisheries. Setting the study theme on Antarctic zooplankton ecology, particularly on krill–salp interaction, she participated in the Australian National Antarctic Research Expedition. An unfortunate ship breakdown in the midst of the icy Antarctic Ocean resulted in the cancellation of her observations and experiment, but she was able to obtain samples on other opportunities and complete her Ph.D. After a long time being away, Sanae luckily got a job and returned to JAMSTEC – this time as a scientist.

At JAMSTEC, Sanae has been working on a long-term ecosystem change study using historically collected zooplankton samples/data sets, such as the Odate Collection. Although Sanae's initial target region was the western North Pacific, she has been involved in several international projects aiming for global comparison of climate–marine ecosystem variation under the framework of PICES (Task Team on *Climate Forcing and Marine Ecosystem Response*; 2004–2009), SCOR (WG 125 on *Global Comparisons of Zooplankton Time Series*; 2005–2008), and other groups. Most recently, she has been participating in the North Pacific Continuous Plankton Recorder (CPR) project and Global Alliance of CPR Survey (GACS), and is a member of PICES' Advisory Panel on *Continuous Plankton Recorder Survey in the North Pacific* and MONITOR.

With her back-packer experience, Sanae loves working with people from various cultural backgrounds in a fully international environment, and so participating in PICES activities has been always her pleasure. She is interested in variety of things from sports to arts, enjoying such pastimes as playing tennis, swimming, and snowboarding, and yoga and guitar playing is her daily exercise. Sanae even earned money for her tuition when she was a graduate student by making cartoons/illustrations for popular science materials. "Marriage of science and arts" is Sanae's motto and promoting collaborative projects of scientists, artists and musicians is her future dream.

FUTURE Advisory Panel on Anthropogenic Influences on Coastal Ecosystems (AP-AICE)

Dr. Steven Bograd (USA) was elected Chairman of AP-AICE, replacing Dr. Thomas Therriault at PICES-2013. PICES thanks Dr. Therriault for his service as Chairman of AP-AICE since its inception in 2009.

Dr. Steven Bograd is a physical oceanographer at NOAA's Southwest Fisheries Science Center, Environmental Research Division, in Pacific Grove, California, and holds Research Associate positions at the Scripps Institution of Oceanography (SIO) and the Institute of Marine Sciences, University of California-Santa Cruz. His research is focused on physical–biological interactions, eastern boundary current systems, climate variability, marine biologging, and fisheries oceanography. Steven is currently involved in a number of projects studying climate variability and its impacts on the marine ecosystems of the North Pacific Ocean.

Steven received B.Sc. degrees in physics and atmospheric sciences at the University of Arizona, a M.Sc. in atmospheric sciences at the University of Washington, and a Ph.D. in physical oceanography from the University of British Columbia in 1998. He worked for several years at NOAA's Pacific Marine Environmental Laboratory on the Fisheries Oceanography Coordinated Investigations (FOCI) program, and held a California Coordinated Oceanic Fisheries Investigations (CalCOFI) post-doctoral fellowship at SIO from 1998–2000. He also served as acting CalCOFI Coordinator at SIO in 2000. Steven has been at NOAA since 2001.

Steven participated in his first PICES Annual Meeting in Victoria, BC, in 1992, and has been active in PICES for many years. He currently serves on the Physical Oceanography and Climate Committee (POC), Working Group 27 on *North Pacific Climate Variability and Change* and AP-COVE. He has been active in other community service, including as co-Principal Investigator of the Census of Marine Life's Tagging of Pacific Predators (TOPP) program, on the Governing Council of the Central and Northern California Ocean Observing System (CeNCOOS), and on several working groups of Stanford's Center for Ocean Solutions. He is currently an Associate Editor at *Fisheries Oceanography* and an Academic Editor at *PLoS ONE*.

Steven was born and grew up in Mississippi, USA, but has spent most of his adult life on the West Coast, of both the United States and Canada. He enjoys watching and playing soccer, and spending time with his wife, Xuhua, his daughter, Zoya, and his dog, Huxley.

News from the PICES Secretariat

After 14 years of dedicated service to PICES, Dr. Skip McKinnell is stepping down as Deputy Executive Secretary as of January 31, 2014. Dr. Harold (Hal) Batchelder will take up the position upon Skip's retirement on March 1, 2014.

Members of the PICES community were asked to provide thoughts on Skip's contributions to PICES and PICES science, and we heard from many. All your messages will be given to Skip. A few excerpts are included below.

Skip has been an extremely valuable asset to the PICES community. He always had excellent advice on how to get things accomplished within the organization. His advice was thoughtful, accurate, and widely sought. Moreover, his many scientific accomplishments contributed in substantive and meaningful ways to the PICES mission. Above all this, he has been a wonderful colleague and will be missed.

Gordon Kruse, USA

Skip has always displayed a deep and abiding passion for understanding how the North Pacific "works" – both in theory and in practice. In his quest, he was worked with a very broad array of experts and played with a lot data... In his role as Deputy Executive Secretary, Skip really set his mind and energies to "upping" the quality and quantity of published scientific output from PICES. He has been incredibly successful at this and the organization is well recognized for its scientific publications, due largely to his efforts….

Robin Brown, Canada

I met with Skip in 2002 October at Qingdao. … It was the first time for me to be invited to an international conference and I knew only a few foreign scientists at there. However, Skip talked to me very friendly and I was very relieved. His generousity made me comfortable, and I had a good impression of PICES. …Always he gave us good suggestions, ideas, and inspirations. In addition, for Asian people, he is one of the most important persons who ask native English speakers to slow down the English. He is also one of the slowest and most clear English speakers, and we Asian scientists can breathe easily when Skip joins to the conversation. Hope he will continue to collaborate with us as a scientist and of course as a friend in future. …Thank you again, Skip, for your unmeasurable hospitality as a secretary and your great friendship.

Shin-ichi Ito, Japan

I enjoyed talking with Skip-san during the PICES meetings. Every time, Skip-san told me some recent interesting scientific paper that he read. One day, it was a study about the remains of tuna bones that he had reviewed. His talk stimulated me very much, and I started a fishery archeological study based on remains of salmon bones. I hope that Skip-san will continue to stimulate us, even if he is retired.

Yukimasa Ishida, Japan

For me, Skip was at the heart of the science that PICES produced. Skip knew the marine science of the North Pacific and had a superb ability to identify interesting problems and to ask penetrating questions. … His talks during the regular sessions were "must attend" events. The topics were stimulating and outside the box, the analysis clear and thorough, and the conclusion often the unexpected. His delivery brought the story alive and made it memorable. …His leadership in the PICES Special Publications on the Marine Ecosystems of the North Pacific Ocean 2003-2008 was monumental and of great value to all in the PICES community. The 2010 volume is a critical resource to many of us. …I enjoyed our idle, relaxed times together as much as the intellectually stimulating times. …His departure is a great loss to PICES.

George L. Hunt, Jr, USA

When I began attending PICES and ICES meetings as a young scientist, remembering the names of new colleagues was daunting. …But whether in an airport terminal in Frankfurt or a salmon symposium in Seattle, Skip has been a friendly face in a sea of unfamiliar scientists. His continued contribution in oceanographic research while serving as Deputy Executive Secretary of PICES administrator is truly admirable. Beyond these official contributions to PICES and our conceptual understanding of the Pacific Ocean, Skip is a friend and colleague who has always found the time to discuss science, even with the newest of PICES participants. I look forward to continued work with Skip as he devotes more time to contemplating the dynamics of climate and fisheries in the world's oceans.

Ryan Rykaczewski, USA

… I have worked for BASS, CFAME, FIS, WG 16, WG-FCCIFS, NPESR, and PICES-related meetings for all of which Skip-san provided us excellent Secretariat service, as well as his excellent scientific insights. I greatly appreciate his service for the past 14 years, and also hope for his continuation of scientific work that originated from PICES but is not yet published. I hope to see you again in Japan and to enjoy strange Japanese seafood, as we did before.

Akihiko Yatsu, Japan

You have been a great one to mine dusty file drawers for nearly forgotten data and to bring it to light and fresh use through your publications. This is so important to keep us researchers from unknowingly repeating what has already been done before, and to provide those priceless views from the past that yearly grow more valuable as our future faces increasing climatic uncertainty. …I've always enjoyed your insight, advice, and dry sense of humor in managing and coordinating groups and I will miss that…..

Nancy Davis, NPAFC

One may wonder why PICES has become a household name among marine scientists, but one thing is clear: Skip has played a tremendous role hoisting the flag. As you are preparing for a new career let me only ask one favor of you: continue to be involved with science. I feel fortunate to be in your home province and hope for many more opportunities to meet, work, and enjoy life in your company.

Villy Christensen, Canada

Skip is indeed capable as both an administrator and a scientist, which is not an easy job. …. His peer review publications on salmon are impressive. Professor Ichiro Yasuda writes in the memorable article of his award-winning studies that one of his important achievements (*i.e*. 18.6-year period tidal cycle) is thanks to Skip s valuable advice. Other than to basic science, he also made valuable contributions to science under political pressure,… His wider view and great human network of marine science may make him admirable Deputy Executive Secretary of PICES.

Taro Ichii, Japan

…What sticks out more for me are personal interactions like i) the science discussions where you would come down the hall to my office (or me to yours) and we would chat about implications of the 18.6 year tidal cycle or your own calculations of the PDO or your latest ideas on Fraser sockeye returns; and ii) the laughs and stories enjoyed at numerous informal PICES dinners … I will miss, but certainly cherish the memories of, these times and hope that they will continue, albeit less frequently, in the future.

Mike Foreman, Canada

I want to thank Skip for all that he has done for PICES and the scientific community as a whole. His service to PICES is a major reason why the organization has been such a success. He knows how to ask tough questions in a way that inspires the scientist to think carefully about the direction of his or her research. This is a rare talent that nurtures careful thought and advances innovation and creativity. … I will miss him a great deal, but my hope is that he continues to attend future PICES meetings.

Anne Hollowed, USA

Skip McKinnell is an adept scientist and administrator, a rare combination. He also has a great ability to understand and transcend cultural and institutional differences. I've particularly enjoyed working with Skip over the years and talking science. No matter the subject or circumstance, Skip has a great breadth of knowledge, keen insight, and often unique perspective; I am enlightened every time we get together…. Skip has been a great ambassador for PICES and for Canada. We will miss you Skip, but wish you and yours well with your future adventures.

Frank Schwing, USA

Skip McKinnell is an outstanding oceanologist, one of a few who understands the ocean. In PICES, he showed his worth working as an effective organizer and manager who realized many large projects together with his colleagues. Being a highest professional scientist and an editor of many PICES publications he won great respect. At the same time, communicating with the colleagues from different countries, he is a modest and charming man who senses both the realities of our world and humor that sometimes reflects these realities…

Anatoly Velikanov, Russia

…He has always impressed me with his great skills at facilitating meetings and being able to cut through the often foggy discussions to identify the critical issues and questions. This is always done in a manner that is sensitive to how the different cultures around the North Pacific conduct science and conduct meetings…. He has been a tremendous asset to the Organization and, along with the Executive Director, has been largely responsible for the respect and status PICES now has as an international organization, and the high level and quality of its activities and scientific outputs…. Many thanks, Skip, for all of your very hard work and dedication!

Ian Perry, Canada

Hal Batchelder was born in New York, but grew up near Boston, Massachusetts, spending the summers of his youth at the Atlantic beaches in New Hampshire and camping and hiking the woods of New Hampshire and Maine. Hal and his younger brother were always in the woods behind their house, and created a series of "forts" that occupied endless hours of his non-school time. His father is a structural engineer, and once when Hal was asked by a teacher in grammar school to describe what his father does for a living, he responded, "he builds bridges out of toothpicks and glue". Hal was encouraged to pursue his own interests, which tended to involve natural sciences and the outdoors. In grade school he decided to be a 'forest ranger', and eventually attended the University of Maine to pursue this interest in forestry. However, as an undergraduate he became more interested in marine science, especially intertidal ecology, and later, plankton ecology.

In 1977, Hal moved west to the Pacific coast and Oregon State University (Newport and Corvallis), where he obtained a Master's degree in Oceanography working on the population dynamics and structure of intertidal sea anemones. After finishing his M.Sc., Hal obtained a technical position on a research project run by Professors Charles Miller and Bruce Frost to sample zooplankton from the Canadian Weatherships *Quadra* and *Vancouver* at Station P in the North Pacific, during their last 18 months prior to retirement (the ships, not the Professors!). When not at sea, he spent most of his time dissecting, identifying and counting subarctic zooplankton. Eventually, Hal returned to student status and completed a Ph.D. on the population dynamics and vital rates of the copepod, *Metridia pacifica*, in the subarctic Pacific. Hal moved across the U.S. again, to a post-doctoral and later a marine research scientist position at the University of Rhode Island where he studied the distribution and taxonomic sources of bioluminescent light in the subtropical and subarctic regions of the North Atlantic as part of the "*Biowatt*" and "*Marine Light Mixed Layer*" research programs.

Despite his Atlantic coast roots, Hal preferred the Pacific coast and especially Oregon. After seven years in Rhode Island, he was looking for employment opportunities on the West coast, and was fortunate to be hired in 1992 as the first scientific director of the National U.S. GLOBEC Steering Committee Office at the University of California, Davis. The US GLOBEC (Global Ocean Ecosystems Dynamics) program was initiated a couple of years earlier and was just starting to become a force in coastal marine science. Hal greatly enjoyed the science administration and coordination of this exciting new program linking climate variability with ecosystem dynamics. A couple of years later, the GLOBEC office relocated to the University of California, Berkeley. It was at this time that Hal became interested and passionate about sailing, and could be found on Friday evenings and Saturdays sailing solo or with friends on San Francisco Bay in a Santana-30 sailboat. After six years as national GLOBEC coordinator, where he was able to work closely with new colleagues (Zack Powell) and old college chums (Bill Peterson), the US GLOBEC office relocated to the University of Maryland. Tired of cross-country moves, Hal decided to stay in Berkeley to coordinate a new Northeast Pacific (NEP) regional program of US GLOBEC, and to resume his research interests that had been set aside to foster the development of the US GLOBEC program. As the GLOBEC NEP program began to initiate intensive and sustained field work in the Northern California Current in 2000, Hal relocated to the Oregon State University as an Associate Professor and later Professor (Senior Research), and from 2000 to 2009 he served as Executive Director of the U.S. GLOBEC NEP Regional Coordinating Office. He was able to resume a research career with projects focused on understanding the population dynamics and bioenergetics of North Pacific krill (*Euphausia pacifica*) and juvenile coho salmon, and the North Atlantic copepod, *Calanus finmarchicus*. Other projects have examined connectivity of marine reserves along the coast of Oregon, and mortality of copepods in Dabob Bay, Washington.

Hal attended PICES-1993 (Seattle, USA) and PICES-1998 (Fairbanks, USA), but was not involved in expert groups of PICES prior to 2001. Since 2001 (the 10th Anniversary Meeting of PICES), he has served on many PICES groups, starting as the Co-Chairman of the Climate Change and Carrying Capacity program and member of the Science Board (2001–2009), and more recently as U.S. delegate to the Governing Council (2012–2013). He has contributed in numerous other ways to PICES, most importantly on the first North Pacific Ecosystem Status Report Working Group, the Fisheries and Ecosystem Responses to Recent Regime Shifts (FERRRS) Working Group, the Study Group on *Future Integrative Scientific Programs* (SG-FISP), and as a member of the FUTURE Advisory Panel on *Status, Outlooks, Forecasting and Engagement* (SOFE).

The only downside of the move in 2000 from Berkeley to Corvallis is that Oregon does not have the outstanding sailing that can be found on San Francisco Bay. The sailboat was sold—sigh! And, in 2004, Hal took up sea kayaking in rivers and estuaries, which he hopes to do more of from his new position in the PICES Secretariat. Other hobbies are reading, watching U.S football, bicycling and hiking. Hal and his wife have long included cats as family members in their household—they are sources of joy and heartbreak (when they pass-on)—and several will be moving to Canada with them.

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