



## PICES science in 2014: A note from the Science Board Chairman

This past year was marked by change within PICES. Not only within the flagship integrated scientific program, Forecasting and Understanding Trends, Uncertainty and Responses of North Pacific Marine Ecosystems (FUTURE) but also within the PICES Secretariat, with changes in both the Executive Secretary and Deputy Executive Secretary positions. Since PICES-2013, in Nanaimo, Canada, the Organization continues to respond to emerging challenges and advancement of marine science in the North Pacific. Our scientific expertise is shared through symposia and workshops, peer-reviewed literature, PICES scientific reports, exchange of ideas and information among scientists, capacity building, and collaborations with other international organizations. Combined, these provide opportunities for the next generation to become involved in PICES science. An excellent example of this was the [FUTURE Open Science Meeting](#) (OSM) held in April to mark the mid-point of FUTURE; the program included one plenary session, eight theme sessions, and four workshops. The OSM was an opportunity to display FUTURE achievements and to identify gaps in addressing the overarching question, “What is the future of the North Pacific, given current and expected pressures?” This milestone event lasted five days and attracted over 115 participants. The OSM also allowed PICES to review progress and identify challenges facing the program. A FUTURE Evaluation Team composed of PICES and non-PICES experts prepared a [report](#) and Science Board, with support from Governing Council, acted at PICES-2014 to implement some of the

recommendations. Specifically, we have created a FUTURE Scientific Steering Committee (SSC) that replaces the three FUTURE Advisory Panels, AICE (*Anthropogenic Influences on Coastal Ecosystems*), COVE (*Climate, Oceanographic Variability and Ecosystems*) and SOFE (*Status, Outlooks, Forecasts, and Engagement*) to provide oversight and guidance during the second half of this program. More about the changes within FUTURE will be disseminated following the first meeting of the FUTURE SSC, which will take place in early March 2015 in La Jolla, California, USA.



The joint FUTURE Advisory Panel meeting, held to discuss the new governance structure of FUTURE, attracted wide participation. Dr. Jake Rice (Chairman of the FUTURE Evaluation Team) addresses the audience at PICES-2014.

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The Convention Center, behind the Big-O on the grounds of the Expo site, where PICES-2014 took place.

As an intergovernmental organization, PICES science is primarily delivered through its expert groups and since PICES-2013, we have added four Study Groups and one Working Group. Two Study Groups were created to directly address the specific needs of FUTURE: SG-SEES (*Socio-Ecological-Environmental Systems*) was established to explore mechanisms for integrating environmental and marine science with social and economic considerations, and SG-BC (*Biodiversity Conservation*) was established to provide PICES a better understanding of how biodiversity is being addressed (or not) in the North Pacific. The other two Study Groups were formed to explore potential collaborations with other North Pacific organizations, specifically the North Pacific Anadromous Fish Commission (NPAFC) and the Northwest Pacific Action Plan (NOWPAP). In addition, WG 31 (*Emerging Topics in Marine Pollution*) was established to explore and better understand various aspects of marine pollution in the North Pacific. You will be able to read more about these expert groups as products become available. All of these have web pages on the [PICES website](#) which provide up-to-date information about their specific tasks.

The scientific excellence of PICES is reflected in the recognition by a number of other organizations and the cooperative work we do with them. Since the last Annual Meeting, PICES has been represented at a variety of meetings, workshops, and symposia hosted by organizations such as ICES, IMBER, IOC, NOWPAP, NPAFC, and SCOR, to name a few. Two major meetings co-sponsored by PICES in 2014 were the 29<sup>th</sup> Lowell Wakefield Fishery Symposium on “*Fisheries bycatch: Global issues and creative solutions*” held in Anchorage, Alaska, USA, May 2014 (see the article by Gordon Kruse in this issue) and an ICES Symposium on the “*Ecological basis of risk analysis for marine ecosystems*” held in Porvoo, Finland, June 2014 (see the [article](#) by Alexei Orlov in the previous issue of [PICES Press](#)). Looking forward, PICES, ICES and IOC will be hosting the 3<sup>rd</sup> International Symposium on “*Effects of climate change on the world’s oceans*” in Santos City,

Brazil, March 23–27, 2015. In addition, PICES and ICES will be co-sponsoring the 6<sup>th</sup> Zooplankton Production Symposium: “*New challenges in a changing ocean*”, in Bergen, Norway, in May 2016.

In addition to convening symposia, PICES also often serves as a theme session co-sponsor. In 2014 these included an IMBER/PICES Theme Session on “[Responses of society to marine and global changes as a core mandate for IMBER: Ways forward](#)” at the IMBER Open Science Conference held in Bergen, Norway, June 2014, and three ICES/PICES theme sessions held at the ICES Annual Science Conference held in A Coruña, Spain, September 2014: [Theme A](#) “*Gelatinous zooplankton on a global perspective: Interactions with fisheries and consequences for socio-economics*”, [Session I](#) “*The increasing importance of biofouling for marine invasions: An ecosystem altering mechanism*”, and [Session Q](#) “*Physical and biological consequences of North Atlantic circulation patterns*”. Two of the four best presentation awards at the ICES conference were awarded to two early career scientists in the jellyfish session!

As a science-based organization, it is essential that we document our scientific achievements. To this end, the final reports from two PICES expert groups ([Report](#) of the PICES/ICES Working Group on *Forecasting Climate Change Impacts on Fish and Shellfish*; [Report](#) of the Study Group on *Marine Pollutants*) that completed their terms of reference, and a [proceedings](#) of the Section on *Ecology of Harmful Algal Blooms in the North Pacific* workshop held at PICES-2013 were published as PICES scientific reports 45, 46 and 47, respectively.



Capacity building is another high priority activity of PICES. A major component of our capacity building is accomplished by hosting “summer” schools on marine sciences. In 2014, PICES hosted a summer school on “*End-to-End models for marine resources management and research*” at Gangneung-Wonju National University, Korea, August 26–29, 2014 (see the article by Isaac Kaplan *et al.* in this issue). Twenty-nine early career scientists from four PICES member countries (Canada, China, Japan and Korea) and nine other countries attended this 4-day school. PICES

thanks Professor Chung Il Lee for ably organizing this event. In addition to PICES summer schools, PICES also supports summer schools organized by large-scale international ocean research projects. This included IMBER's International Summer School, ClimECO4 (*Delineating the issues of climate change and impacts to marine ecosystems: Bridging the gap between research, assessment, policy and management*), held this past summer in Shanghai, China. Travel funds from PICES enabled one instructor and five PhD students from PICES member countries (Canada, U.S. and China) to attend. In 2014 we provided travel funding to 35 students or early career scientists to attend the PICES Annual Meeting or symposia co-sponsored or organized by PICES.

Another component of capacity building for PICES is to share methodologies and information by organizing workshops or training courses in developing countries around the Pacific Rim. With generous funding from Japan's Ministry of Agriculture, Forestry and Fisheries for the project on "*Marine ecosystem health and human well-being*", PICES scientists conducted two capacity-building workshops and an aquaculture pond experiment in Indonesia this past year. PICES also is involved in another project funded by the Japan Ministry of Environment on "*Effects of marine debris caused by the Great Tsunami of 2011*" whose goal is to assess and forecast the effects of debris generated by the tsunami that followed the 2011 earthquake in northeastern Japan (see the article by Cathryn Clarke Murray in this issue). This project is especially interested in the potential impacts of invasive marine species on the coasts of North America and Hawaii. The

research is structured around three major themes: modeling debris transport, surveillance and monitoring, and aquatic invasive species. The tsunami debris Project Science Team has been actively engaged and will plan Year 2 activities very soon.

PICES-2014 was convened in Yeosu, Korea, at the site of World Fair, Ocean Expo-2012. Thirty-two organizations were represented at this Annual Meeting, nine of which co-sponsored workshops and/or topic sessions. The meeting theme "*Toward a better understanding of the North Pacific: Reflecting on the past and steering for the future*" attracted over 350 participants from 20 countries and included 311 oral and poster presentations.



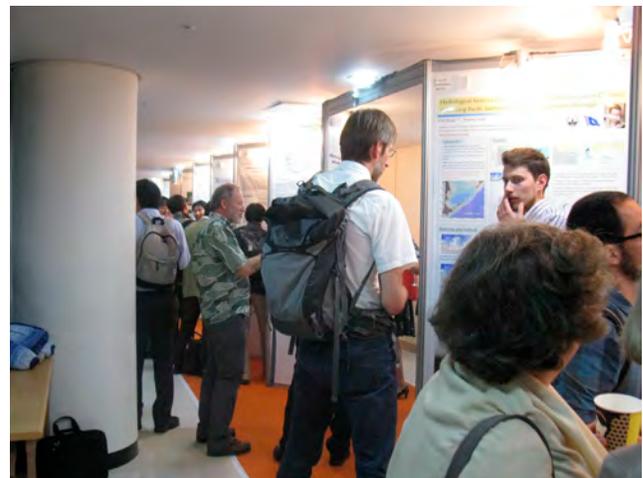
Some of the participants at the joint PICES/NOWPAP Study Group on Scientific Cooperation in the North Pacific Ocean meeting, one of 32 business meetings conducted at PICES-2014. (From left): Alexander Bychkov, Harold (Hal) Batchelder, Jennifer Boldt, Alexander Tkalin (Study Group Co-Chairman, NOWPAP), Thomas Therriault, Chuanlin Huo (Study Group Co-Chairman, PICES), Xiaodong Zhong, Takafumi Yoshida and Toru Suzuki.



Participants at the PICES-2014 Science Board meeting (from left): Angelica Peña (BIO), Elizabeth Logerwell (FIS), Jennifer Boldt (MONITOR), Harold (Hal) Batchelder (PICES Secretariat), Toru Suzuki (TCODE), Kyung-Il Chang (POC), Hiroaki Saito (AP-COVE and Science Board Vice-Chairman), Thomas Therriault (Science Board Chairman), Chuanlin Huo (MEQ), Phillip Mundy (AP-SOFE), Steven Bograd (AP-AICE), and Igor Shevchenko (representing Russia).



Some expert group meetings that took place at PICES-2014. (Clockwise from top left) Working Group (WG 28) on Development of Ecosystem Indicators to Characterize Ecosystem Responses to Multiple Stressors, “Effects of marine debris caused by the Great Tsunami of 2011” Project Science Team, Working Group (WG 27) on North Pacific Climate Variability and Change, Working Group (WG 30) on Assessment of Marine Environmental Quality of Radiation around the North Pacific.



Three of the convenors, Francisco Werner (USA, ICES), Suam Kim (Korea, PICES), Sei-Ichi Saitoh (Japan, PICES) for the PICES-2014 Workshop (W1) on “Dynamics of pelagic fish in the North Pacific under climate change”, listen to the presentation by the fourth convenor, Gerald DiNardo (USA, ICES), out of screen shot. Participant, Kenneth Drinkwater (representing ICES) is in the forefront.

The PICES-2014 Poster Session was a popular venue, drawing a large crowd.



Coffee breaks provided a chance for participants to socialize and to talk science.



The PICES Secretariat (from left): Rosalie Rutka, Christina Chiu, Alexander (Alex) Bychkov, Julia Yazvenko and Harold (Hal) Batchelder.



A packed house waiting for the Best Presentation awards to be announced at the PICES-2014 Closing Session.

PICES recognizes exceptional contributions to North Pacific marine science in the form of the Wooster and POMA awards. The recipient of the 2014 Wooster Award was Dr. Fangli Qiao of the First Institute of Oceanography, State Oceanic Administration, People’s Republic of China, for a career of sustained excellence in marine science research that has (so far) spanned more than 20 years. His most cited publication provided clarity on the importance of surface waves in large-scale circulation through vertical mixing, which is now used as the theoretical basis for ocean model improvement. The 2014 PICES Ocean Monitoring Service Award (POMA) was awarded to the National Institute for Environmental Studies (NIES) of Japan for the Trans-Pacific Volunteer-Observing-Ship (VOS) Survey program. This unique program was developed to better understand global carbon budgets that require broad spatial and temporal *in situ* observation of oceanic CO<sub>2</sub> partial pressure (*p*CO<sub>2</sub>). The spatial-temporal coverage was obtained by installing gas-chromatographic *p*CO<sub>2</sub> instruments on board cargo ships sailing trans-Pacific routes. For more on these award recipients see the following article.



PICES Chairman, Dr. Laura Richards, addressing guests at the Chairman’s Reception, held after the official closing of PICES-2014, in the spacious Aqua Planet on the Expo grounds in Yeosu.

Finally, our next Annual Meeting, PICES-2015 on “Change and sustainability of the North Pacific”, will take place in Qingdao, China, from October 15–25, 2015. I look forward to seeing you there.



Executive Secretary, Alexander Bychkov, with past and present Science Board Chairs (from left: Thomas Therriault, 2014, John Stein, 2007–2010, Ian Perry, 2001–2004 and Patricia Livingston, 1998–2001).



Thomas Therriault  
Science Board Chairman

## 2014 PICES awards

The presentation ceremony for two prestigious PICES awards took place on October 20, 2014, during the Opening Session at the 2014 PICES Annual Meeting in Yeosu, Korea.

### *Wooster Award*

In 2000, PICES established an annual award for scientists who have made significant contributions to North Pacific marine science and have achieved sustained excellence in research, teaching, administration, or a combination of these in the area of the North Pacific. The award was named in honour of Professor Warren Wooster, a principal founder and the first Chairman of PICES. Prior recipients of the [Wooster Award](#) were Michael Mullin (USA; 2001), Yutaka Nagata (Japan; 2002), William Percy (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), Richard Beamish (Canada; 2012) and Vera Alexander (USA; 2013).

The 2014 award presentation ceremony was conducted by Drs. Laura Richards (Chairman of PICES) and Thomas Therriault (Chairman of Science Board). Dr. Therriault announced that the 2014 Wooster Award was being given to Dr. Fangli Qiao (First Institute of Oceanography, State Oceanic Administration, China), and read the following Science Board citation (reading of the citation was accompanied by [a slide show dedicated to Dr. Qiao](#)):

*In 2000, the PICES Governing Council approved the establishment of an award named in honour of Professor Warren Wooster, a principal founder and the first Chairman of PICES, and a world-renowned researcher and statesman in the area of climate variability and fisheries production. The award is given annually to an individual who has made significant scientific contributions to North Pacific marine science, such as understanding and predicting the role of human and climate interactions on marine ecosystems.*

*It is my great pleasure to announce that the recipient of the 2014 Wooster Award is Dr. Fangli Qiao of the First Institute of Oceanography (FIO), State Oceanic Administration, People's Republic of China, for a career of sustained excellence in marine science research that has spanned more than 20 years.*

*Fangli was born in a small Chinese village in 1966 and entered the Ocean University of China in 1984 with the highest score. In 1988, he was recommended as a Master's candidate, and received his PhD in 2003. Dr. Qiao was promoted to his full professor position within six years after starting at FIO due to his excellence in ocean*

*research. He has more than 200 publications in peer-reviewed journals, two published books, and serves on the editorial boards of three international journals.*

*His most cited publication clarified the crucial importance of surface waves in large-scale circulation through vertical mixing, which is now used as the theoretical basis for ocean model improvement. This theory has been confirmed by laboratory experiments and field observations. Numerical experiments show that this mixing scheme is much more important than traditional shear-induced mixing. Previous ocean circulation models produced insufficient vertical mixing, under-predicting surface mixed layer depth and over-predicting sea surface temperature. These improvements are important for modeling the climate system, and he shared this with IOC/WESTPAC member states through the development of an operational wave-tide-circulation coupled Ocean Forecasting System, which was launched in May 2012 and will benefit coastal populations in Southeast Asia.*

*Fangli provided important scientific support for several public health issues, including identifying the causes of algal blooms and accumulations in the Qingdao coastal area of the Yellow Sea in 2008, and the spread of radiation from the damaged Fukushima nuclear plant in March 2011. In addition to his scientific achievements, Fangli has made substantial contributions to administration of science and professional service. As Deputy Director General and more recently Director General he has been in charge of international cooperation for FIO for nearly 10 years.*

*Dr. Qiao assisted in the founding of the UNESCO/IOC Regional Training and Research Center on Ocean Dynamics and Climate (UNESCO/IOC-ODC) and has served as Director since its establishment in June 2011. To date, 169 trainees from 26 countries have participated in ODC training courses.*

*He has been active in PICES as a member of Science Board from 2005–2012 and currently serves as a member of POC, WG 29, and Governing Council. He has encouraged a number of early career scientists from China to become engaged in PICES.*

*Ladies and gentlemen, please join me in congratulating Dr. Fangli Qiao as the 2014 recipient of the Wooster Award.*

*Dr. Qiao accepted the award with the following remarks:*

*Thank you! What a surprising and amazing honor! There are so many outstanding scientists in the PICES community;*

*I am humbled in receiving the Wooster Award, but also very happy for this recognition. PICES is a big family; I have learned a lot from this family during the past ten years. As you know, improving simulation and forecasting of the ocean and climate has been one of PICES' top priorities. However, all ocean circulation and climate models face common problems, that is, a lack of vertical mixing in the upper ocean. Where is the missing energy? At last, we have found that surface waves play a dominant*

*role in the upper ocean, which is not only important for improving ocean and climate models, but is also relevant for the marine ecosystem. I would like to acknowledge that the above achievements are the result of contributions from many wonderful colleagues and mentors; I am truly grateful to the collaborations. Ladies and gentlemen, I would like to share the Wooster Award with all of you. It could not happen without your full support. Thank you again, and I hope to meet all of you in Qingdao in 2015.*



Dr. Fangli Qiao with Dr. Laura Richards, PICES Chairman, and Dr. Thomas Therriault, PICES Science Board Chairman (left photo), and with Dr. Haiwen Zhang, Chinese National Delegate to PICES (right photo), after receiving the 2014 Wooster Award.



### ***PICES Ocean Monitoring Service Award***

Progress in many aspects of marine science is based on ocean observations, monitoring, and management and dissemination of data. In 2007, a [PICES Ocean Monitoring Service Award \(POMA\)](#) was established to recognize the sustained accomplishments of those engaged in these activities. 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; the California Cooperative Fisheries Investigations in 2012, and the A-line Monitoring Program in 2013.

Drs. Richards and Therriault conducted the POMA presentation ceremony. Dr. Therriault announced that the 2014 award was being given to the Trans-Pacific Volunteer-Observing-Ship (VOS) Survey Program of the National Institute for Environmental Studies of Japan, and read the following Science Board citation (reading of the citation was accompanied by a [slide show dedicated to the Program](#)):

*The PICES Ocean Monitoring Service Award (POMA) recognizes organizations, groups and outstanding individuals that have contributed significantly to the advancement of marine science in the North Pacific through long-term ocean monitoring and data management. The award also strives to enlighten the public on the importance of those*

*activities as fundamental to marine science. It draws attention to an important aspect of the PICES Convention that is less appreciated: “to promote the collection and exchange of information and data related to marine scientific research in the area concerned”.*

*It is my great pleasure to announce that the recipient of the 2014 POMA award is the National Institute for Environmental Studies (NIES) of Japan for their Trans-Pacific Volunteer-Observing-Ship (VOS) Survey Program.*

*To understand global carbon budgets requires broad spatial and temporal in situ observation of oceanic CO<sub>2</sub> partial pressure (pCO<sub>2</sub>). The atmosphere–ocean difference of pCO<sub>2</sub> controls the flux and efflux of oceanic CO<sub>2</sub>. While many historical pCO<sub>2</sub> observations were obtained from oceanographic research vessels, it was recognized that the need for more complete spatial and temporal coverage could be satisfied partially using volunteer observing ships (VOS). This approach was pioneered in 1985 by the late Dr. C.S. Wong of the Institute of Ocean Sciences in Canada. He installed a gas-chromatographic pCO<sub>2</sub> instrument on board a cargo ship sailing between the west coast of Canada and Oceania that allowed repeated observations of pCO<sub>2</sub> over the equator until 1988 when the ship route changed. Communication between Dr. Wong and Dr. Yukihiro Nojiri called for a new VOS program, and in 1994 a pCO<sub>2</sub> VOS survey was revived using the Skaugran, a lumber and car carrier sailing between the U.S. west coast and Japan. Following negotiations with the captain, chief*



Dr. Yukihiro Nojiri with Dr. Laura Richards, PICES Chairman, and Dr. Thomas Therriault, PICES Science Board Chairman (left photo), and with members of his team (right photo), after receiving the 2014 PICES Ocean Monitoring Service Award.



engineer, and operator and owner, NIES prepared the on-board system and technical staff, usually students.

A second VOS, *Alligator Hope*, a container carrier operating between Tokyo and Seattle/Vancouver was outfitted. Dr. Nojiri obtained special funding to improve the on-board  $p\text{CO}_2$  system that was more automated and able to be operated by a one of the ship's crew. After 16 round trips, *Alligator Hope* had a route change to Oceania so the NIES project looked for a new candidate ship for the North Pacific. Since car carriers belong to the manufacturers, they appeared to offer longer-term stability for the Program.

The shipping companies, Toyofuji Shipping and Kagoshima Senpaku, having strong connections with Toyota Motors exporting Japanese cars to North America, Asia and Oceania, have been helping the NIES VOS project since 2001. They graciously allowed  $p\text{CO}_2$  systems to be installed on several ships, including the third VOS for the North Pacific, the *Pyxis*. Due to the efforts of NIES, Global Environmental Forum Foundation, Kimoto Electric Company, and the shipping companies, the *Pyxis* made 86 round trips, which must be a record for a single VOS in the world's  $p\text{CO}_2$  observations.

Dr. Hitoshi Mukai of NIES secured funding for an Oceania  $p\text{CO}_2$  line and, with cooperation from Toyofuji Shipping, designed an atmospheric and oceanic  $p\text{CO}_2$  observation space on the *Transfuture 5*, which is now in its ninth year.

The three VOS in the North Pacific achieved 148 trans-Pacific round trips from 1995 to 2013. It amounts to about 30 trips around the globe. This project has been encouraged and supported by PICES member countries and contributed to Working Groups 13 and 17, and now the Section on Carbon and Climate. The project has resulted in 17 scientific publications on North Pacific biogeochemistry, eight on global ocean  $p\text{CO}_2$  database and analysis, and 18 on atmospheric sciences through the on-board sampling and measurement of atmospheric components. Additional results and details are available on the project's web page.

In 2007, world experts on ocean surface  $p\text{CO}_2$  determined that an integrated observational Surface Ocean  $\text{CO}_2$  Atlas, SOCAT, should be compiled. The NIES VOS data set contributed 14% of the total global  $p\text{CO}_2$  data in SOCAT. The SOCAT database demonstrated the value of VOS surveys in providing better geographic and seasonal  $p\text{CO}_2$  data, thanks in large part to NIES VOS Program.

Ladies and gentlemen, please join me in congratulating NIES, who is represented here by Dr. Yukihiro Nojiri, as the 2014 recipient of the PICES Ocean Monitoring Service Award.

Dr. Nojiri provided the following remarks of appreciation:

First, I want to express my gratitude to the late C.S. Wong (Institute of Ocean Sciences, Department of Fisheries and Oceans, Canada). NIES VOS observations were started by his proposal for collaboration. His laboratory people were on-board members in our first VOS, the Skaugran surveys. I visited him in March 2013, before he passed away in June. He was something like my father in oceanography, and he also took care of many Japanese oceanographers.

When we started  $p\text{CO}_2$  observations in 1995, we were not familiar with data exchange among ocean  $\text{CO}_2$  scientists. However, now we have the global open data exchange network, SOCAT. We developed this system under many international organizations, and PICES is an important supporter for the North Pacific. The PICES support for ocean  $\text{CO}_2$  scientists started in the mid-1990s, which was coincident with our VOS observations.

Most essential support was from shipping companies, captains, chief engineers and ship crews of the volunteer ships, and port authorities. The efforts of staff from NIES, GEF, Kimoto Electric Co., MIRC and many collaborators in Japan were inevitable. Finally, I want to acknowledge our partners such as IOS (Canada), NIWA (New Zealand), CSIRO (Australia), NOAA (USA), IOCCP and many other international supporters.

## Fisheries bycatch: Global issues and creative solutions

by Gordon Kruse

According to a study by the Food and Agriculture Organization (FAO) of the United Nations, fishery discards averaged 7.3 million metric tons worldwide during 1992–2001. Despite evidence for a substantial reduction in discards in recent years, this waste of fish resources remains an important public concern, especially when so many fisheries worldwide are fully or overexploited. From a conservation view, bycatch can compromise fisheries sustainability, especially if mortality of discards or retained bycatch is not factored into estimates of total fishing mortality for commercially harvested species. Conservation concerns extend to noncommercial and protected species, when bycatch endangers species with vulnerable life histories and protected species at low population abundances (e.g., marine mammals, seabirds, and other fish). Economic issues include increased sorting costs associated with catches of undesirable species, sexes, or sizes and foregone harvests of valuable target species owing to harvest restrictions or area closures to protect bycatch species. Social issues include resource conflicts involving competing users of marine resources and difficult allocations of catch/bycatch among different stakeholder groups.

However, much progress is being made. In recent decades, reductions in bycatch have resulted from improved enforcement and more novel solutions. Successes have resulted from cooperative efforts with the fishing industry, including development of more selective gear designs, novel bycatch reduction devices, and deterrent mechanisms, some of which capitalize on new understandings of animal behavior. Incentive programs have led to other creative approaches, such as individual bycatch quotas, industry-operated “hot spot” programs, and implementation of full retention and accountability regulations.

These considerations motivated an international symposium, titled “*Fisheries bycatch: Global issues and creative solutions*,” which was convened during May 13–16, 2014, in Anchorage, Alaska, USA. The Scientific Steering Committee included Gordon Kruse (Chairman, University of Alaska Fairbanks, U.S.A.), Heui-Chun An (PICES representative, National Fisheries Research & Development Institute, Republic of Korea), Bram Couperus (Wageningen University, The Netherlands), Paula Cullenberg (Alaska Sea Grant, U.S.A.), Jane DiCosimo (North Pacific Fishery Management Council, U.S.A.), Carrie Eischens (North Pacific Research Board, U.S.A.),



Gordon Gislason, GSGislason & Associates Ltd., Canada), Doug McBride (U.S. Fish and Wildlife Service, U.S.A.) Steven A. Murawski (University of South Florida, U.S.A.), Craig Rose (NOAA Fisheries, U.S.A.), and Chris Siddon (Alaska Department of Fish and Game, U.S.A.). Members of the

Steering Committee organized the scientific aspects of the symposium, chaired sessions, and serve as editors for the symposium proceedings.

The symposium was co-sponsored by PICES, the International Pacific Halibut Commission, and multiple U.S. co-sponsors, including Alaska Sea Grant, Alaska Department of Fish and Game, NOAA Alaska Fisheries Science Center, North Pacific Fishery Management Council, North Pacific Research Board, North Pacific Fisheries Research Foundation, U.S. Fish and Wildlife Service, and the School of Fisheries and Ocean Science of the University of Alaska Fairbanks. The host organization was Alaska Sea Grant, which handled all meeting logistics. This symposium was part of a long-standing Alaska Sea Grant symposium series; specifically it was the [29<sup>th</sup> Lowell Wakefield Fisheries Symposium](#).

The symposium attracted broad international interest. Five out of the six PICES member countries were represented. The symposium was attended by approximately 120 participants from 14 countries: Australia, Canada, Chile, China, Denmark, France, Japan, Mozambique, New Zealand, Norway, South Africa, South Korea, United Kingdom, and the United States. This size and diversity fostered a very collegial atmosphere to discuss and contrast approaches in most regions of the world’s oceans.

The goal of this symposium was to bring together fishery and social scientists, managers, fishermen, and other stakeholders from around the world to report on creative approaches to solving fishery bycatch issues. For purposes of this meeting, we defined bycatch in broad terms to include retained incidental catch, fishery discards, and unobserved mortalities as a result of direct encounters with fishing gear. The conveners sought contributions on new methods and technologies, advancements toward full accounting of fishing mortality into harvest control rules, approaches toward industry-derived solutions, incentive programs, new regulatory solutions, as well as studies on social and economic implications related to bycatch concerns. We pursued broad input on addressing bycatch issues concerning a diversity of fish, invertebrate, mammal, seabird, and other species. We especially encouraged

contributions on how to deal with data-poor species, protected and endangered species, and species with vulnerable life histories (e.g., long-lived species with low rates of reproduction and natural mortality).

Alaska Sea Grant Director, Paula Cullenberg, and Steering Committee Chairman, Gordon Kruse, opened the symposium with welcoming addresses. The keynote speaker was Steve Murawski (University of South Florida, U.S.A.), who kicked off the session with a presentation, titled “*Global perspectives on fisheries bycatch: The legacy of Lee Alverson.*” Steve expertly summarized recent global progress on bycatch issues since Lee Alverson’s landmark 1994 publication, “A global assessment of fisheries bycatch and discards”. That publication established that over a quarter of global fisheries catch was discarded at sea. The paper triggered a worldwide call to upgrade the assessment of bycatch and to broadly implement bycatch reduction through improved management measures. Today, all major fisheries regulatory organizations have bycatch management as one of their central principles.

The first theme session addressed “*Fisheries bycatch—What are the biological and ecological issues?*” It was chaired by Chris Siddon. An invited talk was given by Shijie Zhou (CSIRO, Australia), titled “*Bycatch, discards, and selective fishing: Biological and ecological effects and their impact on fisheries.*” He reviewed the effects of selective fishing and associated bycatch and discards. Unintended effects include modifying food web and ecosystem structure, altering energy flow and species interactions, reducing system resilience and fisheries production, and inducing phenotypic and genotypic changes. He suggested that sharp reduction of bycatch through highly selective fishing may not necessarily lead to sustainable fisheries. Rather, Shijie advocated spreading a moderate level of fishing pressure proportionally over a wide range of ecological components as a better means to fulfill objectives of ecosystem approach to fisheries.

Gordon Gislason and Paula Cullenberg co-chaired the second theme session, titled “*Economic and social considerations of bycatch.*” Gordon Gislason kicked off the session with an invited talk, titled “*Bycatch management in fisheries—Impacts and challenges.*” He addressed biological, economic, and social dimensions of bycatch management including stock assessment, total allowable catch setting, and regulations including monitoring. By drawing from experience from North America, Australia, and Europe, he identified the important roles of incentives and individual accountability. Initiatives to address bycatch can affect fishery economics through allocations of fish resources, markets, seafood prices, and the costs of fishing. He pointed out that the manner in which bycatch is addressed can affect public confidence in fisheries management, including the social license to fish.

Gordon Kruse and Steve Murawski chaired Theme Session 3, titled “*Accounting for bycatch of nontarget fish species.*” The session began with an invited talk by Dr. James Nance (NOAA Fisheries, U.S.A.), titled “*Bycatch in the Gulf of Mexico shrimp fishery.*” Bycatch in trawl shrimp fisheries has been a long-standing concern. On average in the Gulf of Mexico, about 68% of the catch in weight is composed of fish (mostly groundfish), 16% commercial shrimp species, 13% noncommercial crustaceans, and 3% by other invertebrates. Relatively low quantities of fish species, such as king mackerel and red snapper, are taken but these species have attracted a lot attention because of their commercial and recreational importance. Additionally, endangered species, such as sea turtles, and marine mammals may interact with shrimp trawls.



Gordon Kruse was honored by Alaska Sea Grant Director, Paula Cullenberg, at the symposium for serving on eleven Lowell Wakefield fisheries symposium steering committees, and chairing nine of them.

Gordon Kruse chaired Theme Session 4 on “*Solutions for monitoring protected and endangered species.*” Lotte Kindt-Larsen (Danish Technical University, Denmark) led off with a fascinating invited talk, titled “*Big brother is watching...*” In lieu of observer programs, which can be prohibitively expensive, she reported on the cost-effective use of closed-circuit television (CCTV) cameras to document bycatch of marine mammals. She reported results of a study in which Danish commercial gillnetters were equipped with remote electronic monitoring (REM) systems, which provided video footage, time, and location of all catches. Results were proven to be much more reliable than fishermen’s logbooks, as bycatch of marine mammals and seabirds can fall out before the net is brought onboard. It is possible to identify seabird species from video footage, which had a large beneficial effect on bycatch rates. In 2014 the program was expanded to monitor bycatch of the endangered harbor porpoise population and other marine mammals and seabirds in the Baltic Sea.

Heui-Chun An and Carrie Eischens chaired Theme Session 5 on “*Gear developments and other technological solutions.*” Dr. An presented a very comprehensive, invited talk, titled “*Review of fishing technology to reduce bycatch in Asia.*” He reported that discards associated with fisheries in the Northwest Pacific amount to an estimated 9 million tons, which accounts for 33.8% of the global discards according to statistics of the FAO. This bycatch occurs in active fishing gears, such as trawls, and also in passive gears, such as gillnets, traps, and longline fisheries. He reported that in Asia bycatch reduction devices have been applied in a number of trawl fisheries and that the main approach to reduce bycatch in gillnets and traps is the adjustment of mesh size and inclusion of escapement rings.



Dr. Heui-Chun An (rear, left) and colleagues are engrossed in a poster presentation at the bycatch symposium.

Theme Session 6, titled “*Fishery regulatory approaches and solutions,*” was co-chaired by Jane DiCosimo and Doug McBride. This session was kicked off with an invited talk by Alan Haynie (NOAA Fisheries, U.S.A.), titled “*The right bycatch management tool for the right problem: How catch shares and incentive programs are being utilized and how we can do better.*” Alan drew upon

experiences in bycatch management along the U.S. west coast and Alaska. He concluded that, because of different management objectives and legal requirements, there is no “one size fits all” approach for bycatch reduction. The function of management programs depends upon biological, economic, and institutional factors, such as how the fishing industry is organized and whether onboard observers are employed. He concluded by presenting a useful framework on how incentives can impact fisher behavior and bycatch.

The final session, “*Industry incentives, solutions, and cooperative research,*” was chaired by Craig Rose. Participants agreed that this session was one of the highlights of the symposium. It included several talks by commercial fishermen, as well as informative comments and discussions by other members of the fishing industry who attended. The invited talk for this session was given by an Alaska fishing industry representative, John Gauvin (Alaska Seafood Cooperative, U.S.A.). His talk was titled, “*Developing effective solutions to bycatch in Alaska through cooperative research: Gear modifications to reduce Pacific halibut bycatch in sole and cod fisheries of the Bering Sea and Gulf of Alaska.*” John presented excellent case studies of cooperative research to develop effective ways to reduce bycatch. Keys to success included features such as use of fishermen’s knowledge and experience to develop each solution; collaboration between scientists/managers, fishermen, and gear manufacturers; institutional arrangements for funding, experimental design and field testing; and an iterative process for design, testing and implementation. Additionally, technologies, such as underwater cameras and recording sonar systems, improved understanding of gear performance and fish behavior needed to fine tune bycatch reduction devices.



Symposium participants listen to fishing industry representative, John Gauvin, talk about cooperative research to develop halibut excluders for trawl nets in Alaska.

Steve Murawski provided an outstanding symposium wrap-up for the three and a half day meeting. He emphasized that Alaska fisheries provide a very good model for the rest of the world in that they enable innovation by engaging partnerships among industry, government scientists, academics, and non-governmental organizations. He stressed that there is a global need to provide incentives to the fishing industry and fishery managers to use bycatch prevention techniques such as smart gear and performance-based fishing privileges.



Gordon Kruse awards the best student oral presentation to Melanie Underwood (Institute of Marine Research, Norway) for her talk, titled “Excess fish exclusion device: Passive system releases fish at depth during trawling.”

The best student oral presentation was awarded to Melanie Underwood (Institute of Marine Research, Norway) for her talk, titled “Excess fish exclusion device: Passive system releases fish at depth during trawling.” The best student

poster award was presented to Susie Zagorski (Alaska Pacific University, U.S.A.) for her poster, titled “Quantifying habitat impacts of raised ground-gear for the Bering Sea pollock fishery.”



The poster session provided an excellent opportunity for symposium participants to get to know each other and to share research findings and ideas.

In conclusion, this symposium was another outstanding successful collaboration of PICES with other international organizations. It was a pleasure and privilege for me to work with PICES and other colleagues from around the world on this symposium. The program, copies of presentations, and book of abstracts are available at the symposium website: <http://seagrant.uaf.edu/conferences/2014/wakefield-bycatch/index.php>. The symposium proceedings will be published as an electronic book by Alaska Sea Grant in early 2015. Once published, the book may be purchased online from the [Alaska Sea Grant bookstore](#).



Dr. Gordon H. Kruse (Gordon.Kruse@alaska.edu) is the President’s Professor of Fisheries and Oceanography at the School of Fisheries and Ocean Sciences, University of Alaska Fairbanks. He maintains broad interests in stock assessment, population dynamics, fishery oceanography, and fishery and ecosystem-based management strategies. Gordon has worked in Alaska for 30 years on a diversity of marine invertebrate and fish species. He teaches graduate courses in Marine Ecosystems, Management of Renewable Marine Resources, and Ecosystem-based Fisheries Management. Gordon is the former Chairman and Vice-Chairman of the PICES Fishery Science Committee. He continues to serve as a committee member.

## 2014 PICES Summer School: End-to-End models for marine resources management and research

by Isaac Kaplan, Kenneth Rose, Chung Il Lee, Emanuele Di Lorenzo, Chris Harvey and Rubao Ji

The PICES summer school on “*End-to-end models for marine resources management and research*” was held at Gangneung-Wonju National University, Republic of Korea, August 26–29, 2014. The summer school presented opportunities for learning, both for instructors and students, and opened trans-Pacific lines of collaboration on new techniques for coupled biological and physical modeling.

End-to-End (E2E) models have applications in a wide variety of disciplines, such as natural resource management, wildlife conservation and agriculture. Recently, E2E models have become popular in marine systems because they provide an approach that can mechanistically link climate forcing and higher trophic levels, like fish. They can be extended to include human behaviors and harvesting, creating a complex socio-ecological system model. These models have become desirable due to the interest in ecosystem-based management, and possibly because of improved and more accessible computing power, and increased understanding of the complex interactions and processes that govern ecosystems.

The 4-day summer school introduced graduate students and early-career scientists to the types of E2E models, their advantages and shortcomings, and provided basic knowledge for advanced applications. Students gained an appreciation of the complexity of ecological interactions in the sea, and the implications and uncertainty that can result

in complex models from imperfect understanding of these systems. The summer school described marine ecosystem modeling approaches, with a focus on E2E models and their components. The course consisted of lectures, seminars, and hands-on training in E2E model applications.

Course instructors included Drs. Kenneth Rose (Louisiana State University, USA), Chung Il Lee (Gangneung-Wonju University, Korea), Emanuele Di Lorenzo (Georgia Institute of Technology, USA), Chris Harvey (NOAA, USA), Isaac Kaplan (NOAA), and Rubao Ji (Woods Hole Oceanographic Institution, USA). The steering committee also included Drs. Yang-Ki Cho and Chun-Ok Jo (Seoul National University, Korea).

Twenty-nine students attended the course, hailing from Australia, Bangladesh, Canada, China, India, Japan, Korea, Nigeria, Oman, Peru, Singapore, Tanzania, and Ukraine. This included 15 PhD students and 11 Master’s students. Student interests ranged from oceanography to fisheries, marine policy, and social impacts. Students’ modeling backgrounds also ranged widely. Several strategies accommodated this, including an emphasis on hands-on group work, introductory lectures before more technical information was introduced, and a gradual evolution in the complexity of topics, starting with simple nutrient-phytoplankton-zooplankton models and building to more complex topics later.



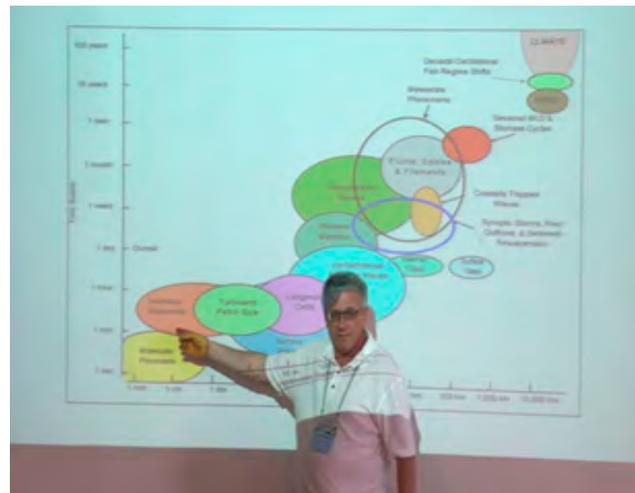
Students and lecturers, 2014 PICES End-to-End Model Summer School at Gangneung-Wonju National University.

Table 1. Summary of model types, characteristics, and lecturers.

	Dynamics	Difference Equations	Differential Equations	Space Dimension	Ecosystem Trophic Level	Humans	Speed	Usability	Interface	Who to contact
<b>Circulation Models</b>	eulerian	-	yes	from meters to 100 km	none	no	resolution dependent	varies	fortran code	Emanuele Di Lorenzo
<b>NPZD</b>	eulerian	-	yes	yes, scale of km	Lower trophic levels no fish	no	fast	6	form model library	Ji Rubao
<b>ECOPATH</b>	box model	yes	-	single box tons/km <sup>2</sup>	upper trophic level, fish	harvest	very fast	2	GUIs	Chris Harvey
<b>ECOSIM</b>	box model	-	yes	single box tons/km <sup>2</sup>	upper trophic level, fish	harvest	fast	3	GUIs	Chris Harvey
<b>ATLANTIS</b>	eulerian	-	yes	yes, scales of several km	all	coupled harvest with management	slow	8	from model library	Isaac Kaplan
<b>IBM</b>	lagrangian	-	yes	yes, scales of km	NPZ, fish and humans	coupled harvest with management	very slow	9	custom coding	Kenny Rose

The course focused on introducing students to a suite of E2E models (Table 1). On the first day, Dr. Isaac Kaplan presented an overview of different types of E2E models, and recent applications of these models. He discussed current and potential resource management uses for the models, contrasted them to other simpler models, and discussed strengths, weaknesses, and challenges of E2E models. Key topics included use of the models to address climate change, nutrients loading, and other non-fishing threats, as well as food web impacts of fishing. Data needs and availability for Atlantis and other E2E models were also discussed.

After Dr. Kaplan’s opening lecture, day one continued with presentations about the mathematics of modeling. Dr. Emanuele Di Lorenzo presented the basics about continuous and discrete representations of processes, time, and space. The important concept of Eulerian *versus* Lagrangian views was described and illustrated. Dr. Kenneth Rose followed with a similar presentation about the mathematics and representations commonly used in modeling, with an emphasis on their implementations with upper trophic organisms like fish. Dr. Rubao Ji provided a background lecture on how zooplankton are represented in ocean models. Zooplankton form a major link from the physics and lower trophic levels to the higher trophic levels, which is a common theme from all versions of E2E models. Students completed a hands-on computer exercise in small groups, using MATLAB and a simple nutrient-phytoplankton-zooplankton model to see how solution methods can affect simulated dynamics.



Dr. Kenneth Rose introduces the time and space scales considered by different types of end-to-end models.

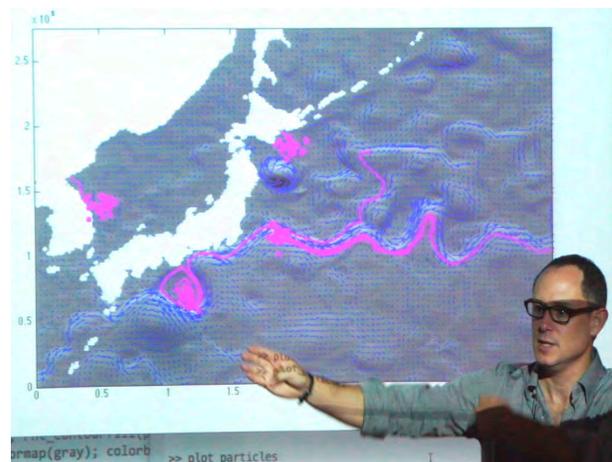
On the second day, Dr. Chris Harvey walked the students through the popular food web modeling software, Ecopath with Ecosim (EwE). Dr. Harvey presented some guidelines for how to define the boundaries of an ecosystem and the level of functional and taxonomic detail that is necessary to address modeling questions. The students got an overview of EwE’s use of thermodynamic mass and energy balance as the primary basis for the underlying difference and differential equations, and also learned about the way key rates, such as growth, mortality, reproduction, feeding, and fishing are calculated to develop parameters for EwE. The students explored the data requirements for developing

EwE models, and learned about some important case studies that used EwE. One such case study was presented by Dr. Chung Il Lee, who showed EwE modeling output related to the current structure of the Hupo Bank ecosystem in the southwestern part of the East Sea. This project uses EAST-1 project data supported by the Ministry of Oceans and Fisheries, Korea. He also discussed long-term change in ecosystem structure before and after climate regime shifts in the southwestern part of the East Sea, and prediction of squid (*Todarodes pacificus*) catch around the northwest Pacific marginal seas.

In hands-on computer lab sessions, the students built their own EwE models of a simplified marine food web, made iterative changes to the model inputs in order to satisfy thermodynamic requirements, and examined summary statistics generated by the software. They then ran dynamic simulations with their models to represent temporal changes in climate and fishing pressure, and learned how to calibrate their models to time series data.

The third day of the course focused on Atlantis E2E models. This whole-ecosystem modeling framework has been developed at CSIRO, Australia, and implemented for over a dozen ecosystems around the world, including the California Current (U.S. West Coast). Dr. Kaplan began the day by asking students to dive directly into output from an Atlantis model for the California Current. After this brief plunge into model outputs, he discussed the strategic goals that motivate Atlantis model development, and described the model dynamics and mechanics. Then, using a 'live' Atlantis model of the California Current, students learned to run and calibrate the model. After a short (3-hour) simulation, students learned to visualize their outputs and evaluate their calibration. The day also included example applications from the California Current, including topics such as evaluating the role of forage fish in the ecosystem, and exploring the impacts of ocean acidification.

The final day was dedicated to how the individual-based (or agent-based) approach can be used in E2E models. Dr. Rose led the presentations with a series of lectures, starting with an overview of individual-based models (IBMs), and then focused lectures on each of the major processes that are often represented in IBMs of higher trophic levels of growth, mortality, reproduction, and movement. The final lecture was about the computational and bookkeeping approaches used to enable simulations of thousands of individuals in E2E models. Dr. Rose ended the final lecture with some advice about best practices in ecosystem modeling, which is especially important for ensuring transparency and credibility of complicated E2E models. Dr. Di Lorenzo introduced how to model passive tracers, passive particles (individuals), and "smart" particles (individuals) with behavior. He led a hands-on tutorial using MATLAB and a two-dimensional grid to illustrate fish movement modeling, related to the earlier conceptual presentation by Dr. Rose. This included a brief interpretive dance by Drs. Di Lorenzo and Rose to illustrate the basic concepts of Eulerian and Lagrangian particle tracking, and behavioral movement.



Dr. Emanuele Di Lorenzo lectures on particle tracking and movement models.



Hands-on experience was an essential part of the course.



*Small group work was included in the syllabus, typically for half the day.*

One of the highlights of the summer school was a series of student presentations at the end of the third day. Students discussed advanced modeling work from their graduate programs and home institutions. These included state-of-the-art physical oceanography simulations for the Indian Ocean, particle dispersal modeling for aquaculture management, and techniques for parameter estimation for individual-based models. These presentations and other conversations led to late night sessions discussing modeling efforts and sharing manuscripts. The summer school certainly opened opportunities for extensive international collaboration, with learning as a “two way street” for both students and lecturers.

The lecturers would like to thank the primary sponsors, PICES and the EAST-1 Project. Co-sponsors also included Gangneung-Wonju National University, NOAA, Gangwon Sea Grant, IMBER, SCOR, NPRB, and Seoul National University. The facilities and logistics at Gangneung-Wonju University were outstanding, with state-of-the-art classrooms, new laptops available to every student, and a beautiful seaside setting. Social events included a traditional

Korean barbecue organized by Dr. Lee. Students appreciated both the course work and the setting, and in fact, one student suggested that “The duration of the program should be lengthened... at least 6 or 7 days,”—an opinion shared by the lecturers.



*Student presentations at the end of the third day.*



*Gangneung-Wonju University's Marine Biology Center for Research and Education, site of the 2014 PICES Summer School.*



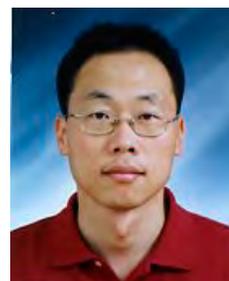
*Traditional Korean barbecue, one of many social events organized by Dr. Lee and the sponsors.*



*Dr. Isaac Kaplan (Isaac.Kaplan@noaa.gov) is a Research Fishery Biologist at NOAA's Northwest Fisheries Science Center in Seattle, Washington, USA. His recent focus has been the development of end-to-end ecosystem models that simulate food webs, fisheries, and oceanography in a spatially explicit framework. The models have been used to test the direct and indirect effects of fisheries and fisheries management for forage fish, groundfish, and other species. He has developed and collaborated on Atlantis end-to-end models for the California Current, Gulf of California (Mexico), Gulf of Mexico, Chesapeake Bay, and Guam. Isaac's modeling currently focuses on impacts of ocean acidification and climate change, and the ecosystem role of forage fish.*



*Dr. Kenneth Rose (karose@lsu.edu) is a Professor in the Department of Oceanography and Coastal Sciences at Louisiana State University in Baton Rouge, Louisiana, USA. His research has focused on the mathematical and simulation modeling of aquatic populations and food webs. He has developed models that have been used in theoretical analysis and for management. Kenny has been one of the developers of the individual-based approach in fish and fisheries modeling. Most recently, he has adapted the individual-based approach for end-to-end modeling. Kenny has long been involved with PICES, and is presently a member of two ICES working groups focused on the role of coastal habitats and on methods for end-to-end modeling.*



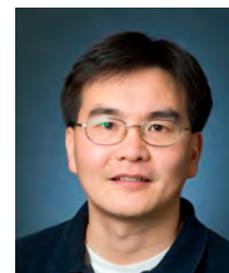
*Dr. Chung Il Lee (leeci@gwnu.ac.kr) is a Professor in the Department of Marine Bioscience, Gangneung-Wonju National University, Korea. He received his PhD in 2003 from Pukyong National University in Busan. His expertise includes fisheries oceanography, food web models, and climate effects on Korean fisheries.*



*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 Working Group 27 on North Pacific Climate Variability and Change, leads the Study Group on Socio-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 CLIVAR ENSO Diversity Working Group and is a member of the CLIVAR POS Panel.*



*Dr. Chris Harvey (Chris.Harvey@noaa.gov) is a Research Fishery Biologist at NOAA's Northwest Fisheries Science Center in Seattle, Washington, USA. His research interests include trophic interactions, bioenergetics modeling, and food web modeling in marine ecosystems along the west coast of North America, including Puget Sound and the California Current large marine ecosystem. He is one of the co-science leads of the California Current Integrated Ecosystem Assessment, which is a broad collaborative effort to provide physical, ecological, and social science in support of ecosystem-based management of the California Current.*



*Dr. Rubao Ji (rji@whoi.edu) is a tenured Associate Scientist in the Biology Department at the Woods Hole Oceanographic Institution. His primary research interest is the interface between the fluid dynamics and the biology of the sea, with a focus on the impact of physical forcing on plankton phenology, biogeography and connectivity. Dr. Ji is currently a fellow of the NOAA Cooperative Institute for the North Atlantic Region (CINAR) and a co-chair of the ICES Working Group on Integrative, Physical-Biological, and Ecosystem Modelling (WGIPEM).*

## Seabirds as early warning indicators of climate events in the Pacific

by G.R.W. Humphries, E. Velarde, D.W. Anderson, B. Haase, W.J. Sydeman

During the strong El Niños of 1982–83 and 1997–98, studies of marine life provided insight and foresight into the evolution and dissipation of these events. Top marine predators, such as seabirds, are particularly responsive to changes in oceanographic conditions during El Niño (Ainley *et al.*, 1995) and other anomalous ocean conditions (Sydeman *et al.*, 2006). In the past, changes in ocean temperature, stratification, currents and other physical factors have been associated with disruptions to coastal food webs, resulting in shifts in seabird distribution, changes in the timing of breeding and migration (phenology), reproductive failures, and even severe adult mortalities (*e.g.*, massive seabird die-offs or “wrecks” observed on coastal beaches). Recently, sequential seabird observations from the Southern Hemisphere, progressing to the equatorial and central-north Pacific, suggest ecosystem

impacts prior to an official declaration of an El Niño event in 2014–2015.

Initial signals were provided by seabirds in the South Pacific. Declines in the breeding success and chick size of sooty shearwaters (*Puffinus griseus*, Fig. 1A) in New Zealand, both leading indicators of an El Niño by up to 14 months (Humphries 2014), suggested an impending climate shift. As early as March 2013, shearwater parents abandoned chicks and engaged in prolonged foraging trips, which led to low chick mass and high mortality. Chicks were 93% lighter than normal and burrow occupancy was ~25%, compared to >60% in typical years. These observations corroborated previous work by academics and Māori seabird harvesters who had found that take (*i.e.*, chicks per unit hunting effort) and low nest-occupancy



**Fig. 1.** A) Sooty shearwater on Codfish Island/Whenua Hou Nature Reserve, New Zealand, (46.78330°S, 167.63330°E) November 2013. B) Inca tern at La Chocolatera Point, Salinas, Ecuador (2.18995°S, 81.01056°W). Heermann's gull colony in Estero Valley, Isla Rasa, Gulf of California (28.82470°N, 112.98050°W) during peak nesting in C) May 2012, a non-ENSO year and D) May 2014, a predicted El Niño year. C) and D) are different perspectives of the same region. Photos by Grant Humphries (A), Ben Haase (B), and Enriqueta Velarde (C and D).

rates preceded the onset of the 1997–98 El Niño. In the March–May prior to the 1997–98 event, take and nest occupancy rates were 50% and 10% of normal, respectively (Lyver *et al.*, 1999). Although in 2014 an El Niño was not declared within the 14 month period (using traditional definitions, see below), temperatures in the North Pacific had begun rising to record levels (Freeland and Whitney, 2014).

Further evidence of an oncoming 2014–15 climate event was observed along the Ecuador coast. Counts of Peruvian booby (*Sula variegata*), Inca tern (*Larosterna inca*; Fig. 1B), as well as migratory shearwaters were unusually high, reflective of broad-scale redistributions. Rates (birds counted/hour) of Peruvian booby sightings increased approximately 300% above normal in June 2014. Rare Inca terns were also seen in unusually large numbers, coinciding with previous reports from the 1997–98 El Niño where hundreds of birds were reported between May and October, whereas only a few dozen are seen typically (Haase, 2011). Hundreds of shearwaters were also observed in June when usually few or none are seen.

Next, near complete breeding failures of elegant terns (*Thalasseus elegans*), and Heermann's gulls (*Larus heermanni*), were observed in winter–spring 2014 in the Gulf of California. On Isla Rasa, home to approximately 95% of the world's breeding populations of both species, only 50% of the gulls and 25–30% of the terns made an attempt to breed in April–June, but were unsuccessful (Fig. 1C and D). This observation was mirrored during other El Niño events when breeding success was almost zero for both species (Velarde *et al.*, 2004). Brown pelican (*Pelecanus occidentalis californicus*) nesting in the Gulf of California was also severely disrupted. By June 2014, only ~6% of the known breeding population had nested, while fledging success was an abysmal 0.07% of normal, the lowest since studies began there in 1970. Breeding failure and reduced survival in seabirds during major El Niño events is common (Ainley *et al.*, 1988; Cubaynes *et al.*, 2010), and in the Gulf of California, spring 2014 ranks as the most severe.

While prediction of climatic events on the basis of measured oceanographic and atmospheric data has progressed rapidly, prediction of the timing and intensity of ecological impacts remains elusive. Recent maintenance delays in measurement systems such as the TAO array, have unfortunately limited the ability of scientists to monitor environmental changes in real time. From an ecosystem perspective, this situation may be improved by the cost-effective information obtained from studies of marine life. While some forecasts predicted an El Niño event that would mature during the fall of 2014 (*e.g.*, Ludescher *et al.*, 2014), it is clear that seabirds began to respond to climatic changes in some locations much earlier. Indeed, the signals provided by seabirds suggest ongoing

effects well in advance of the model-based timing forecasts. In part, this is due to the standard definitions used to declare an active, mature El Niño event. These definitions may be appropriate for meeting societal needs, but may have limited utility in an ecological context if the climatic events are short lived, or do not otherwise behave according to expectations based on prior events. Alternatively, unrealized climatic and oceanographic factors that precede events may confer signals evident in the behavioral or demographic attributes of the birds before changes in the physical environment become acute enough to be detected. For example, some define an El Niño as an event where sea surface temperature anomalies in the equatorial Pacific remain greater than 0.5°C above baseline for more than seven months, while others declare an El Niño when a standardized index derived from the pressure differential between Tahiti and Darwin is sustained below –8.0 for four months (Trenberth, 1997). In both cases, it is quite likely that marine biota will respond before temporal or amplitude thresholds are met or exceeded.

Seabirds, as the most conspicuous organisms in marine ecosystems, have consistently shown early responses to El Niño, La Niña, and other anomalous climate events, possibly due to their high metabolic rates and trophic amplification of oceanographic or food web variability (Sydeman *et al.*, 2006). In regard to 2014, the complete breeding failures and large-scale extralimital or extemporaneous movements described here have been observed previously only during severe El Niño events, such as 1982–83 and 1997–98. While an El Niño event of moderate characteristics is still predicted for 2014–2015, it would seem prudent to also consider at this stage, “what are the birds telling us”?

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Dr. Grant Humphries ([humphries.grant@gmail.com](mailto:humphries.grant@gmail.com)) is a marine ecologist and computer programmer who focuses on spatial ecology, modeling using machine learning algorithms and seabirds. He is currently employed as a postdoctoral research associate at the Farallon Institute with Dr. William Sydeman, and at the University of California, Davis, with Dr. Gabrielle Nevitt. Dr. Humphries has published on several ecosystems including both Polar Regions, the Bering Sea, and terrestrial environments in New Zealand and Alaska.

Dr. Enriqueta Velarde ([evelarde@uv.mx](mailto:evelarde@uv.mx)) is senior full-time researcher at the Institute of Marine Sciences and Fisheries of the Universidad Veracruzana, Mexico. Her research focuses mainly on seabird breeding and feeding ecology, conservation and management of insular ecosystems, distribution of seabirds at sea and in the islands of the Gulf of California, as well as effects of climate, oceanographic conditions and fisheries on seabird breeding parameters and distribution. An applied aspect of her research has been the use of seabird data for the prediction of commercial fisheries. Photo credit: Ralph Lee Hopkins, 2010.

Dr. Dan Anderson ([dwanderson@ucdavis.edu](mailto:dwanderson@ucdavis.edu)), a marine ornithologist and avian ecotoxicologist, is currently continuing a five-decade study of Western North American Brown Pelicans. In 1976, Anderson joined the faculty at the University of California, Davis continuing his contaminant work and conducting long-term studies of seabird populations, El Niño effects, human disturbance effects, marine bird habitat selection, migration and movements of seabirds, and related work, much of it in Baja California and the Gulf of California. He is now retired but was formerly Director of the Ecotoxicology Program at UC Davis and former Chair of his department. Current research also involves studies of contamination effects, distribution, and dynamics of organic and inorganic materials in birds from coastal and wetland environments, including the Klamath Basin, Clear Lake, San Joaquin Valley, Rio Colorado Delta/Gulf of California region, and West Coast marine environments. Anderson is also involved in the conservation and management of avian populations and their habitats.

Dr. Ben Haase ([bhaase2012@gmail.com](mailto:bhaase2012@gmail.com)) is a naturalist – guide who has specialized in marine mammals and seabirds. He is the author and co-author of more than 30 scientific publications involving his work on a variety of subject matters. He is one of the pioneers of a long-term study on south-east Pacific Humpback whales, and has been involved with shorebird banding projects in Canada and Ecuador. He has recently published the book “Sea and coastal birds of continental Ecuador and the Ecuasal lakes”, and is currently the curator of the cetacean collection at the Whale Museum in Salinas, Ecuador.

Dr. William (Bill) Sydeman ([wsydeman@comcast.net](mailto:wsydeman@comcast.net)) is a veteran ecosystem ecologist and participant in the PICES community. Dr. Sydeman served as the co-Chair for the Advisory Panel for Marine Birds and Mammals from 2003 to 2010. He has worked on the concept of seabirds as ecosystem indicators for decades, and currently conducts a variety of projects on forage nekton (krill and forage fish), seabirds, and marine mammals from the North Pacific to the South Atlantic (Benguela Current) focusing primarily on climate change, winds and upwelling, and ecosystem impacts.

### Call for nominations

We are now soliciting nominations for the 2015 [Wooster Award](#) and the 2015 [POMA](#). The closing date for nominations for both awards is **March 31, 2015**. Both awards will be presented during the Opening Session of PICES-2015 in Qingdao, China.

Send nominations to [robin.brown@pices.int](mailto:robin.brown@pices.int) at the PICES Secretariat and include the following information: nominee’s name, title, institutional affiliation and address, CV, and statement of justification for the nomination.

## Japan launches a new, state-of-the-art training ship – the *Oshoro Maru V*

by John Bower

Japan has launched a new, state-of-the-art training ship that will operate in the North Pacific. The 6.7 billion yen (approximately US\$63 million) *Oshoro Maru V* (Fig. 1) replaces the *Oshoro Maru IV*, which began operating in 1984. The new ship was built by the Mitsui Engineering & Shipbuilding Co., Ltd. in Tamano, Okayama Prefecture, where the keel-laying ceremony recognizing the start of construction was held in March 2013. The completion ceremony was held at its home port Hakodate in August 2014, and its first cruise with students aboard was conducted off southwestern Hokkaido in early September 2014.

The ship's history extends back to the original *Oshoro Maru*, which was built in 1909 (Bower, 2001). In recognition of the long-term research and monitoring conducted aboard this and subsequent ships (*Oshoro Maru II* (1927–1962), *Oshoro Maru III* (1962–1983), and *Oshoro Maru IV* (1984–2014)) in the North Pacific (Fig. 2), the *Oshoro Maru* was awarded the PICES Ocean Monitoring Service Award (POMA) in 2008 (PICES Press 17(1): 8–9). As with the previous ships, the *Oshoro Maru V* is operated by the Faculty of Fisheries at Hokkaido University.



Fig. 1 *Oshoro Maru V*.



Fig. 2 Left to right: *Oshoro Maru I*, *Oshoro Maru II*, *Oshoro Maru III* and *Oshoro Maru IV*.

**Design features and ship dimensions**

The *Oshoro Maru V* has several new design features. First is its electric propulsion system, which comprises three electric generators and two electric motors. The generators power the motors, which turn the ship’s propeller. Compared with the *Oshoro Maru IV*, which used a direct-drive system to link the engine to the propeller, the *Oshoro Maru V* runs quieter with less hull vibration and lower underwater noise emissions. This reduces the disturbance to animals being studied, as well as other marine life.

The ship has retractable fin stabilizers mounted below the waterline on both sides that emerge and extend laterally to reduce ship roll. Together with the ship’s anti-rolling tanks, they provide a more stable and comfortable sampling platform.

The ship meets the ice strengthening requirements for Ice Class C, which will allow expanded operations into sub-arctic and arctic regions. It is currently the only ice-strengthened training ship in Japan.

Other features include:

- High-lift rudder and bow thruster, which increase maneuverability,
- Variable-pitch, highly-skewed propeller with four blades,
- Bulbous bow below the waterline to reduce drag,
- Large bilge keels to reduce roll at low speeds and when drifting,
- Restroom and shower/bath for female students and researchers.

The ship can accommodate up to 67 students and teachers/researchers in addition to its 32 crew. Its dimensions and other information are listed in Table 1.

Table 1 *Oshoro Maru V* general information.

Domestic gross tonnage	1,598
International gross tonnage	1,998
Length	78.3 m
Beam	13.0 m
Draft	5.0 m
Main generators	1,200 kW × 3 units
Electric propulsion motors	Three-phase induction motors (× 2 units) 1,000/300 kW
Cruising speed	About 12.5 knots
Maximum trial speed	14.50 knots
Boarding capacity	99 persons (60 students, 32 crew, 7 teachers/researchers)
Range	About 10,000 nautical miles
Fuel tank capacity	445.5 m <sup>3</sup>
Freshwater tank capacity	306.6 m <sup>3</sup>
Builder	Mitsui Engineering & Shipbuilding Co., Ltd. (Tamano, Okayama, Japan)
Launched	March 14, 2014
Completed	July 28, 2014

### *Education and science capabilities*

One of the main missions of the *Oshoro Maru IV* was to train cadets enrolled in a one-year postgraduate course in ship and fishery operations, which ended in 2002. The new ship's mission is still primarily educational, but the focus now is to train and educate students to better understand marine ecosystems and resource management.

The ship has been designed and engineered to carry out a wide range of scientific, sampling and teaching activities. It is equipped to operate surface gillnets, trawls (surface, midwater, and bottom), longlines, and two automatic squid jiggling machines. Other features and equipment include:

- A lowered forward (well) deck close to the waterline to facilitate gillnet and longline retrieval and other sampling,
- Deck space for a mobile container laboratory. Four container laboratories are available: clean, wet, dry, and low-temperature ( $-30^{\circ}\text{C}$ ). Size of each lab:  $8.0\text{ m}^2$ ,
- Stern A-frame,
- CTD profiler with a  $24 \times 12$ -liter bottle Rosette sampler and winch with an 8000-m cable,
- Full-circle scanning sonar,
- Acoustic Doppler current profilers,
- Multiband quantitative echo sounder,
- Visual observation platform on compass deck (above bridge),
- Remotely operated vehicle (ROV),
- Shipboard LAN system.

Laboratories have expanded and include the following:

- Wet lab:  $37.8\text{ m}^2$ ,
  - Refrigerator-freezer,
  - Ultra-low temperature ( $-80^{\circ}\text{C}$ ) freezer,
  - Draft chamber,
  - Incubator,
  - Ultra-pure water system.
- Dry lab (CTD observation and acoustic equipment):  $10.0\text{ m}^2$ ,
- Analysis and experimental lab:  $3.0\text{ m}^2$ .

The *Oshoro Maru V* completed its first cruise with students aboard in early September 2014 off southwestern Hokkaido. During its first year of operation, the ship will remain in waters near Japan, but it might resume its summer cruises to the North Pacific in 2016. During these and other cruises, Captain Shogo Takagi and his crew will continue to welcome aboard guest scientists from PICES member countries.

### *Reference*

Bower, J.R. 2001. The *Oshoro Maru*: A short history of Hokkaido University's workhorse in the North Pacific. *PICES Press* 9(1): 25–28.



Dr. John Bower (A4101) began his fisheries career as an NMFS observer aboard several South Korean trawlers in the Bering Sea. He was then a Peace Corps Volunteer in the Philippines, where he became interested in cephalopods. He completed graduate degrees at the University of Hawai'i (Department of Oceanography) and the Hokkaido University (Faculty of Fisheries) studying nektonic squids. He is now an Associate Professor at Hokkaido University, where he studies cephalopods in the North Pacific. Please contact him for more information about the ship and its cruise schedule ([akaika@fish.hokudai.ac.jp](mailto:akaika@fish.hokudai.ac.jp)). [Photo shows John and the captain of the *Oshoro Maru*, Mr. Shogo Takagi (A4059), following the 2014 Hakodate Half Marathon.]

## PICES calendar of events

[NPAFC Symposium](#) on “Pacific salmon and steelhead production in a changing climate: Past, present, and future”, May 17–19, 2015, Kobe, Japan (co-sponsored by PICES)

[International Symposium on “Harmful algal blooms and climate change”](#), May 19–22, 2015, Göteborg, Sweden (co-sponsored by PICES)

[International Scientific Conference on “Our common future under climate change”](#), July 7–10, 2015, Paris, France

[PICES-2015, “Change and Sustainability of the North Pacific”](#), October 15–25, 2015, Qingdao, China

PICES/ICES Intl. Workshop on “Modeling effects of climate change on fish and fisheries”, August 10–12, 2015, Seattle, USA

9<sup>th</sup> International Conference on Marine Bioinvasions, January 26–29, 2016, Sydney, Australia (co-sponsored by PICES)

[ICES Symposium](#) on “Understanding marine socio-ecological systems: Including the human dimension in Integrated Ecosystem Assessments”, May 30–June 3, 2016, Brest, France (co-sponsored by PICES)

[6<sup>th</sup> PICES/ICES Zooplankton Production Symposium](#) on “New challenges in a changing ocean”, May 9–13, 2016, Bergen, Norway

## Workshop W4 on “Networking ocean observatories around the North Pacific Ocean”

by Ken Denman, Jack Barth, S. Kim Juniper, Jae Hak Lee and Hidekatsu Yamazaki

Around the North Pacific Ocean, various coastal ocean observatories are operating or under development. These observatories include cabled systems as well as integrated observing systems that employ buoys, Autonomous Underwater Vehicles (AUVs), gliders, moorings, satellite imagery, and other observing tools. In addition, there exist several long-term time-series programs, and the Argo drifter program. The primary objective of the Workshop (W4) on “Networking ocean observatories around the North Pacific Ocean” was to bring together operators of these observatories to discuss how to make progress on the following issues:

- Set up plans for coordinated data sharing, data standards, common sampling protocols, and open access on the Internet;
- Set out a timeline for developing an integrated (nearly) real-time synthesis of observations in the North Pacific by linking coastal and open ocean observatories as well as Argo;
- Define a specific science challenge/question that could be best addressed through a network of observing systems in the Pacific Ocean;
- Discuss the requirements for assimilating data from ocean observatories into multidisciplinary models.

Most of these facilities are regional and coastal in scope, making PICES the ideal organization to host such a workshop. The need for a network of observing facilities was articulated in the conference description of the joint PICES/ICES Workshop on “Global assessment of the implications of climate change on the spatial distribution of fish and fisheries” that was held in May 2013 in St.

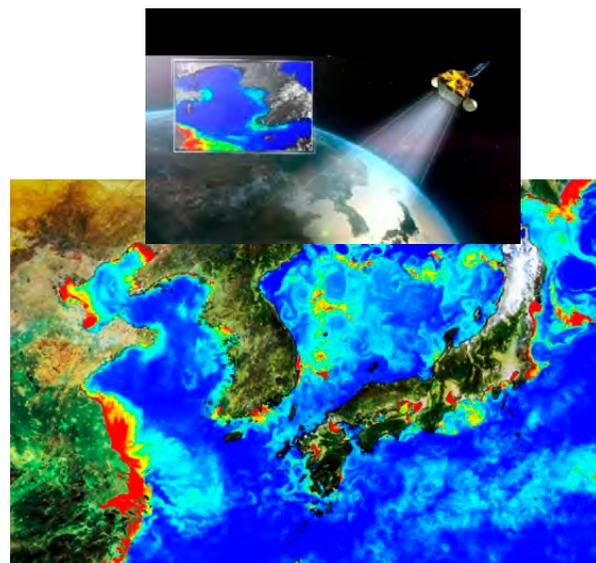
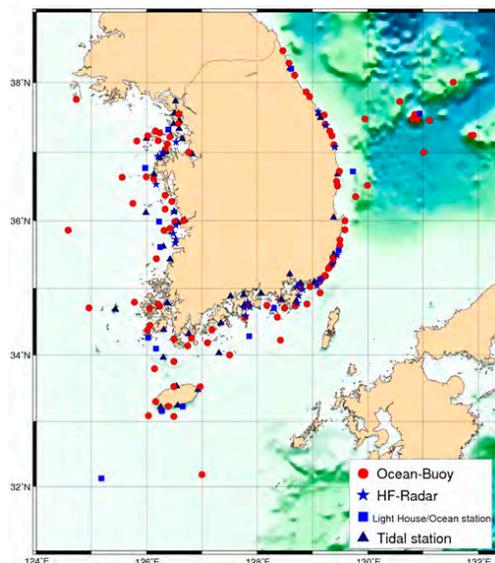
Petersburg, Russia: “... observations and model projections (are) needed to develop a global synthesis of the implications of climate change on fish and fisheries”.

Between 15 and 20 people attended W4 (held October 17 at PICES-2014, Yeosu, Korea). Seven presentations were provided, followed by a discussion on common issues, the need for a group that would meet annually, and recommendations for how to form such a group. Ocean Networks Canada was a co-sponsor of the Workshop.

### Short descriptions of presentations

The session consisted of one invited 30-minute address and six contributed 20-minute talks, summarized here in order of presentation.

Jae Hak Lee from the Korea Institute of Ocean Science and Technology (KIOST) described ‘*The status of ocean monitoring in Korea*’. He first reviewed Korean real time ocean monitoring activities stressing the coastal oceans and the integration of many different observing platforms, including a Geostationary Ocean Color Imager launched in 2010. Coverage is 8 times/day over an area 2500 km by 2500 km centered over Korea, with resolution of 500 m by 500 m. Contributing to international programs, Korea has launched 302 Argo floats since 2001 – in the East Sea/Sea of Japan, the Pacific Ocean, and the Southern Ocean – of which approximately 75 are still active. In the OceanSites program, Korea currently maintains three sites: one in the East Sea/Sea of Japan, and two sites in the equatorial western Pacific. Korea is experimenting with subsea and wave gliders.



(Left) Real time monitoring sites around the Korean peninsula, (right) KIOST's Geostationary Ocean Color Imager.

Jack Barth from Oregon State University, USA, presented a ‘*Ten-year retrospective of the Northwest Association of Networked Ocean Observing Systems (NANOOS)*’ on behalf of Jan Newton (NANOOS Executive Director) and many other NANOOS colleagues. NANOOS is one of approximately 10 regional components of the U.S. Integrated Ocean Observing System (IOOS). The stakeholder priorities for NANOOS are maritime operations, ecosystem impacts (including hypoxia and HABs), fisheries, mitigating coastal hazards, and climate (including ocean acidification). Major observational systems include HF radar for mapping surface currents and waves, buoys in the Pacific Northwest, buoys and moorings in the Columbia River estuary and Puget Sound, long-term coastal glider programs, and monitoring beach and near-shore bathymetry. In order to meet the different data delivery needs of a variety of user groups, substantial effort has gone into development of the online NANOOS Visualization System (NVS), including the NVS Data Explorer.

Mary Grossmann from the Okinawa Institute of Science and Technology, Japan, described the OIST Cabled Teleoperational Observatory Performing Undersea Surveillance (OCTOPUS), a new coastal observatory deployed since August 2013 at about 20 m depth on a coral reef in the nearshore zone off Okinawa. In addition to measuring standard oceanographic and biochemical variables, the focus is on biological imaging with several cameras, a passive hydrophone (for cetaceans and vessel traffic). Results were presented from the Continuous Plankton Imaging System (CPICS), a fixed station Visual Plankton Recorder, deployed in cooperation with Scott Gallager of Woods Hole Oceanographic Institution (WHOI; USA). Using five-minute temporal resolution, counts of six predatory plankton groups show day–night transitions, and hourly counts of 10 classes of plankton show strong presence–absence changes with the passage of two typhoons during October 2013.

Hidekatsu Yamazaki of the Tokyo University of Marine Science and Technology, Japan, described the Joint Environmental Data Integration (JEDI) System which employs novel observational and modeling technologies to evaluate multi-scale variations of pelagic marine communities and biodiversity under the influence of the Kuroshio and internal waves in coastal habitats. The JEDI System includes deployment of a cabled observatory and a moving AUV platform MEMO-pen. The cabled observatory, the Oshima Coastal Environmental data Acquisition Network System (OCEANS), was deployed from Oshima Island southwest of Tokyo Bay. Also conducted in cooperation with Scott Gallager of WHOI, OCEANS employs a full suite of physical, biological and chemical instrument systems operating from an underwater cabled node. The AUV has a specially-designed low vibration propulsion system with a pump jet system rather than a

rotating propeller, which allows microstructure turbulence measurements and use of a plankton microscope camera (CPICS). Measurements are interpreted in the context of a high resolution numerical model of the area that shows spatial and temporal patterns of internal waves at tidal frequencies in the vicinity of Oshima Island.

Holger Brix (with Burkard Baschek) from the Institute of Coastal Research, Helmholtz-Zentrum Geesthacht, Germany, presented an invited talk on the multi-platform Coastal Observing System for Northern and Arctic Seas (COSYNA), mostly focused on the German Bight in the North Sea west of Hamburg. The mission of COSYNA is the development and testing of analysis systems, consisting of observations and numerical modelling, for the operational synoptic description of the environmental status of the North Sea and Arctic coastal waters. COSYNA aims to provide knowledge tools that will help authorities and other stakeholders manage routine tasks, emergency situations and evaluate trends. Types of observations include: i) point measurements, including buoys, fixed stations and underwater nodes, ii) surface transects on ferries with FerryBox systems, and on research vessels, iii) 3D transects with SCANFISH and gliders, and iv) mapping of spatial fields using optical remote sensing (satellite) and radar (HF and X-band). Several of these systems and example observations were presented in addition to examples of the comparison of regional model results and measurements. An end-to-end sensor to user(s) data flow chart was shown and the COSYNA Data Portal was described. Two applications were introduced – offshore ‘windparks’ and hunting gyres with 3D real time mapping. One outreach project of COSYNA is the Global Coast to link expertise from different coastal observatories around the globe.

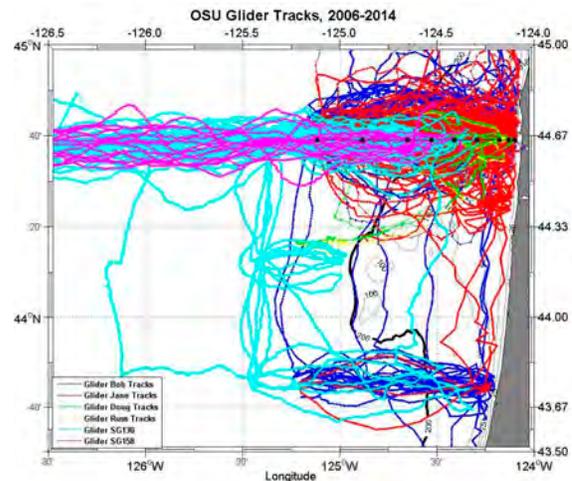
Kim Juniper, from Ocean Networks Canada (ONC) located at the University of Victoria, gave a talk on ‘*Cabled ocean observatories as tools for studying biodiversity change*’. He presented six Essential Biodiversity Variables (EBVs) developed by the Biodiversity Observation Network of the Group on Earth Observations (GEO BON): Genetic composition, species populations, species traits, community composition, ecosystem function, and ecosystem structure. Information on all of these variables except the first can now be obtained from cabled observatories. He presented several examples of EBV studies at ONC cabled sites around Vancouver Island and in the Canadian Arctic. Time-series video imagery coupled with oceanographic sensors are used to study temporal and spatial changes in benthic community composition and ecosystem processes in a variety of near-bottom environments: i) hydrothermal vent sulphide worms, ii) an epibenthic megafaunal community in a submarine canyon, iii) epibenthic community responses to severe hypoxia in a coastal inlet, iv) surface-sediment bioturbation rates over a fixed area, and v) seasonal faunal dynamics at a shallow coastal Arctic

site. He concluded with two issues that require attention: First, the need for more efficient tools to extract biological data from imagery (ONC has a growing archive of over 10,000 hours of HD video imagery), which include computer algorithms for automated counting of fish and other animals, and ‘citizen science’ using a video game ‘Digital Fishers’ to ‘pre-analyze’ hundreds of video clips; second, the opportunity for collaboration between ocean observatories using EBVs as a tool for structuring biological observations between different research groups.

Jack Barth from Oregon State University, USA, gave a talk that described the use of autonomous underwater gliders to observe continental margins and ocean boundary currents. His results were from the California Current upwelling system, one of four major coastal upwelling systems that together comprise on 1% of the global ocean surface area but which provide more than 20% of wild caught seafood globally. During some summers over the Oregon shelf, hypoxia develops at depths below 30 m causing stress and mortality to sea life. To monitor changes in upwelling and hypoxia, AUV gliders equipped with a CTD and sensors for dissolved oxygen, chlorophyll and CDOM fluorescence, light backscatter and depth-averaged velocity have been traversing a cross-shelf section twice per week since April 2006. Through September 2014, there have been 3485 glider-days, and 260,190 vertical profiles covering a horizontal distance of over 82,000 km. The gliders have documented upwelling episodes, development of upwelling fronts, subsurface hypoxia and buoyant fresh water plumes from the Columbia River. Significantly, the gliders generate data even during severe storms that generate 10-m seas, when oceanographic research vessels, if present, would suspend *in situ* sampling. There are plans to add new sensors, including bioacoustics.



Gliders can be operated from just about any size boat, from (left) OSU's 16-m R/V Elakha, (right) from a rowboat off the Chilean coast.

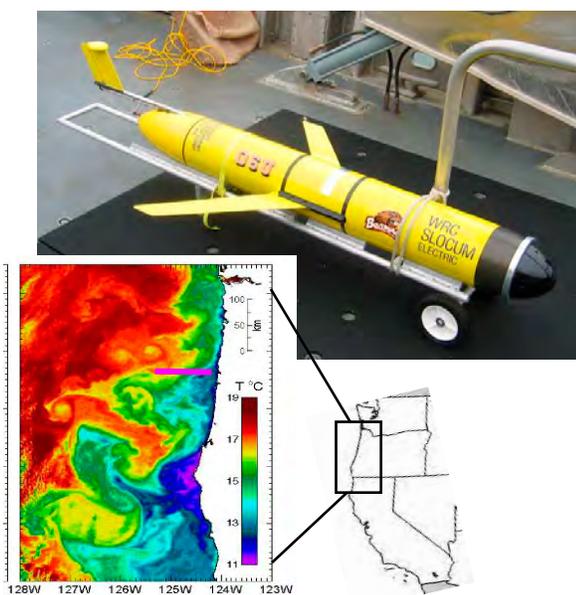


OSU Glider operations from April 2006 to September 2014.

**Discussion issues**

During the discussion following the presentations, a number of common issues emerged, which include:

- Excepting dissolved oxygen, biochemical sensors continue to be unreliable for long-term deployment.
- For groups who make much of their data available online in ‘near real time’, there appear to be no common automated quality assurance, quality control techniques.
- Groups who make much of their data available online in ‘nearly real time’ need to develop effective methods for correcting/calibrating the data, after they have been posted initially, and for notifying users of these data corrections/updates.
- The usual manner in which data are presented on-line for researchers is completely inadequate for ‘operational’ users of the data – fisheries managers, environmental quality managers, controllers of safe marine traffic and transport, *etc.* How different groups attempt to adapt their data displays to their users’ needs differs from group to group – again, sharing experiences can lead to development of common ‘best practices’.
- There is a general sense that obtaining funding for developing and installing ocean observatories is easier than maintaining funding for operating the facilities,



Autonomous Underwater Vehicle Glider, and cross-margin transect conducted twice per week since April 2006 off the coast of Oregon.

partially because we have underestimated the human resources required for long-term operation and data management, *e.g.*, operating gliders continuously over many years, rather than for limited time ‘missions’.

### **Recommendation and response**

There was broad agreement that the ‘operators’ of coastal observing systems around the North Pacific would benefit from meeting on a regular basis and developing an evolving set of ‘best practices’ – basically sharing experiences on ‘what works and what does not work’, and working towards common data formats such as NetCDF file formats.

Our formal recommendation was to propose that the PICES Technical Committee on Monitoring (MONITOR) and Technical Committee on Data Exchange (TCODE) set up an Advisory Panel for ‘Developing Best Practices and Common Data Protocols for Coastal Ocean Observing Systems’ (AP-COOS). Such a structure would allow this AP to hold focused workshops at PICES on topics like those described earlier under ‘Discussion issues’. Once this

working format has been established, it may be advisable to make contact with similar entities within ICES and IOC.

The proposal was considered by the Science Board and submitted to Governing Council at the end of the PICES 2014 Annual Meeting. Council approved the establishment of an Advisory Panel on *North Pacific Coastal Ocean Observing Systems* (AP-NPCOOS), under the direction of MONITOR and TCODE. Initial Terms of Reference have been drawn up: the Advisory Panel will have Co-Chairs – one from the western North Pacific and one from the eastern North Pacific, with 2 to 4 members from each Contracting Party. The Terms of Reference include:

1. Develop and advise about best practices for coastal ocean observing systems;
2. Convene workshops/sessions to engage those involved in coastal ocean observing systems from around the North Pacific; and
3. Advise on linkages between coastal ocean observing systems and both PICES activities (*e.g.*, FUTURE Science Program, North Pacific Ecosystem Status Report) and open-ocean observatories (*e.g.*, Argo).



*Dr. Kenneth Denman (denman@uvic.ca) is Adjunct Professor in the School of Earth and Ocean Sciences at the University of Victoria. Most recently he was Chief Scientist with Ocean Networks Canada. Until 2010 he was Senior Scientist with Fisheries and Oceans Canada (DFO), seconded since 2000 to Environment Canada’s Canadian Centre for Climate Modelling and Analysis (CCCMA). Dr. Denman’s research interests include current and future impacts of climate change, including ocean acidification, on marine ecosystems and fish populations. He was a Coordinating Lead Author of the Second and Fourth Assessment Reports of the Intergovernmental Panel on Climate Change (IPCC).*

*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).*

*Dr. S. Kim Juniper (kjuniper@uvic.ca) is Chief Scientist for Ocean Networks Canada. He has been a Professor in the School of Earth and Ocean Sciences and the Department of Biology at the University of Victoria, and holder of the British Columbia Leadership Chair in Ocean Ecosystems and Global Change since 2006. He came to the University of Victoria from the Université du Québec à Montréal where he was Professor of Biology and Director of the GEOTOP Research Centre. He received his BSc from the University of Alberta (1976) and a PhD from Canterbury University in Christchurch, New Zealand (1982). The primary focus of his research is the biogeochemistry and ecology of submarine hydrothermal systems.*

*Dr. Jae Hak Lee (jhlee@kiost.ac) has been working at the Korea Institute of Ocean Science and Technology (KIOST) as a Research Scientist since 1992. He received his BSc and MSc from the Seoul National University (1978, 1982) and a PhD from Yale University (1991). The primary field of his research is observational physical oceanography. Within PICES, he is a member of the Advisory Panel for a CREAMS/PICES Program in East Asian Marginal Seas.*

*Dr. Hidekatsu Yamazaki (hide@kaiyodai.ac.jp) is Professor in the Department of Ocean Sciences, Tokyo University of Marine Science and Technology. He received PhD in ocean engineering from Texas A&M University in 1984. He worked at the Department of Oceanography, Naval Postgraduate School (NPS) and switched his expertise from ocean engineering to oceanography. His interest in oceanic microstructures, particularly turbulence and plankton, started at NPS. He also worked at Chesapeake Bay Institute, Johns Hopkins University, and School of Earth and Ocean Sciences, University of Victoria, before he returned to Japan in 1993. His research spans from oceanic microstructures to fisheries ground environments as well as various biophysical coupling problems. As Associate Editor of *Limnology and Oceanography: Fluids and Environments*, he handles small-scale physical-biological interaction subjects and mixing problems.*

## The impact of Japanese tsunami debris on North America

by Cathryn Clarke Murray, Alexander Bychkov, Thomas Therriault, Hideaki Maki and Nancy Wallace

### Introduction to the project

The Great Tōhoku Earthquake, or Great East Japan Earthquake, with magnitude 9.0, struck off the coast of Japan on March 11, 2011, and triggered a massive tsunami. This event was a natural disaster of staggering proportions, causing loss of human life, property destruction and environmental damage. One example of environmental cost was that of about 5 million tons of debris swept from the land and coastal systems into the ocean (Ministry of the Environment, Japan, 2014). The Government of Japan estimates that 70% of that debris sank close to shore, leaving 1.5 million tons floating in the North Pacific with the potential to arrive on North American coastlines (Bagulayan 2012; Lebreton and Borrero 2013).



Fig. 1 Marine debris accumulation in Kanapou Bay, Kaho'olawe, Hawaii (photo credit: NOAA).

The first confirmed instances of Japanese tsunami debris washing up on the shores of North America occurred in March 2012. Since then, over 1400 debris sightings have been reported, of which 50 pieces could be confirmed as Japanese-origin tsunami debris. This includes two large concrete docks, originally from Misawa, Japan, that were found on beaches in Oregon and Washington (with a number of non-native species attached). In addition, more than 150 small boats have washed ashore, many of which have been confirmed as lost during the tsunami. The North American coast already endures marine debris from terrestrial and aquatic sources (Keller *et al.* 2010; Ribic *et al.* 2012), but there may be additional impacts from the increase in abundance and differing debris types due to the tsunami (Fig. 1).

Aside from the impacts of additional marine debris, there is the possibility of debris carrying coastal Japanese organisms to North American coasts. The two docks together, mentioned above, had hundreds of Japanese

species and tens of thousands of individuals attached, alive, and some reproductively active. Many of the species were not known previously from North America and have the potential to invade coastal ecosystems (Gewin 2013). For example, five species of hydroid collected from tsunami debris were confirmed as non-native to the northwest United States (Calder *et al.* 2014).

PICES, with Working Group 21 on *Non-indigenous Aquatic Species* completed in 2012 and Working Group 31 on *Emerging Topics in Marine Pollution* formed in 2013, is well-placed to contribute to research on the potential impacts of Japanese Tsunami marine debris. As a result of generous funding from the Government of Japan through its Ministry of the Environment (MoE), PICES has initiated a new project to investigate the impact of tsunami-generated marine debris on North American coastal ecosystems. This 3-year effort (April 2014–March 2017) is directed by a Project Science Team (PST) made up of researchers from Canada, Japan, the United States and the PICES Secretariat, and is co-chaired by Thomas Therriault (Department of Fisheries and Oceans, Canada), Hideaki Maki (National Institute for Environmental Studies, Japan) and Nancy Wallace (NOAA Marine Debris Program, USA).

An initial PST meeting was held from July 30–August 1, 2014, at NOAA's Sand Point facility in Seattle, USA, and a meeting of the Project Co-Chairmen took place on October 17, 2014, in conjunction with the PICES Annual Meeting in Yeosu, Korea (Fig. 2). The next Project Co-Chairmen's meeting is planned for February 2015, in Sidney, Canada (the seat of the PICES Secretariat), followed by a PST meeting in March 2015 in Honolulu, combined with a visit to local debris beaches.

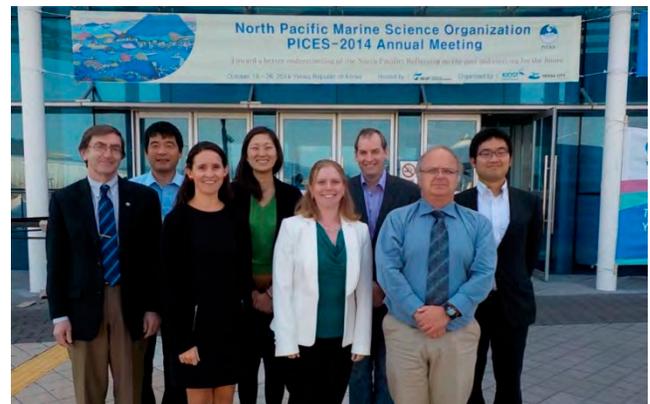


Fig. 2 Participants of the Project Co-Chairmen meeting, October 17, 2014, Yeosu, Korea (from left to right): Alexander Bychkov (PICES Secretariat), Hideaki Maki (Japan), Cathryn Clarke Murray (PICES/MoE Visiting Scientist), Karin Baba (Japan), Nancy Wallace (USA), Thomas Therriault (Canada), Robin Brown (Canada) and Kosuke Ishimaru (MoE, Japan).

The project will focus on three main areas of research:

- (1) Surveillance and monitoring of tsunami-generated marine debris landfall;
- (2) Modeling movement of marine debris in the North Pacific; and
- (3) Risk (including potential impacts) from invasive species to coastal ecosystems.

In this article, we briefly introduce one of our activities under the surveillance and monitoring component of the project – aerial surveys. Other project components will be described in upcoming issues of PICES Press.

**Aerial surveys**

As part of the surveillance and monitoring research, data gaps were identified for the northeast Pacific coast. While beaches in Washington State, Oregon and California are regularly visited, cleaned and monitored, little surveillance and monitoring occurs on the remote western-facing beaches of British Columbia and Alaska at risk of tsunami-debris landfall (based on model predictions). Aerial surveys are cost-effective ways to monitor these vast, largely uninhabited coastlines where debris may be accumulating, and to identify potential “hot spots”. Detecting large pieces

of debris and sampling them for any potential invasive species attached is a priority.

In October 2014, aerial surveys of British Columbia coastlines began, and to date over 650 kilometers have been captured, from Cape Scott south to Port Renfrew on the west coast of Vancouver Island (Fig. 3). The British



Fig. 3 Southern British Columbia aerial survey flight path (green line).



Fig. 4 Aerial photo surveys of western Vancouver Island, British Columbia, Canada: Japanese skiffs indicated by circles with dotted yellow lines on remote beaches (top photos); pristine beach (bottom left) and rocky beach (bottom right).

Columbia survey complements aerial surveys by the State of Alaska completed in 2013 and 2014 as part of their debris response and removal activities (State of Alaska 2014), and uses the same survey methodology (Airborne Technologies, Inc. 2009). These surveys consist of overlapping oblique photographs taken from a small plane flying between 500 and 1000 m from the beach (Fig. 4). Post-survey processing assigns unique identifiers (tags) for specific types of debris and quantifies the amount of debris on a qualitative scale from 0–5. When combined with ongoing beach monitoring data from NOAA (Opfer *et al.* 2012; Lippiatt *et al.* 2013) and disaster debris sightings (NOAA MDP 2013), debris accumulation hot spots will be identified and prioritized for future surveillance and research.

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*Dr. Alexander Bychkov (bychkov@pices.int) was the Deputy Executive Secretary of PICES from 1996–1999 and the Executive Secretary of the Organization from 1999–2014. He serves now as a Special Projects Coordinator with PICES, and the project on “Effects of marine debris caused by the Great Tsunami of 2011”, funded by the Ministry of the Environment of Japan, is one of his primary responsibilities.*

*Dr. Thomas Therriault (thomas.therriault@dfo-mpo.gc.ca) is a Research Scientist with Fisheries and Oceans Canada working on a variety of invasive species issues. He is the Canadian Co-Chair of the project on “Effects of marine debris caused by the Great Tsunami of 2011”, funded by the Ministry of the Environment of Japan, and Chairman of PICES Science Board.*

*Dr. Hideaki Maki (hidemaki@nies.go.jp) is a Senior Researcher at the National Institute for Environmental Studies (NIES), Japan. He has studied microbial degradation of crude oil in marine environments and conducted some field experiments of crude oil bioremediation. Recently, he has been monitoring water and sediment parameters relevant to hypoxia in Tokyo Bay. After the Great East Japan Earthquake, he has been involved in monitoring hydrocarbons contamination of sediments in the Tohoku coastal sea. Hideaki is the Japanese Co-Chair of the project on “Effects of marine debris caused by the Great Tsunami of 2011”, funded by the Ministry of the Environment of Japan, and serves as a member of the PICES Marine Environmental Quality Committee and Working Group on Emerging Topics in Marine Pollution.*

*Nancy Wallace (nancy.wallace@noaa.gov) is the Director of the National Oceanic and Atmospheric Administration’s Marine Debris Program, which is the federal lead for researching, preventing, and reducing the impacts of marine debris in the United States. She is the US Co-Chair of the project on “Effects of marine debris caused by the Great Tsunami of 2011”, funded by the Ministry of the Environment of Japan, and serves as a members of the PICES Working Group on Emerging Topics in Marine Pollution. Nancy has worked on ocean policy related issues for the past decade. Her work includes resource conservation with the National Park Service, developing sustainable catch limits for fisheries off the east coast of the United States and efforts to improve water quality in the Gulf of Mexico.*

## The state of the western North Pacific in the first half and warm season of 2014

by Takashi Yoshida

The western North Pacific in the first half and warm season of 2014 was characterized by persistent below-average sea surface temperatures (SSTs) around 30°N. The area of these temperatures was at its largest in May 2014, extending widely in the mid-latitudes of the western North Pacific from 20°N to 40°N between 120°E and 160°W. The negative anomaly weakened in August 2014 due to enhancement of the North Pacific High to the southeast of Japan, but strengthened again in September and October (Fig. 1).

The sea ice extent in the Sea of Okhotsk was less than the 30-year average during the sea ice season from December

2013 to May 2014. On March 5 it reached its seasonal maximum of 1.01 million km<sup>2</sup>, which was 14% below the 30-year average of 1.17 million km<sup>2</sup> (Fig. 2). The seasonal maximum shows a long-term downward trend of  $6.0 \times 10^4$  km<sup>2</sup> per decade, which corresponds to 3.8% of the Sea of Okhotsk's total area (Fig. 3). While the sea ice extent in the Sea of Okhotsk during the season was generally below average, spring sea ice melt around the Japanese island of Hokkaido was slow, and drift sea ice in the Pacific remained until late April. Its April appearance in waters southeast of Cape Erimo was the first during that month in 44 years of observation (Fig. 4).

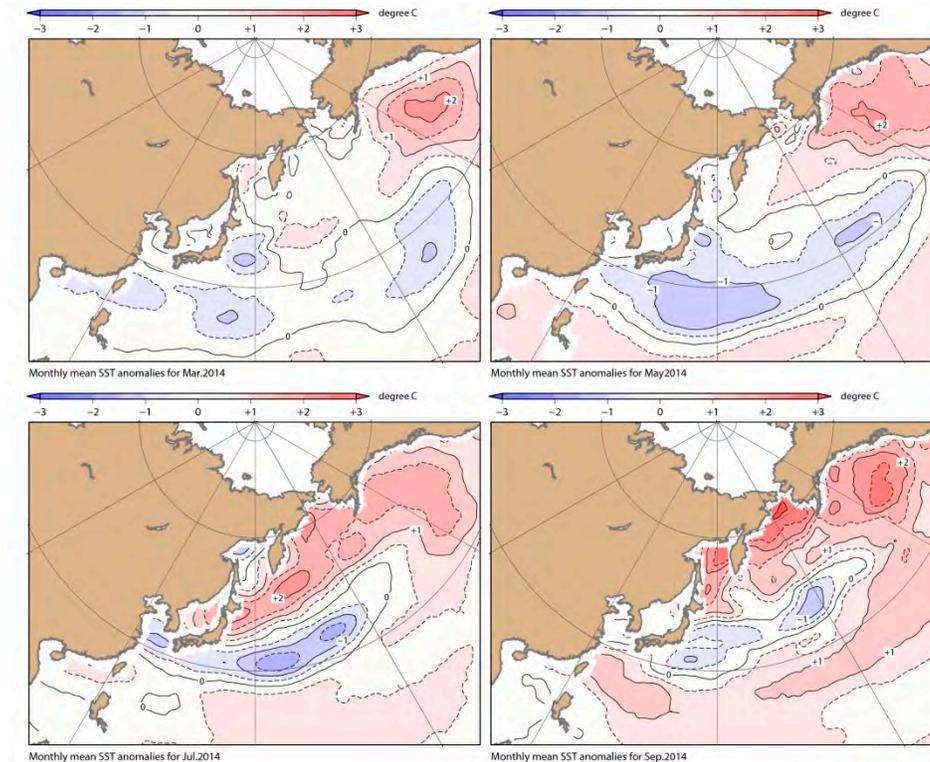


Fig. 1 Monthly mean sea surface temperature (SST) anomalies for March, May, July and September 2014. Monthly mean SSTs are based on JMA's COBE-SST (Centennial in situ Observation-Based Estimates of variability of SST and marine meteorological variables). Anomalies are deviations from the 1981–2010 climatology.



Dr. Takashi Yoshida (tyoshida@met.kishou.go.jp) is the Head of the Office of Marine Prediction at the Japan Meteorological Agency in Tokyo. His group is tasked with issuing various oceanographic products, including wave analysis, coastal sea level monitoring, ocean temperature and current monitoring, sea ice analysis and their forecasts. He was involved in PICES as a member of Working Group 6 on “Subarctic Gyre” and contributed Western Pacific assessments to PICES Press previously in the 1990s.

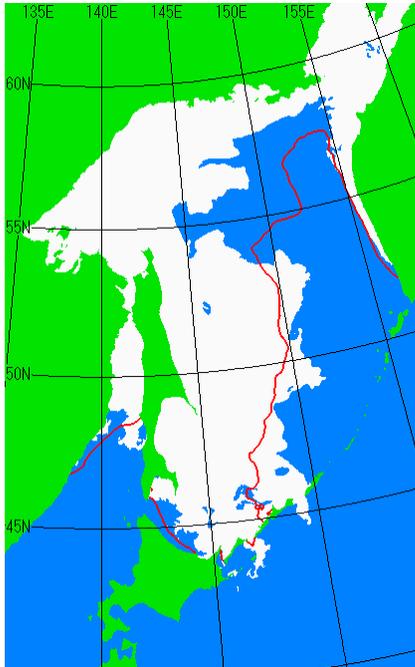


Fig. 2 Sea ice extent in the Sea of Okhotsk on March 5, 2014. The red line shows the 1981 to 2010 average extent for this date.

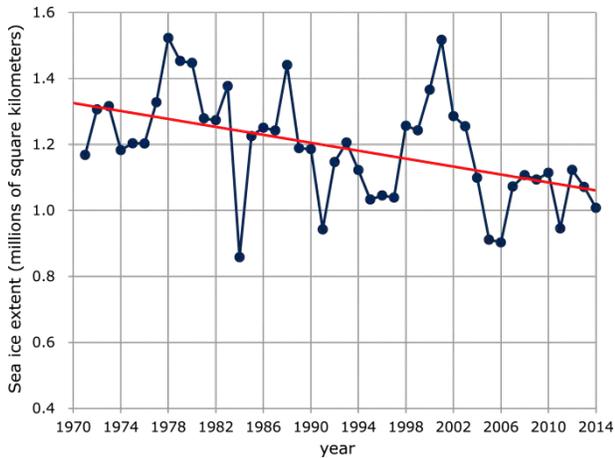


Fig. 3 Time-series representation of annual maximum sea ice extent values in the Sea of Okhotsk from 1971 to 2014. The red line represents the long-term linear trend.

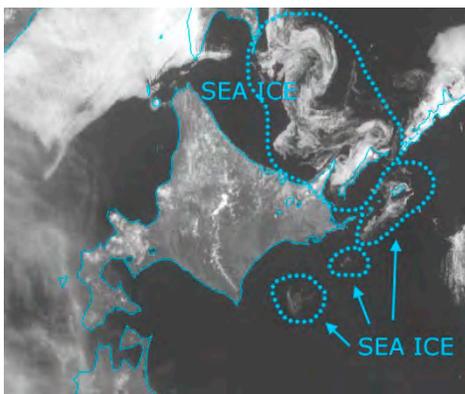


Fig. 4 MTSAT visible satellite image of drift sea ice around Hokkaido on April 20, 2014.

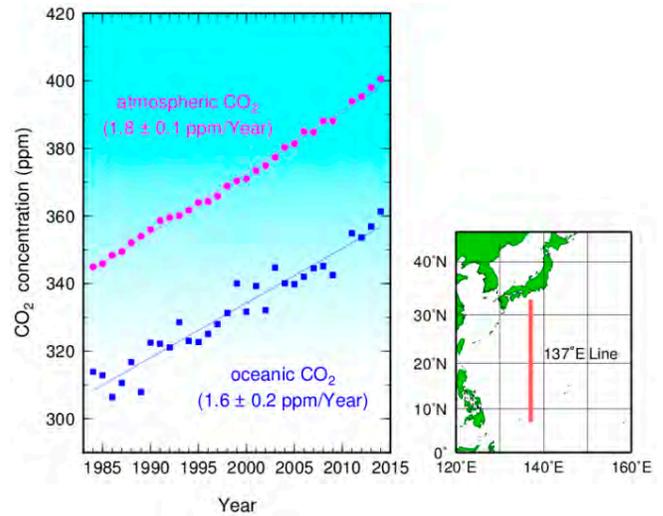


Fig. 5 Annual changes in oceanic (blue squares) and atmospheric (magenta dots) CO<sub>2</sub> concentrations averaged between 7°N and 33°N along 137°E (the red line in the righthand panel) for winter from 1984 to 2014.

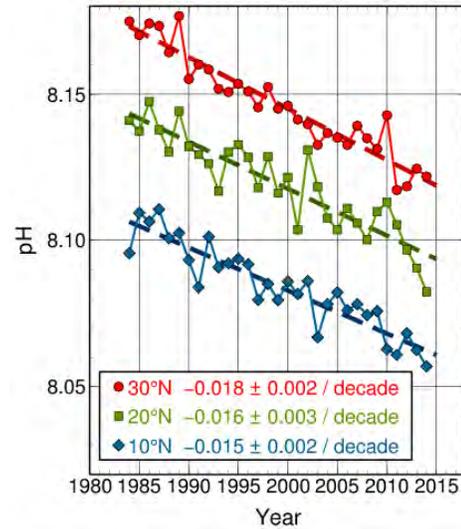


Fig. 6 Long-term trends of pH at 10, 20 and 30°N along 137°E. The numbers in the figure indicate the rate of change with a 95% confidence interval.

The Japan Meteorological Agency (JMA) has conducted oceanographic observations in the western North Pacific for more than 40 years to monitor the long-term variability of ocean-related changes. This work includes monitoring to highlight long-term trends of oceanic/atmospheric CO<sub>2</sub> concentrations and to determine pH in surface seawater from 3°N to 34°N along JMA's repeat hydrographic line at 137°E in winter. The 31-year record shows that mean growth rates for oceanic and atmospheric CO<sub>2</sub> concentrations averaged between 7°N and 33°N along 137°E stand at 1.6 ppm/year and 1.8 ppm/year, respectively (Fig. 5). Values of pH in surface seawater show a clear long-term trend of decrease at rates of approximately 0.01 to 0.02 per decade at each latitude (Fig. 6).

## The Bering Sea: Current status and recent trends

by Lisa Eisner

### Climate and oceanography

The sea surface temperatures over the eastern Bering Sea shelf were 2°C warmer than normal during the period of April through September 2014. This warmth can be attributed to the combination of the relatively mild winter of 2013–2014 and atmospheric forcing during the spring and summer of 2014. Mean sea level pressure was slightly above average for the period of interest (Fig. 1), and the winds were anomalously weak in an overall sense, as illustrated by the time series of daily wind speeds at St. Paul in the Pribilof Islands (Fig. 2). This wind series shows the occurrence of moderate storms during the middle of June and in the first half of July, but daily wind speeds were routinely weaker than normal from early June into August. Winds were also light in September 2014, with the exception of a strong storm in the second week of the month.

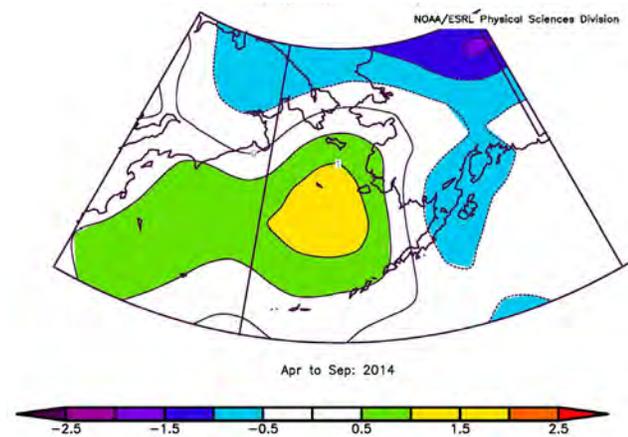


Fig. 1 NOAA mean sea level pressure (mb) anomaly (deviations from 1981–2010 climatology) for April–September 2014. Figure courtesy of N. Bond.

In addition, it appears to have been less cloudy than usual during the summer of 2014, at least on the southern part of the shelf where there were sufficient ship observations. The anomalies there were on the order of 4–6% relative to climatological mean cloud fraction coverage of ~85%, (indicating that the cloud coverage was ~80% in summer 2014).

The water at depth was also warmer than it had been for a number of years; the extent of the summer cold pool (defined as the region of bottom water colder than 2°C) south of 60°N was the smallest since 2005. The smaller cold pool is mostly due to a considerably reduced extent of sea ice extent during winter 2014 than in recent years.

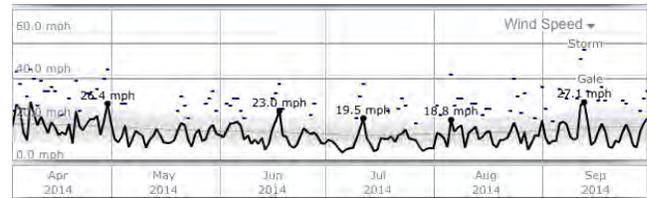


Fig. 2 Daily wind speeds (heavy black line) at St. Paul, Alaska (PASN) for April–September 2014. The thin gray line indicates the climatological mean; the gray band encompasses the 10% to 90% percentiles in the daily wind speeds. Figure courtesy of N. Bond.

### Coccolithophore bloom

The return to warmer conditions featured a large coccolithophore bloom, small (5 µm) phytoplankton cells with plates composed of calcium carbonate, which give the water a milky aqua-colored appearance (Fig. 3). This bloom started in July and persisted through September 2014, and was observed both *in situ* and in satellite images (Figs. 3 and 4). *In situ* measurements of chlorophyll-*a* fluorescence and light attenuation (related to particle load) indicated that the bloom occurred over approximately the top 20 m of the water column (from the sea surface to the pycnocline). A bloom of this magnitude had not been observed since the early 2000s. These kinds of blooms tend to be favored in nutrient-poor waters, but it is uncertain which oceanographic factors are most important for bloom development and persistence.

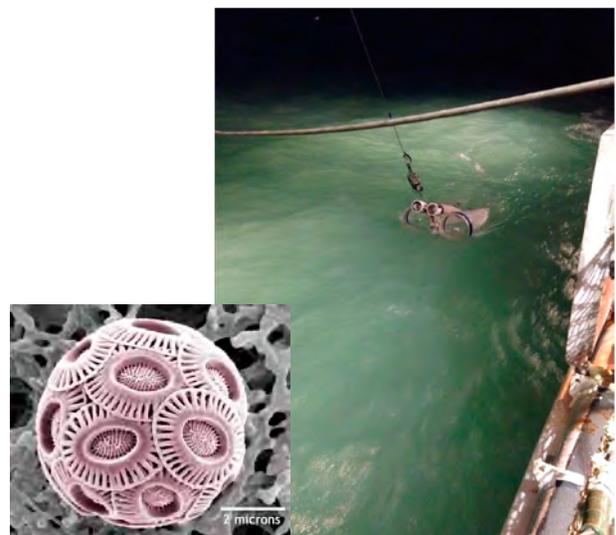


Fig. 3 Left: Coccolithophore, *Emiliana huxleyi*, 400 × 337 (photo courtesy of <http://earthguide.ucsd.edu>). Right: Zooplankton bongo tow in a coccolithophore bloom during August–September 2014 in the southeastern Bering Sea (photo from BASIS survey).

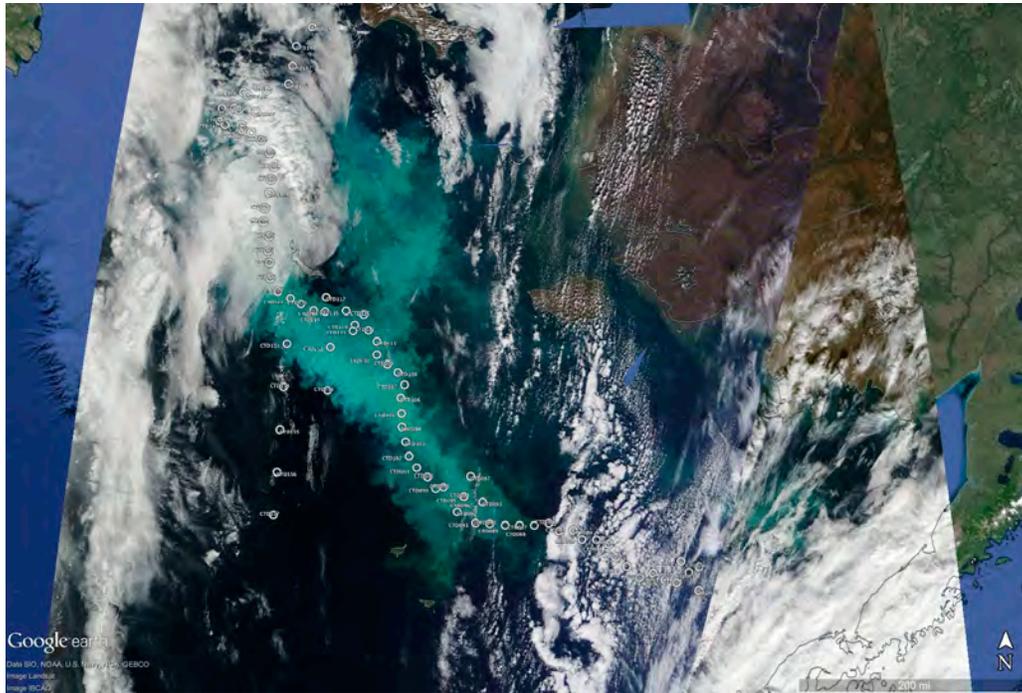


Fig. 4 Image of a coccolithophore bloom (aqua-colored water) from late September 2014 in the eastern Bering Sea. Stations sampled on the fall PMEL 70 m isobath survey (September 21–26) are shown. Satellite imagery: NASA EarthData - <https://earthdata.nasa.gov/labs/worldview>. Overlay of stations by S. Bell.

Coccolithophore blooms may adversely affect the food web at higher trophic levels. The U.S. Fish and Wildlife Service observed a large number of dead marine birds on the surface of the water in the eastern Bering Sea in mid to late August this year. The marine bird die-off appeared to be associated with the coccolithophore bloom. Preliminary estimates indicate that approximately 7,800 birds died during this event, although mortality was likely higher due to low carcass visibility. Based on a few birds identified to species, the majority of the birds affected by the die-off were juvenile and adult murres (*Uria* spp., Fig. 5), and the few collected birds were emaciated. Low numbers of other species were observed, including shearwaters (Fig. 6), northern fulmars, and horned puffins. A similar die-off in shearwaters was documented in 1997 when warm sea conditions contributed to the formation of a coccolithophore bloom in the Bering Sea.



Fig. 6 Adult shearwaters. Photo courtesy of E. Labunski.

A short video on the 2014 coccolithophore bloom, produced by the Pacific Marine Environmental Laboratory (PMEL/NOAA) can be found at <http://youtu.be/1goDJLicy9Q>.

### Eastern Bering Sea Fisheries

Changes in fish abundance and spawning are related to oceanographic conditions. Spring environmental conditions in the northeastern Bering Sea are watched closely each year in part because they are tightly coupled with the timing of salmon spawning migrations. Early spring conditions in March–April in the Shpanberg Strait–Norton Sound area were among the warmest of the past 54 years. April mean air temperature in Nome (12.0°C) was the second warmest since 1961, and the average sea ice concentration of 36.5% was the sixth lowest since 1970. Nonetheless, the May mean sea surface temperature (–0.56°C) was only slightly cooler than the 54-year mean (–0.42°C), and much warmer than the 2001 record low of



Fig. 5 Adult murres. Photo courtesy of E. Labunski.

-3.8°C. The combination of an extremely warm early spring, followed by an average to cool late spring produced a Chinook salmon spawning migration to the Yukon River that started quite early, but which lasted into the early summer. The date of the 15th percentile of the migration on the Yukon delta (June 12) was only the 18th earliest since 1961, and the date of the 50th percentile (June 21) was right on the 54-year average.

High numbers of juvenile Atka mackerel (Fig. 7), sablefish (Fig. 8), juvenile sockeye salmon and age-0 pollock were caught during the NOAA Alaska Fisheries Science Center (AFSC) Bering Arctic Sub-Arctic Integrated Survey (BASIS) in the southeastern Bering Sea. Juvenile Atka mackerel and sablefish were also present in joint surface trawl surveys by NOAA and the Alaska Department of Fish and Game in the northeastern Bering Sea, which is atypical for this region. Catches of age-0 walleye pollock, juvenile sockeye salmon, immature Chinook salmon, Arctic lamprey, and larval flatfish also were unusually high this year in the northeastern Bering Sea. In contrast, capelin catches were low as is consistent with catches during warmer climate conditions.



Fig. 7 Juvenile Atka mackerel caught on BASIS surveys in the southeastern Bering Sea. Photo courtesy of A. Shimada.

Walleye pollock biomass increased this year based on catches from the NOAA AFSC bottom trawl surveys in the eastern Bering Sea. High biomass was primarily due to the strong 2008 year class, with a stronger than expected showing in the 2007 year class, as well. NOAA AFSC

acoustic surveys recorded many age-2 fish, indicating that the 2012 year class is also strong (Ianelli *et al.*, Stock Assessment and Fisheries Evaluations (SAFE) report for 2014).



Fig. 8 Juvenile sablefish caught on BASIS surveys in the southeastern Bering Sea. Photo courtesy of A. Shimada.

### Upcoming meetings

Meetings in 2015 of interest to scientists working in the Bering Sea include:

- [Alaska Marine Science Symposium](#), January 2015, Anchorage, Alaska, USA;
- [Polar Marine Science meeting](#), “Polar Shelves and Shelf Break Exchange in Times of Rapid Climate Change”, March 15–20, 2015, Lucca, Italy;
- [3<sup>rd</sup> PICES/ICES/IOC Symposium](#), “Effects of Climate Change on the World’s Oceans”, March 23–27, 2015, Santos City, Brazil;
- [30<sup>th</sup> Wakefield Symposium](#), “Tools and Strategies for Assessment and Management of Data-Limited Fish Stocks”, May 12–15, 2015, Anchorage, Alaska, USA;
- [PICES-2015](#), “Change and Sustainability of the North Pacific”, October 15–25, 2015, Qingdao, China.

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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.

## The warm blob – Conditions in the northeastern Pacific Ocean

by William Peterson, Marie Robert and Nicholas Bond

Anomalously warm water dominated much of the North Pacific Ocean for the past year, first observed in October 2013 as a mass of warm water extending 30 degrees of longitude and 8 degrees of latitude, centered on the dateline at ~40°N. This warm water mass shifted east in November to 45°N and 155°W and to 45°N 140°W by December where it was more or less centered through summer 2014 (Fig. 1). In January 2014 (as reported by Freeland and Whitney, 2014), SST anomalies were +3°C above the long-term (1982–2014) seasonal average and centered at 42°N 148°W. This warm water mass expanded longitudinally during the summer months of 2014 such that anomalously warm waters were seen in the Bering Sea and west into the Sea of Okhotsk (Fig. 1). Throughout this period, +3°C anomalies persisted. Not only was the northern North Pacific anomalously warm, but +2°C temperature anomalies persisted off the coast of Baja California, Mexico, and into southern California throughout the summer of 2014. This was not a shallow puddle of warm water – rather the layer was thick – along Line P, warm water was found to depths of 100 m in February 2014 (PICES Press, Vol. 22, No. 2) and had not changed during the June 2014 Line P cruise (Fig. 2).

It can be safely said that this warming event was unprecedented. What looked initially like a major El Niño event was clearly not, and was not related in any way to conditions at the equator. For scientists in North America, this mass of warm water has been fondly named “the blob” by the State Climatologist of Washington State (Nick Bond). This term is now in common usage.

The unusually warm sea surface temperature (SST) in the NE Pacific is linked to a highly anomalous sea level pressure (SLP) weather pattern. During October 2013 through January 2014, much higher than normal SLP was present over the northeastern Pacific (Fig. 3), with a peak magnitude approaching +10 hPa. For the region of 55–45°N, and 150–130°W, this was a record high value for the years 1949–2014 (about 2.6 standard deviations above normal for the 4 month period) with the next largest value being about 2.2 standardized units above normal during October 1978–January 1979. For the southern part of the high SLP (along latitude 45°N), anomalous winds from the east induced a northward component ocean surface current that advected warm subtropical water into the higher latitudes of the northeastern Pacific. Freeland and Whitney (2014) noted that this pattern disrupted the usual westerly winds that cross the subarctic Pacific, winds that normally transport nutrients south into the subtropics in winter, fueling production in the Transition Zone which in normal years leads to the Transition Zone chlorophyll front, an important feeding area for migratory fish and seabirds.

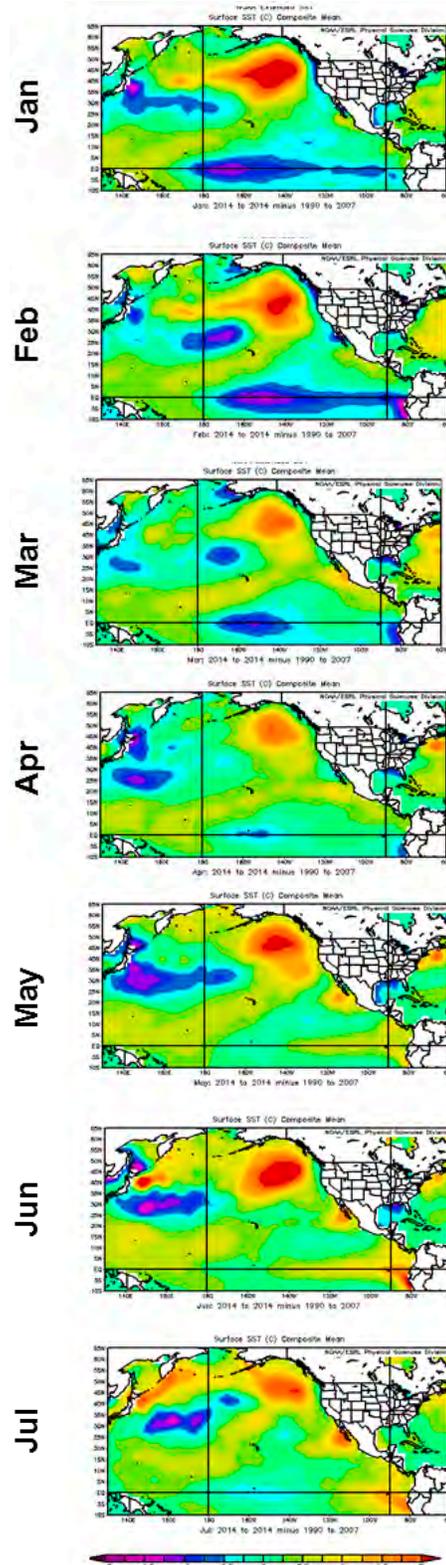


Fig. 1 SST anomalies during 2014.

However, production processes were severely disrupted in 2014, which may be one reason why tropical species moved into the Gulf of Alaska to feed.

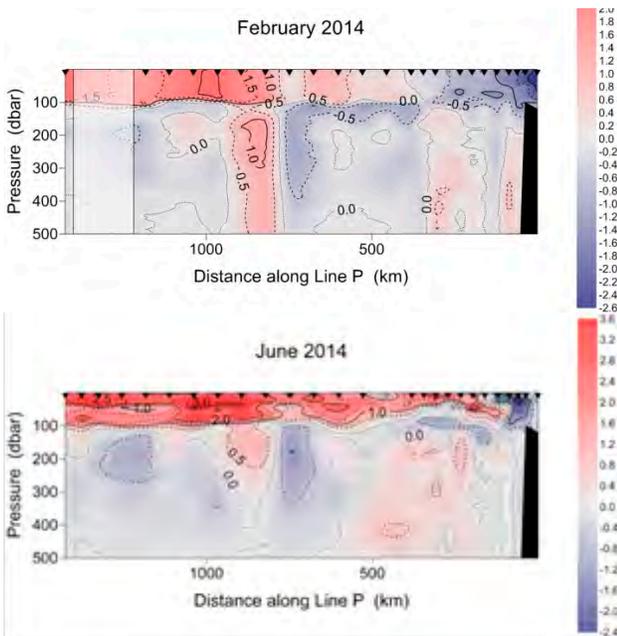


Fig. 2 SST anomalies along Line P in February and June 2014. The light area on the left side of the February graph indicates no data were taken due to rough sea conditions.

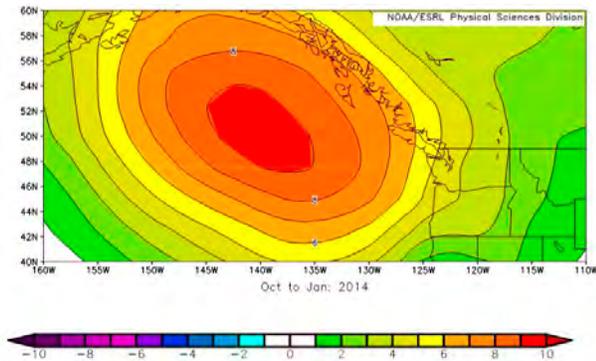


Fig. 3 Mean sea level pressure anomalies (hPa) over the Gulf of Alaska for October 2013–January 2014.

A plot of ocean color data in the Gulf of Alaska (from the MODIS satellite) did not reveal unusual chlorophyll-*a* concentrations in 2014. Figure 4 shows chlorophyll concentrations in April–May along a band of the Alaskan coast ranging from near Kodiak Island east and south to the Alaska–British Columbia border and out to a distance of approximately 200 miles (320 km) from shore. The year 2011 stands out as having anomalously low Chl-*a* (as do 1998 and 1999) but the remainder of the years are clearly well within “typical” values. Similarly, in the central Gulf of Alaska bounded by 50–57°N 137–150°W, 8-day composites of ocean color images do not suggest that 2014 was a year of reduced productivity (Fig. 5).

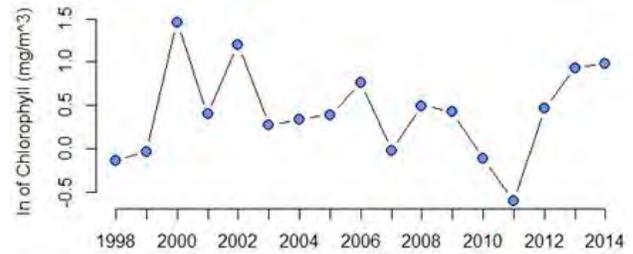


Fig. 4 Chl-*a* concentration averaged for April–May (spring bloom period) for the coastal Gulf of Alaska. Averaging was done along the entire coast from the Alaskan Peninsula east and south to the Alaska–British Columbia border and out to approximately 200 miles (320 km) from shore.

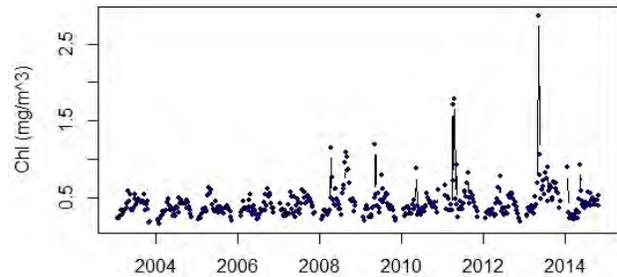


Fig. 5 Chl-*a* concentration using 8-day composites of ocean color images for the offshore regions of the central Gulf of Alaska bounded by 50–57°N 137–150°W.

In the northern California Current, the anomalously warm conditions offshore may have influenced the local winds because the start of the upwelling season was delayed, being the second latest start to the upwelling season in 30 years. Upwelling was among the weakest and the length of the upwelling season among the shortest since the 1990s. Upwelling conditions in 2014 strongly resembled those observed in 2005, a year of very late and weak upwelling. When averaged over the May–September upwelling season, deep upwelled waters on the shelf were among the warmest and freshest in 18 years of data collection, being as fresh as, but only slightly cooler than, the 1998 El Niño. Once upwelling was established, cool ocean conditions were observed along the coast from Vancouver Island south to northern California, but further south, off central and southern California, the coastal ocean was anomalously warm during summer 2014. In late September the warm “blob” came ashore along the northern California Current and the copepod community immediately transitioned from a “cold water-upwelling assemblage” to a “warm water assemblage”. Notably unusual copepod species included *Rhincalanus nasutus* and *Clausocalanus furcatus*, species that have not been seen in coastal waters of Oregon since the 1998 El Niño event.

There have been many anecdotal observations of the occurrence of tropical fishes far north of their usual ranges. These include large numbers of pomfret throughout the Gulf of Alaska, several reports on thresher sharks and ocean sunfish in coastal waters of the Gulf of Alaska, a skipjack

tuna caught by a gill netter near Prince William Sound, and Fraser River sockeye nearly all returned through Johnstone Strait (Canadian waters), but none through Juan de Fuca Strait (shared American–Canadian waters).

In the northern California Current, high numbers of ocean sunfish as well as ‘by-the-wind-sailors’ (*Velevella velevella*) were noted (although they are commonly seen during warm years in coastal waters; thus their presence is not particularly unusual). Catches of juvenile salmon during coastal surveys off Washington and Oregon were below average, but not alarmingly so. The market squid fishery (calamari) which usually ranges from southern California north to Monterey Bay, shifted north, and squid were caught from Monterey Bay north to Eureka (near the Oregon–California border). A 50-lb wahoo (*Acanthocybium solandri*, known as ono in Hawaii) and several opah (*Lampris guttatus*) were caught in southern California waters; both are first records for the state. A 335-lb yellowfin tuna was caught off Cabo San Lucas (Baja California, Mexico), a record for sport fishers. Finally, green turtles were found on a beach near Florence, Oregon, and one was seen off San Francisco, California, again, well north of their usual range.

Ecological and economic impacts on commercially important salmonid fisheries will not be known for a year or two but early signs suggest that for some stocks, the warm water was not harmful. For example, record returns of pink salmon have been forecast for 2015 for fish

returning to southeast Alaska (Joe Orsi, NMFS, Auke Bay, Juneau, Alaska; personal communication). Forecasts for the northern California current are for below average returns for Chinook and coho salmon returning to the Columbia River in 2016 based on analysis of 16 physical and ecological indicators (however, this forecast is based only on conditions off Washington and Oregon and do not consider any potential influence of conditions in the Gulf of Alaska; <http://www.nwfsc.noaa.gov/research/divisions/fe/estuarine/oejp/g-forecast.cfm>).

What does the future hold? At the time of writing this report (December 2014), there is no doubt that an El Niño event is brewing at the equator. However, at the same time last year, similar indications were apparent, and that El Niño never materialized – in fact, equatorial waters became anomalously cool during much of the summer of 2014 at the same time when most of the North Pacific was unusually warm. Finally, the canonical pattern of positive phase of the Pacific Decadal Oscillation (PDO) is now seen in North Pacific SST charts. This was not the case throughout much of 2014, so perhaps things are returning to normal SST patterns. These are interesting times and although we cannot say yet what the impacts might be on marine biota, this situation has the attention of many fisheries scientists and oceanographers around the Pacific Rim.

#### Reference

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*Dr. William (Bill) Peterson (bill.peterson@noaa.gov) is an oceanographer and Senior Scientist with the Northwest Fisheries Science Center, based in Newport, Oregon, at the Hatfield Marine Science Center. Bill is a Team Leader for the “Climate Change and Ocean Productivity” program. One of the core activities of this program is the biweekly oceanographic cruises carried out by his laboratory along the Newport Hydrographic Line, where hydrography, nutrients, chlorophyll, zooplankton and krill are measured. This ongoing activity was initiated in 1996. A key outcome of these monitoring cruises is that the data are now used to forecast successfully the returns of salmon to the Columbia River and coastal rivers of Washington. Bill has been active within PICES since his first meeting (1998), serving on the Executive Committee of the Climate Change and Carrying Capacity (CCCC) Program Implementation Panel, as Chairman of the CCCC REX (Regional Experiment) Task Team. He served as member of the FUTURE Advisory Panel on Status, Outlooks, Forecasts and Engagement, and as Co-Chairman of Working Group 23 on Comparative Ecology of Krill in Coastal and Oceanic Waters around the Pacific Rim. Currently he is a member of the Biological Oceanography Committee.*

*Marie Robert (marie.robert@dfo-mpo.gc.ca) is a physical oceanographer with the Institute of Ocean Sciences of Fisheries and Oceans Canada, as well as coordinator of the Line P program. She leads each of the three cruises per year, and has responsibility for the products and future research of this program. Line P received the PICES Ocean Monitoring Service Award (POMA) in October 2010.*

*Dr. Nicholas (Nick) Bond (nicholas.bond@noaa.gov) is a principal research scientist with the Joint Institute for the Study of the Atmosphere and Ocean (JISAO) of the University of Washington (UW) and also holds an appointment as an affiliate associate professor with the Department of Atmospheric Sciences at the UW. He is the State Climatologist for Washington. His research is on a broad range of topics with a focus on the weather and climate of the Pacific Northwest and the linkages between the climate and marine ecosystems of the North Pacific. He cheerfully admits to being a weather geek.*

## Changes in the PICES Secretariat

*Dr. Alexander Bychkov is leaving PICES as Executive Secretary, after 19 years of service and 16 years at the helm of the Organization, as of December 31, 2014. As PICES Press did one year ago, when Dr. Skip McKinnell stepped down as Deputy Executive Secretary, we invited members of the PICES community to express their thoughts on what Alex has done for PICES or what he has meant to them. All contributions will be presented to Alex as a legacy of what he has accomplished in PICES the lasting impression he has made on both the Organization and individuals involved. Here are a few of the responses.*

I would like to express my sincere thanks for your efforts as PICES Executive Secretary. You have been a figure of solid leadership for my long tenure on the PICES Governing Council. You taught me a lot about how to navigate my way through the maze of international relations. You were always the one who first anticipated a problem and came forward with options to solve it before anyone else seemed aware that a problem even existed. You have ably guided PICES through its formative years to a mature organization with a well-deserved international reputation. Your hand in the administration has been impeccable, and you leave PICES in a comparatively strong financial situation relative to other organizations. You have also been there to provide the personal touch. I recall how much I appreciated your help in finding that hidden espresso bar in Vladivostok in 2005. I look forward to continuing to learn from you over the next two years as you transition to another important role in the Organization.

*Laura Richards, PICES Chairman*

I have always found Alex (and all the PICES Secretariat) welcoming, friendly, interesting and a wonderful force for science. He has always taken such an interest in everyone I have seen him interact with and must have an amazing memory for people – I am forever grateful for him convincing the Japanese caterers to stop watering the whisky when in Sendai and then coming over to me to let me know it was now suitable for consumption ;)

All my best wishes and he will be sorely missed!!!

*Beth Fulton, CSIRO, Australia*

The long-term beneficial and productive collaboration between the Integrated Marine Biogeochemistry and Ecosystem Research (IMBER) project and PICES has been due in large part to Alex Bychkov. Alex has been a champion for IMBER. He supported IMBER activities at all levels, from advertisement of events to providing financial support, and he offered numerous opportunities for the IMBER community to be a visible part of PICES events. He was successful in securing funding for IMBER activities from the PICES Board and then worked with IMBER to provide the funds in a timely manner. Alex's efficient, prompt and professional approach to dealing with requests and funding allowed many early career researchers to benefit from attending international meetings and summer schools. The IMBER-PICES interactions, which were facilitated by Alex, provide a model for cooperation between international science organizations. The IMBER community thanks Alex for his support and wishes him well in his next endeavors. It has been a pleasure to work with Alex.

*Eileen Hofmann,  
Bernard Avril,  
Lisa Maddison, IMBER*

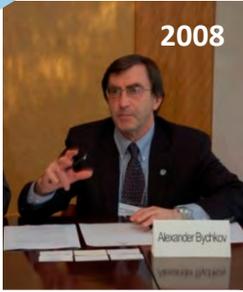
I have had the great pleasure to work with you on several occasions during your time as Executive Secretary of PICES when we sought to foster cooperation between those working on salmon in the North Pacific and North Atlantic Oceans and in the Baltic Sea. One such occasion was the joint ICES, IBSFC, PICES, NASCO and NPAFC meeting that we held in Vancouver in 2002. You were always very positive about, and supportive of, international cooperative initiatives and exchange of information between the marine science (and management) communities in our respective ocean areas and we very much benefitted from your expertise.

All of us in the NASCO Secretariat send all good wishes to you for a long, enjoyable and healthy retirement and we hope that if you are in the UK you will visit us in Edinburgh. You would be most welcome.

Very best wishes,

*Peter Hutchinson, NASCO*





I have taken part in the PICES meetings since 2005 (at Vladivostok, Russia) as a Japanese HAB-Section member. I met Alex for the first time at the HAB-Section meeting at Vladivostok, and I thought he was a Russian HAB-Section member. However, I soon realized that he is the Executive Secretary of PICES and he was energetically visiting each meeting. My first impression of Alex was that his English pronunciation has a, somehow, poetic touch.

After then, I have been watching his dedicated efforts to make PICES meetings successful. Especially, at the PICES meeting in 2012 in Hiroshima, Japan, I observed closely his (and the PICES Secretariat's) great efforts. At PICES-2012, I was involved in the Local Organizing Committee. It was not until I worked in an organizing committee that I realized the difficulties of running an international meeting. Although we (FRA members in Hiroshima) were not familiar with organizing an international meeting, his (and the PICES Secretariat's) sound, correct and prompt advice enabled us to carry out our duties.

Alex-san, thank you for always challenging us all to become better at what we do.

*Shigeru Itakura, National Research Institute of Aquaculture, FRA, Japan*

It is a pity that Dr. Alex Bychkov will step down as PICES' Executive Secretary. Alex spent most of his career as Deputy Executive Secretary and as Executive Secretary. He served the Organization with distinction and dedication par excellence, and his visionary and competent leadership and management have contributed greatly to PICES becoming an internationally respected organization in marine science.

In recognition of this, on behalf of the president of CAFS, Prof. Zhang Xianliang, and all of my colleagues, I would like to express our appreciation to Alex for all his great contributions.

*Li Jilong, Chinese Academy of Fishery Sciences, China*

Alex is a very pleasant person to work with because of his friendliness and fairness. When I was an F&A member, I was in charge of preparing the PICES 2012 Annual Meeting in Hiroshima. So in the previous year, I accompanied him on a visit to Hiroshima to observe the International Conference Center and candidate places for receptions, such as the Museum of Art and Bay Cruise Vessel, together with local organizing members. We enjoyed Hiroshima cuisines for lunch and dinner there. Thanks to his cheerful character, this observation trip with him was a very good memory for me. The fact that he worked in the PICES Secretariat for more than 20 years indicates not only his enormous contributions to PICES but also his high credibility and popularity in the PICES community. We will miss him.

*Taro Ichii, National Research Institute of Far Seas Fisheries, FRA, Japan*

SOLAS and PICES had always had a good relationship, with regular contacts. My predecessor in the job had emphasized when he handed over the job to me that I should pay attention to keep this relationship going. He added that it should be a pretty smooth and easy task thanks to Alex and his work style. I took the job of SOLAS Executive Officer in 2008 and in the first few months I attended a meeting in Toulouse and saw Alex's name in the list of participants. As a good soldier I asked him if we could have a moment to discuss about PICES and SOLAS. We went for lunch together and in an hour I learned so much, not only about PICES but also, and foremost, about our profession, about what it is and what it means to be a science manager/coordinator. I think I will never forget that lunch. Alex represents for me the excellence in science management, the perfect dosage of professionalism and human touch. If you don't know what to do, Alex, after PICES, maybe you could write a book to teach us how to be the best science coordinator – we will all have to learn from you. :-)

I am glad I worked with you all those years. Thank you.

With all my respect,

*Emilie Brévière, SOLAS International Project Office*

Alex has long been one of the PICES faces to me. Twenty years way back, when I began to attend PICES meetings, he was among the few friendly faces. For the remaining years, he has been the timekeeper and rule-teller for many PICES activities I was involved in, with salts of humor, of course. This must have been the same to many colleagues. As Science Board Chair, I owed him a lot in keeping up with my job. Although we had some disagreements on rare occasions, he was a good advisor and friend throughout. Sadly, he is going to retire, but he will be around for a long time I am sure. I believe that the PICES community is greatly indebted to Alex for what we have today.

*Sinjaee Yoo, KIOST, Korea*

When I joined PICES, I had to immediately act as a Co-Chair of the MODEL Task Team. Alex always encouraged me and I was always helped by him. However, the first “mission impossible” commanded by Alex to me was to hold a sport event at PICES-2006. The task was very hard since I was young and had no power, but it was an excellent experience for me to really join the PICES family. Thank you again for Alex’s premeditative mission. He is an excellent Mentor of young PICESians.

*Shin-ichi Ito, The University of Tokyo, Japan*

Words cannot express my appreciation for all of the work you have done to advance PICES science around the world. I know that Warren Wooster would be so proud of what you have accomplished during your tenure as Executive Secretary of PICES. PICES enjoys a reputation for advancing innovative new approaches to marine science throughout the world. Much of this is because of you and your staff.

On a personal note, I will miss your guidance and advice on planning and preparing for meetings. You know when to prod us to complete our work and when to help us when we are overwhelmed. This is a rare talent of a great leader. I also want to thank you for remembering to find ways to make our work fun and inspiring. You have promised all of us that our work with PICES makes a difference, and it has! My career has been greatly enhanced by PICES and you.

I hope you can have some well deserved fun now in your new advisory capacity with PICES.

*Anne Hollowed, NOAA, USA*

Thank you very much for your great kind assistance and constructive suggestions during and since the establishment of our Study Group on *Radionuclide Science in the North Pacific Ocean* (SG-RS) and Working Group on *Assessment of Marine Environmental Quality of Radiation around the North Pacific* (WG-AMR or WG 30). It was your constructive suggestions that made us clearer how to make preparations for our two groups’ establishment and how to follow PICES rules and FUTURE program for our WG development. Moreover, your vision and excellent leadership and management, and your amiable and easy approach have left a deep impression on us.

*Yusheng Zhang, Third Institute of Oceanography, SOA, China*

After 15 years as his friend and neighbour in the adjacent office, I learned to appreciate that Alex Bychkov did not just work for PICES – he lived for it. Governing Council could not have asked more of an individual, nor could he have given less. To the marine science world he was the PICES ambassador of fairness, willingness, competence and dedication. He has an innate capacity to be nice to people. He inspired great things from those of us in orbit around him. He will be missed.

Fortunately, Alex has established a life with his family in Victoria. As we both like good coffee, I won’t need to miss him as much as others may. You don’t know what you’ve got till it’s gone (j.m.).

*Skip McKinnell, Canada*

... I have only overall warm memories from many years of working with Alex in my various capacities as POC Chair, WG 20 Co-Chair, and member of several other PICES WGs. Being only down the hall from Alex’s office meant numerous visits (whose frequency increased with proximity to upcoming meetings) and gentle arm twisting that were either reminders that I needed to fulfill one of my duties, or requests to send off emails to remind someone else that they should be fulfilling theirs. (I was a sucker for the line “It would be better if the email comes from you than me.”) Always cognizant of cultural differences among the PICES nations, Alex was tactful yet persuasive. I learned much from his suggestions on exactly how “my” emails should be worded.

It has been largely due to Alex’s competent leadership over the last 16 years that PICES has become the internationally respected organization that it is. We owe him a huge debt of gratitude.

Alex, best wishes for a long and healthy retirement!

*Mike Foreman, Institute of Ocean Sciences, DFO, Canada*

Allow me to begin by thanking Alex for all his hard work in PICES for a long time. He has always given me useful advice ever since I participated at my first PICES Annual Meeting in 1999, in Vladivostok. I would also like to thank him for excellent leadership of JGOFS NPPS as Co-Chair. I shared very meaningful time with him. His stepping down means a serious loss to the PICES community.

*Toru Suzuki, Japan Hydrographic Association, Japan*

As the first intern for PICES, I came to the PICES Secretariat in June 2000. That was my first time to work in an international organization. As a head of the Secretariat, Alex gave me a lot of help to understand the operation of the Secretariat and PICES itself. At Hakodate, Japan, in 2000, I attended my first PICES Annual Meeting. After the Annual Meeting finished, all the Secretariat staff had a happy photo to celebrate the successful Annual Meeting.

*Gongke Tan, First Institute of Oceanography, SOA, China*

...Alex ... a person who has left with me many meaningful memories. Alex is an easy person to underestimate, because in early contacts one gets the impression that his hand is light. And it indeed is a light hand that he applies – as long as things are going as they should. This is not to say he is a subtle control freak, for he is not. But he is never without a vision, and never without a commitment to see that vision through to something real. How that vision materializes; what the roles for all the PICES people are; who plays which role: all that is very much up to all of us. He just makes sure that there IS a “how”, a “what”, and a “who” – he makes sure that PICES has been more than just talk. It has been concrete action – products of a wide assortment: science reports, decadal scale plans, outreach, and much more.

Warren Wooster was integral to creating PICES, and in his early role, to many people on the outside (and not a few on the inside), Warren was PICES. In the time that Alex has been Executive Secretary that changed – but changed for the better for PICES. PICES now is known, strong, and respected as a marine science organization in its own right. Only a true leader and a fine person could have made that transition. Every one of us associated with PICES is better off for what Alex has led PICES into becoming, and we will all miss him.

*Jake Rice, Fisheries and Oceans Canada*

Dear Alex,

Congratulations on an outstanding career with PICES – which is not over yet!! Your boundless energy, enthusiasm, direction and encouragement have made PICES into a very well-respected global marine science organisation. PICES has been a long and important part of my scientific career. I have watched with admiration as you took over the Executive Secretary position in the mid-1990’s, and built PICES into the active, collegial and dedicated organisation that it is today. It takes a special person to guide scientists and to direct their talents – there is much truth in the phrase ‘herding cats’. You have done all this with charm, persuasion, and sophistication – a true example of a gentleman scientist. Of course, your incredible memory for details and encyclopedic ‘everything-at-your-fingertips’ knowledge has been a tremendous asset, and perhaps has led the rest of us to become somewhat lazy by depending on you to keep us on track and to remember what we had agreed to do.

Some of my fondest memories are of travelling with you. Your knowledge of, and interest in, the artistic treasures and delights of foreign cities meant that I always had a guide and companion to whatever city we were in, both new and familiar. I remember, in particular, meetings in Paris one cold week in February (several years ago) when, with snow on the ground, we went in the evenings to the Picasso museum, the Musée Jacquemart-André, and other small, less often visited, museums that were absolutely stunning.

Alex, I am very glad that you will continue to be part of the PICES family for some time yet, and I look forward to many more excursions into the scientific and cultural life of our human and natural worlds. You have ‘set the bar’ incredibly high. Thank You for all of your time and dedication – it takes a special person to be able to have accomplished what you have accomplished with PICES! The Organisation would have been much smaller and poorer without your tremendous efforts. Congratulations!

*Ian Perry, Pacific Biological Station, DFO, Canada*



*Slava Lobanov, V.I. Il'ichev Pacific Oceanological Institute (POI), FEB RAS, Russia*

Of all my years of working with Alex, the times I remember the most are not those spent at the PICES meetings but those that involve what happens between the meetings. After all, these are really the most important times for getting the work done and preparing for the meetings. You have to appreciate when trying to get these things done, PICES is relying on people whose main job is not devoted to PICES. Thus, it is important to have someone in the Organization (*i.e.*, Alex!) who can provide that essential gentle nudge or push to those who need to bring PICES higher on their priority list.

Thus, it follows that the times I remember the most are the ones in which I received the following voice message from Alex: “Dear Pat, This is Alex Bychkov, please return my call at your earliest convenience.” Uh-oh, I knew, this means there is PICES work to be done!! Sometimes it was by me or sometimes by those I supervise who weren’t getting their PICES work done in a timely fashion. Alex is the best at communicating and convincing others to put in their best and highest work for the Organization and it is a big part of the reason for PICES’ success. Alex always made sure I was fully up to speed on all the issues before I went in to chair the F&A meeting. He is a fantastic communicator and excels at communicating the important details and the tasks that need to be accomplished. Since I stepped down from F&A chairman, I no longer receive the messages I somewhat dreaded from Alex as often. I have to say that I miss them....just as I will miss Alex when he no longer has PICES as his first priority.

*Pat Livingston, Alaska Fisheries Science Center, NMFS, NOAA, USA*

Having been involved in diverse activities within PICES since 2001, I have always been impressed with the encyclopedic recall of relevant facts that Alex has displayed time and time again during the past 14 years. I cannot count the number of times that I have approached Alex at Annual Meetings or workshops with questions about this or that PICES issue, and he seems to always have the answer, or is quickly able to retrieve it. This behavior has continued in our relationship since I became Deputy Executive Secretary in the PICES Secretariat a year ago. He is so tuned to the (often hidden) connections across diverse aspects of PICES business, and timely conveys those connections to those who will benefit from them.

Alex was the “perfect storm”, in a good way, for PICES. In the mid-to-late 90s, PICES was becoming better known as a regional program, but it wasn’t until the “Beyond El Niño” conference in La Jolla in 2000, that PICES emerged as a go to organization for coordinating and energizing scientific exchange and cooperation through PICES (co)sponsored symposia, such as the Zooplankton Production Symposia and Climate Effects Symposia series. Much of PICES transition from a regional organization to a truly global organization was driven directly by Alex’s guidance, and his certainty that this was the proper way for PICES to engage internationally.

When I was nominated to co-chair the Climate Change and Carrying Capacity (CCCC) Science program of PICES in 2001, I was relatively unfamiliar with many of the key scientists involved. Ian Perry, the Chair of Science Board, remarked that I could rely on Alex if I needed guidance or information—truer words have never been spoken. Alex exhibited great patience with me during my early involvement with PICES-CCCC, for which I am very grateful. He has been not only a mentor about conducting international relations, but a friend also. I was excited to be hired by the Secretariat last year, and disappointed that my time working with Alex would be short, with his recent stepping down as Executive Secretary. I admire Alex’s ability to identify and subsequently focus on the crux of an issue; but even more, I admire his ability to balance his professional life and his personal life.

*Hal Batchelder, PICES Secretariat*

*“The value of a man should be seen  
in what he gives ...” Albert Einstein*



*Thank you for your massive dedication to  
the PICES community. Sanae Chiba*

*PICES welcomes Mr. Robin Brown, formerly with Fisheries and Oceans Canada, as the new Executive Secretary of PICES. Robin has taken up the position on February 23, 2015. Robin's new email address is Robin.Brown@pices.int.*



Robin Brown was born in Vancouver, British Columbia, and grew up on the water. During his early years, he and his family spent weekends and vacations traveling up and down the inner coastal waters of the BC coast. In his high school and university years, he became deeply involved in sailboat racing in all kinds of craft from high performance dinghies to offshore racing yachts, culminating in an appointment to the National Sailing Team.

Robin attended the University of British Columbia, graduating with a degree in marine biology. In his final year, he was hired by Prof. Tim Parsons as a Research Assistant to assist in operations at the Controlled Ecosystem Pollution Experiment (CEPEX) a large plankton mesocosm facility on the site of the Institute of Ocean Sciences (IOS) in Sidney, BC. This was his first exposure to international science, as the facility hosted investigators from Canada, USA, Japan, Germany and the United Kingdom.

At the conclusion of the CEPEX project, Robin went to work for a local oceanographic consulting company, carrying out projects in optical remote sensing, physical oceanography and chemical oceanography in diverse Canadian locations, including Newfoundland and the Canadian Arctic. In 1985, he was hired by Dr. Ken Denman into the Department of Fisheries and Oceans at IOS as a Multidisciplinary Oceanographer. In 1992 he transitioned to the position of Oceanographic Data Manager. In this position, he undertook his first PICES appointment as the first Chairman of the Technical Committee on Data Exchange (TCODE) and has attended every PICES Annual meeting since 1995.

Since 1999, he was the Manager of the Ocean Sciences Division of DFO at IOS, responsible for a research group of up to 70 physical, chemical and biological oceanographers conducting research in the North Pacific and the Arctic. In this period, he also served on a number of PICES expert groups and committees, including TCODE, Science Board, FUTURE Advisory Panel on *Status, Outlooks, Forecasts and Engagement*, the Finance and Administration Committee and the Governing Council.

In 2012, he was appointed as co-chair of a Canadian Federal-Provincial interagency working group to assess potential impacts of debris resulting from the 2011 Tohoku earthquake and tsunami. In 2013, he was appointed as the lead Canadian Commissioner to the North Pacific Anadromous Fish Commission.

Robin and his wife, Leslie (also a biological oceanographer and a graduate student of Prof. Tim Parsons), live a short distance from the PICES Secretariat at IOS. This allows him to commute by bicycle year-round, which is normal in southern coastal BC, but rare in the rest of Canada. Robin and Leslie are “empty-nesters” with three adult children living in Victoria, Calgary and Kalamazoo, Michigan (USA).

#### PICES Press

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