

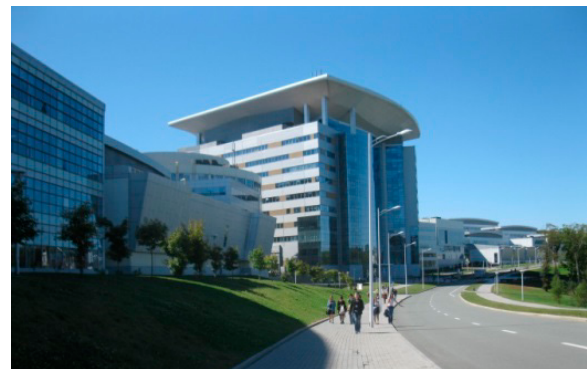
PICES science in 2017: A note from the Science Board Chair

The marine environment is rapidly changing, not only in the PICES region, but globally. It is obvious that the impacts of global warming, such as the increase in temperature, decrease in pH, and expanding regions of hypoxia are having detrimental impacts on marine ecosystems. Responding to the increasing demand on fisheries products and marine ecosystem services, the Convention on the Conservation and Management of High Seas Fisheries Resources in the North Pacific Ocean came into effect on July 2015, and an international legally binding instrument on the conservation and sustainable use of marine biological diversity in areas beyond national jurisdiction was discussed in the United Nations. Under such a changing environment, PICES, in November 2016, celebrated its 25th Anniversary during its Annual Meeting with the theme “*Celebrating the Past, Imagining the Future*”. The future of the North Pacific marine ecosystem was discussed and scientific questions of greatest immediate concern were targeted for addressing by PICES within the next 25 years. In 2017, PICES initiated several new activities to tackle various marine scientific issues we are facing.

One new initiative of PICES for the next quarter century was the establishment of a Human Dimension Committee (HD) that participates in Science Board decision making. Although the establishment of HD was approved at the PICES 2016 Annual Meeting, their membership selection and activities started in 2017. The emphasis on human

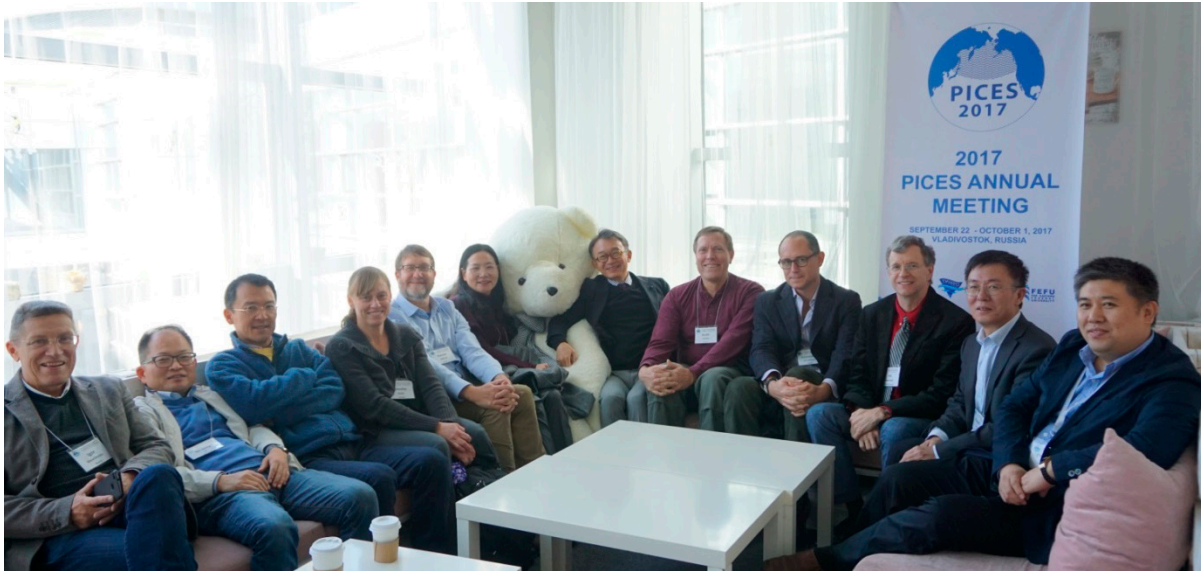
dimension issues clearly shows that PICES recognizes the links between Anthropocene changes in marine ecosystems and economic and social well-being.

The 26th Annual Meeting of PICES (PICES-2017) was held at the Far Eastern Federal University (FEFU) in Vladivostok, Russia, from September 22 to October 1, 2017. The meeting was titled “*Environmental Changes in the North Pacific and Impacts on Biological Resources and Ecosystem Services*”. We had over 350 attendees from 11 countries including 18 representatives of international and regional organizations and science programs. The newly constructed FEFU campus faces the beautiful Zolotoy Rog, or Golden Horn Bay, and many attendees enjoyed the beautiful scenery from the venue or during the daily commute between the campus and downtown hotels.



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Science Board, from left: Igor Shevchenko (representing Russia), Se-Jong Ju (BIO), Motomitsu Takahashi (representing Japan), Jennifer Boldt (MONITOR), Steven Bograd (FUTURE SSC), Sukyung Kang (FUTURE SSC), FEFU teddy bear, Hiroaki Saito (Science Board Chair), Keith Criddle (HD), Emanuele Di Lorenzo (POC), Harold (Hal) Batchelder (PICES Secretariat), Xianshi Jin (FIS), Chuanlin Huo (MEQ); (missing) Joon-Soo Lee (TCODE Chair).

At PICES-2017, HD sponsored a topic session on “*Marine ecosystem health and human well-being: A social-ecological systems approach*” and a workshop on “*Coastal ecosystem services in the North Pacific and analytical tools/methodologies for their assessment*”. Related to and parented by HD, a Working Group on *Marine Ecosystem Services* (WG 41/MES) was established. The role of WG-MES will be to facilitate exchange of information and share the experiences of case studies on MES in North Pacific waters in order to promote ecosystem service science and marine integrated management. A new Study Group on *Marine Microplastics* (SG-MMP) was established to identify major microplastic issues in the North Pacific including marginal coastal seas and to identify knowledge gaps. SG-MMP will collaborate with regional and international bodies studying on the issue such as ICES, GESAMP, and NOWPAP.

A second new direction for PICES (at the 2016 Annual Meeting) was the Organization’s involvement in a Joint PICES/ICES/PAME Working Group on an *Integrated Ecosystem Assessment for the Central Arctic Ocean* (WG 39). Undertaking formal activities in the Arctic is new to PICES. PAME (Protection of the Arctic Marine Environment) is a working group of the Arctic Council, the intergovernmental forum for sustainable development and environmental protection in the Arctic. WG 39 will consider approaches and methodologies for integrated ecosystem assessment in the Central Arctic Ocean. Dr. Sei-Ichi Saitoh was approved as the PICES Co-Chair of the WG. During PICES-2017, WG 39 members held their first meeting and discussed how PICES could contribute to the integrated ecosystem assessment.

PICES was quite active in spring 2017. In April, back-to-back inter-session meetings of WG 35 (*Third North Pacific Ecosystem Status Report*), FUTURE Scientific Steering Committee (SSC) and Science Board were held in Honolulu, hosted by the NOAA Pacific Islands Fisheries Science Center (PIFSC), USA. WG 35 nominated lead authors for assessment reports of 15 biogeographical regions and established a detailed timeline for publishing the third NPESR. The timeline anticipates that regional assessment reports will be completed in the summer of 2018, and that the synthesis chapter and all regional assessments of the NPESR will be available online in the summer of 2019. At the FUTURE SSC meeting, members discussed ongoing activities and potential gaps in attaining the goal of the FUTURE using a [schematic of Socio-Ecological-Environmental Systems](#) with PICES expert groups aligned with their potential products and how they advance FUTURE understanding. The SSC carefully examined the expected output from ongoing and new WGs established after PICES-2016, which are: WG 36 on *Common Ecosystem Reference Points across PICES Member Countries*, WG 37 on *Zooplankton Production Methodologies, Applications and Measurements in PICES Regions*, WG 38 on *Mesoscale and Submesoscale Processes*, WG 39, and WG 40 on *Climate and Ecosystem Predictability*. The SSC is also continuing its work on a FUTURE synthesis paper. Members of WG 35, FUTURE SSC and Science Board had enthusiastic discussions and got a lot of work done despite the beckoning sunshine and radiant Pearl Harbor adjacent to PIFSC. The warm hospitality of the PIFSC staff and the sea breeze of Oahu Island during lunch or in the evening did much to relax the members and rejuvenate them for further discussions.

Small pelagic fish (SPF), such as sardine and anchovy, are key components of marine food-webs and variation in their biomass and composition influence not only ecosystem dynamics but also human societies. In spite of the recognized importance of SPF, no scientific meeting targeting the role of SPF has been held since 1983. In March 2017, PICES and ICES held an International Symposium on “*Drivers of dynamics of small pelagic fish resources*” in Victoria, Canada. The main purposes of the symposium were to revitalize global international cooperation on investigations of SPF and to discuss the impact of climate and/or fishing pressure on the resilience of SPF populations. More than 230 scientists gathered and discussed SPF issues at 13 sessions and workshops. Selected papers will be published in *Deep-Sea Research* and *Marine Ecology Progress Series* in 2018.

One of the remarkable aspects of the SPF symposium was that approximately 20% of the attendees were early career scientists, and some of their travel was supported by PICES. Since the establishment of PICES, capacity building, such as summer schools, travel support, and the internship program, has been an important and major activity of PICES. In 2017, PICES and ICES held their third jointly sponsored Early Career Scientist (ECS) Conference, a flagship capacity building activity of PICES, from May 29 to June 2 in Busan, Korea. The conference was entitled “*Climate, oceans and society: Challenges and opportunities*”. One hundred and three ECS participated from all over the world. Discussions were quite spirited during the sessions and occasionally it was difficult to keep the talks on schedule. The ICES Secretariat gave a unique lecture, providing examples of effective and appropriate use of social media for sharing science ideas and findings, and generating enthusiasm beyond scientists. The Conference was a great success and provided the participants with opportunities to expand their scientific knowledge and their international network of colleagues at a similar stage of their careers.

Science-based decisions are essential for wise and sustainable use of marine ecosystem services in the Anthropocene. Generating and expanding scientific knowledge is a fundamental role for scientific organizations, including PICES. To grapple with various issues and to prepare the best science for society, PICES is strengthening its relationship with international organizations and projects such as ICES, ISC, NOWPAP, SCOR, IOC, WESTPAC, NPFC, NPAFC, and IMBeR. One of the ways to enhance collaboration is by having co-sponsored meetings or sessions, and PICES co-sponsored 10 meetings and sessions in 2017. Another way to enhance collaboration with other marine science partners is to develop joint study groups. During PICES-2017, a joint Study Group with the North Pacific Fisheries Commission for Scientific Cooperation in the North Pacific Ocean (SG-PICES-NPFC) was formed.

One of PICES’ activities is responding to societal requests by carrying out scientific projects. To examine the impact of marine debris ejected by the Great East Japan Earthquake and Tsunami on coastal ecosystems of the eastern North Pacific, the ADRIFT (Assessing the Debris-Related Impact of Tsunami) project, funded by the Ministry of Environment, Japan, was carried out from 2014–2017. It revealed the distribution of tsunami-related debris and novel invasions of exotic species on the Pacific coast of North America and the Hawaiian Islands. Results were published in *Science* magazine and highlighted on the cover page. Other results will appear in special issues of *Marine Pollution Bulletin* and *Aquatic Invasions* in early 2018. A second project on Marine Ecosystem Health and Human Well-Being (MarWeB), funded by the Ministry of Agriculture, Forestry and Fisheries, Japan (2012–2017) also recently concluded. The goal is to identify the relationships between sustainable human communities and productive marine ecosystems in the North Pacific, under the concept of fishery social-ecological systems (known in Japan as the “Sato-umi” fisheries management system). The MarWeB project showed that understanding the differences and commonalities on how human well-being is structured among countries is vital for wise use of ecosystem services.



PICES scientific reports are essential products resulting from most PICES expert groups. In 2017, [PICES Scientific Report No. 52](#) was published on the Marine Ecosystems and Human Well-being project and the Section on *Harmful Algal Blooms* published [PICES Scientific Report No. 53](#) on *Conditions Promoting Extreme Pseudo-nitzschia Events in the Eastern Pacific but not the Western Pacific*, which resulted from a workshop held at PICES-2016. Also, several special journal issues were published in 2017: *Advances in understanding of the North Pacific subtropical front and transition zone ecosystems* in *Progress in*

Oceanography (Vol. 150), and two issues of *Archives of Environmental Contamination and Toxicology* (Vol. 73, No.1, *Ocean Spills and Accidents*) and (Vol. 73, No. 2, *Indicators of Ocean Pollution*). WG 30 on *Assessment of Marine Environmental Quality of Radiation around the North Pacific* and SCOR WG146 jointly contributed to publish a review paper in *Annual Review of Marine Science* (Vol. 9) on the transport and impact of radionuclide contamination in the North Pacific Ocean.

At PICES-2017, 28 business meetings, 16 topic sessions and five workshops were conducted. During the Meeting, scientists showed their enthusiasm for both scientific discussion and educational outreach. Drs. Keith Criddle, Emanuele Di Lorenzo, and Tom Therriault provided

lectures to school children in Vladivostok on the changing North Pacific and society’s dependence on services or goods provided by marine ecosystems. Meanwhile, scientists Steven Bograd, Peter Chandler and Ryan Rykaczewski provided lectures to undergraduate students at FEFU during one afternoon. You can read these educational outreach activities in a separate article on page 11 of this issue. The Annual Meeting Welcome Reception was held at the “Big Panoramic Hall” of FEFU where attendees enjoyed the beautiful scenery of Golden Horn Bay while listening to relaxing saxophone playing and enjoying tasty Russian dishes. We thank the warm hospitality of TINRO-Center, the host of the Annual Meeting, and staff of FEFU.

Highlights at PICES-2017



Participants at the Section on Harmful Algal Blooms workshop.



Dr. Shang (Sunny) Chen convening the Human Dimensions workshop.



The first of three Science Board meetings during PICES-2017.



WG 30 meeting’s Co-Chair, Dr. Yusheng Zhang, front left, listening to remarks from John Smith, front right, just out of photo.



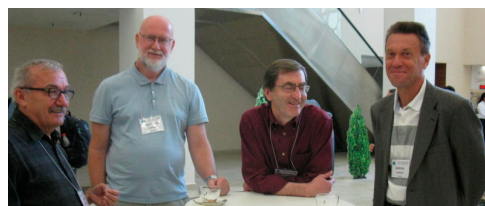
Working Group 35 meeting in session.



Section on Marine Birds and Mammals meeting in progress.



The S-HAB crowd during coffee break. From left: Lingjuan Wu, Chunjiang Guan, Xinfeng Dai, Douling Lu (S-HAB Co-Chair) and Hao Guo.



Sharing some light moments during coffee break. From left: Pavel Tishchenko, Vyacheslav Lobanov, Alexander Bychkov and Andrey Andreev.



Steven Bograd and Sukyung Kang enjoying the *FUTURE* Plenary Session.



Opening Session.



From left: Andrea White, Anne Hollowed, Jackie King, Tom Therriault and Jennifer Boldt at the Welcome Reception.



ICES–PICES ties. Cornelius Hammer with Sukyung Kang.



Overseeing strategic placement of tasty Russian desserts? From left: Vitaliy Samonov, Christina Chiu and Alexey Khoruzhiy.



Master Vladimir Skvortsov (a future PICESian?) with Dr. Hiroaki Saito, Science Board Chair.



Two Russian beauties flanking our favourite Baba Yaga.



PICES Chair, Chul Park (left) enjoying the Welcome Reception with Chuanlin Huo and Fangli Qiao.



TINRO-Center Deputy Director, Alexander Buslov with NPAFC Executive Director, Vladimir Radchenko.



TINRO-Center local organizers, Tanya Semenova, Anna Skvortsova and Vitaliy Samonov finding time at the end of the day to enjoy the Welcome Reception.



Jim Christian and Nick Bond.



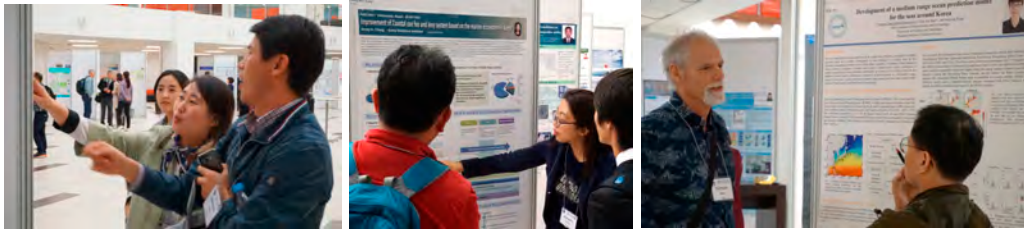
Hal Batchelder and Suam Kim.



Oleg Bulatov (left) and Roman Novikov.



Lev Neretin (NOWPAP Coordinator) and Vyacheslav Lobanov.



Discussing science results at the Poster Session.



The Pinks dragon boaters blasting off at the sporting event in Novik Bay (left) and dragon boat cheering section (right).



Dr. Lev Zhivotovskiy,
Keynote Speaker



Dr. Zhongyong Gao,
Invited Speaker



Desiree Tommasi,
Early Career Scientist
Invited Speaker



Moojin Kim,
Early Career Scientist



James Thorson,
Early Career Scientist
Invited Speaker



Kirill Kivva,
Early Career Scientist
Invited Speaker



Kanae Tokunaga
Early Career Scientist
Invited Speaker



Jianchao Li,
Early Career Scientist



Robert Blasiak
Early Career Scientist
Plenary Speaker



Cody Szuwalski,
Early Career Scientist
Plenary Speaker

Looking ahead to 2018, PICES will sponsor a session on “*The risks of marine debris mega-pulse events: Lessons from the 2011 Great Japan Tsunami*” at the 6th International Marine Debris Conference in San Diego, USA, with the Ministry of Environment, Japan, in March. PICES is coordinating two other activities, including an International Symposium on “*Understanding changes in transitional areas of the Pacific*” in La Paz, Mexico in April, and the PICES/ICES/IOC/FAO 4th International Symposium on “*Effects of climate change on the world’s oceans*”, which will be held in Washington, DC, USA in June. In July, PICES and Ocean Networks Canada will host a Summer School on “*Coastal Ocean Observatory*

Science”, in Victoria, Canada. The next PICES Annual Meeting will be held from October 25 to November 4 in Yokohama, Japan, and has a theme of *Toward integrated understanding of ecosystem variability in the North Pacific*. I look forward to seeing you in Yokohama and at other venues of PICES-hosted events in 2018.



Hiroaki Saito
Science Board Chair

2017 PICES awards

Presentations of PICES awards took place on September 25, 2017 during the Opening Session at the PICES 2017 Annual Meeting in Vladivostok, Russia.

Wooster Award

The Wooster Award presentation ceremony was conducted by Dr. Hiroaki Saito (Chair of Science Board). Dr. Saito announced that the 2017 Wooster Award was being given to Dr. Suam Kim (Pukyong University, Busan, Korea), and read the following Science Board citation which was accompanied by a slide show dedicated to Dr. Kim:

In 2000, PICES Governing Council approved the establishment of an award named in honour of [Professor Warren S. 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 criteria for selection are: sustained excellence in research, teaching, administration or a combination of the three in the area of North Pacific marine science. Special consideration is given to individuals who have worked in integrating the disciplines of marine science, and preference is given to individuals who were or are currently actively involved in PICES activities. Please join me in congratulating the recipient of the 2017 Wooster Award, Dr. Suam Kim.

Dr. Suam Kim is a professor of the College of Fisheries Science under the Department of Marine Biology at Pukyong National University in Busan, Korea. His career in examining fishery resources worldwide has spanned more than 35 years, including his chairmanship of international organizations related to science programs on fisheries and ocean studies such as PICES and NPAFC. He has published over 100 peer-reviewed articles on topics of climate change, fishery resource trends, ecosystem changes and forecasting of fish stocks. He has published 6 books in Korean, and contributed chapters to 28 books domestically and globally.

Dr. Suam Kim was born in Seoul, Korea. He has one elder brother and one younger sister. From early on, he had a great love for nature, and especially the mountains and the sea. Mountains, climbing and skiing were his passions. As a child he dreamed of climbing Mt. Everest. Suam seems to be a risk taker. [karaoki photo] Karaoke—now that is a real risk taker.

He met a girl, her name was Youngyeon, they married, and soon two became three when his daughter Dahjong was born.

Suam's connection to the sea deepened when he entered the Department of Oceanography of Seoul National University in 1972. His education continued with a Masters in Marine Biology in Korea, and a Ph.D. in Fisheries Oceanography at the University of Washington. He did a postdoc at the Alaska Fisheries Science Center of NOAA. In 1989, as a young scientist still, he shifted his focus to studying the Antarctic. In 1992 he was team leader of the Antarctic King Sejong Station, where he managed research operations and studied Antarctic biological resources. He later published "The Antarctic Science Story" in Korean for his daughter based on his experiences from this time.

Dr. Kim has also played an active role in many international organizations in the areas of marine fisheries and oceanography, including for PICES, for the NPAFC, where he is currently Vice-President and a decade ago was chairman, and CCAMLR, where he was Vice-Chairman of the scientific committee. [This and the next slide show photos of Dr. Kim at several PICES events.] Enjoy them, he seemed to. Suam was the local symposium convener of the 2nd Effects of Climate Change on the World's Oceans International Symposium, where he welcomed the participants to the venue, and probably worried about the logistics of the meeting.

After Suam moved to Pukyong National University in 2000 he devoted great energy to fostering the next generation of marine and fisheries scientists. As a member of the Korean Committee of GLOBEC, he convinced an anonymous benefactor to provide funds that would enable young Korean scientists to attend and present their studies in international venues. This support enabled more than 50 young scientists to share their science results in various venues, including PICES. Many of his students received Best Presentation Awards at PICES Annual Meetings.

Suam shared his love of science, and his fondness for mountains, with his students. Please join me once again in congratulating Dr. Suam Kim as the recipient of the PICES 2017 Warren S. Wooster Award.

A slide show of Dr. Kim's Wooster Award nomination can be viewed [here](#).



Dr. Suam Kim, 2017 Wooster Award recipient, with Dr. Chul Park (PICES Chair) left and Dr. Hiroaki Sato (Science Board Chair).



Dr. Kim accepted the award with the following remarks:

I am so much honored to be a Wooster Award recipient. Since my first participation in PICES in 1993, I learned much from PICES friends on science. Actually, my science and career have been growing up within PICES. I owe much to PICES. Through conversations and communication within the PICES society, my team of students has carried out research efficiently. For me, PICES was, and is, my scientific playground. I have always been comfortable whenever I attended PICES meetings. Therefore, I wish everybody here, especially young scientists, to enjoy this PICES meeting, as I have done before.

Still, my homework from Warren Wooster, who was my Ph.D. committee member, is not completed. Because I worked on pollock and krill in the subarctic and Antarctic oceans, respectively, he suggested I write a paper covering both hemispheres. Someday I wish to write it!

Again, I appreciate all friends within PICES society.

Wooster Award recipients

- 2001 Michael Mullin (USA)
- 2002 Yutaka Nagata (Japan)
- 2003 William Percy (USA)
- 2004 Paul LeBlond (Canada)
- 2005 Daniel Ware (Canada)
- 2006 Makoto Kashiwai (Japan)
- 2007 Kenneth Denman (Canada)
- 2008 Charles Miller (USA)
- 2009 Kuh Kim (Korea)
- 2010 Jeffrey Polovina (USA)
- 2011 Bernard Megrey (USA)
- 2012 Richard Beamish (Canada)
- 2013 Vera Alexander (USA)
- 2014 Fangli Qiao (China)
- 2015 Anne B. Hollowed (USA)
- 2016 Sei-Ichi Saitoh (Japan)
- 2017 Suam Kim (Korea)

PICES Ocean Monitoring Service Award

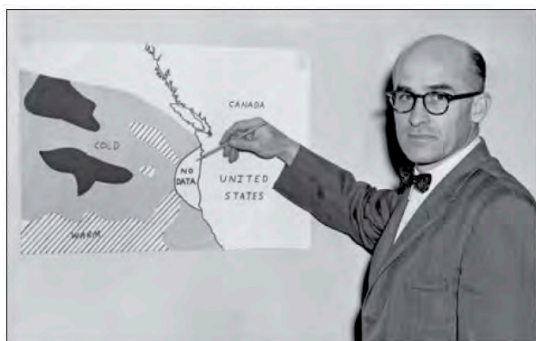
Progress in many aspects of marine science is based on ocean observations, monitoring, and management and dissemination of data. In 2007, a [PICES Ocean Monitoring Service Award \(POMA\)](#) was established to recognize the sustained accomplishments of those engaged in these activities.

Dr. Saito conducted the POMA presentation ceremony and read the following Science Board citation (reading of the citation was accompanied by a slide show describing the award recipient):

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”.

Please join me in congratulating the recipient of the 2017 POMA Award, which is the Newport Hydrographic Line (NH Line) extending along latitude 44°39.1N off the coast of Oregon.

The NH Line was established in 1961, shortly after the creation of a Department of Oceanography in the summer of 1959. The department was a vision of Dr. Wayne Burt, who had joined Oregon State College (it did not become Oregon State University until 1961) as an oceanographer in 1954. The history of the NH Line can be divided into four time periods based on differences in sampling frequency, spatial extent, range of observations measured and measurement methods, and the principal source of funding. The photo of Wayne Burt shown here is famous in the archive of Oregon State University (OSU), as the “no data exist” near the Pacific Northwest coast was the justification for the creation and expansion of oceanography at Oregon State University.



Above: Wayne Burt, in 1958, with a chart of the Northeast Pacific Ocean, pointing out the absence of data off the Oregon coast.

During the decade of “TENOC”—the Next Ten Years of Oceanography (from 1961–1972) basic sampling was done for hydrography and dissolved oxygen and nutrients extending far offshore (over the abyssal plain). TENOC was funded by the Office of Naval Research, which was the main funder of university-based oceanography at the time. The data collected during TENOC provided a valuable basis for future studies, including climate change related to ocean conditions.

1972 to 1996 was called the process study era, as it focused on specific processes, which included several well funded coastal upwelling ecosystem programs, mostly through Oregon State University. Also, the extremely strong El Niño of 1983 was well sampled by Charlie Miller and others at OSU, but for the most part, sampling in the 1980s and early 1990s was sparse. 1996 to 2004 was the GLOBEC LTOP or Long Term Observation Program era of the NH Line. Bill Peterson (at NOAA), using the 37 ft aluminum R/V Sacajawea, started biweekly sampling during spring through autumn and monthly sampling throughout winter along the NH line (out to 25–30 nautical miles). Simultaneously, the US GLOBEC and other programs also focused on this region with long-term observation programs, process studies, spatial surveys of mesoscale features, remote sensing, modeling and

retrospective data analysis; a core observation was about 5 occupations/year of the NH Line during all seasons from 1997 to 2004 for collection of physical, chemical and biological observations.

Since 2004, autonomous gliders began routine year-round crossings of the shelf to deep water with near continuous coverage of variables that could be measured (T, S, DO), but biological sampling continued biweekly by NOAA using the R/V Elakha, a more capable 45 ft nearshore vessel. More recently, a cabled observatory has been installed off Newport for continuous collection of some oceanographic data types, including real time reporting from moorings.

The NH Line fills a gap between much longer time series sites both north (Line P off southern Vancouver Island) and south (CalCOFI, in the southern California Bight). Significantly, the NH line is the only one that provides biweekly to monthly sampling useful for analysis of within year upwelling, El Niño/La Niña events and PDO variability. The time series sites from southern Canada to California enable regional comparisons. Many papers have been published. More than 32 papers have been published about the zooplankton dataset time series collected since 1969.

Information (zooplankton composition; biodiversity; ichthyoplankton biomass, temperature, salinity) collected from the NH Line and linked with broader scale indicators provides a basis for assessment of coho and Chinook salmon recruitment one and two years in advance, respectively. The approach is simple and understood by managers and clients. The Oregon shelf system is highly seasonal, with summertime near bottom hypoxia becoming more severe in recent decades. The NH Line provides time series to examine trends in the nearshore ocean and for other needs, including training of young scientists.

Since 1967 and through today, research and data derived from the NH Line have been integral to more than 120 publications. Bill Peterson of NOAA was the one constant in maintaining the NH Line since 1996. Others have been involved in various capacities in sampling the NH Line, including June Patullo, who started the sampling of the NH Line in 1961 during TENOC. The logical person to accept this award is Bill Peterson of the Northwest Fisheries Science Center of NOAA, as he was the hero and the driving force behind the sampling of this valuable time series program. Unfortunately, Bill passed away on August 12 last month, and to remember him I ask you to bow your heads for a minute of silence to honor Bill for his dedication to the NH Line, to ocean science more generally, and to mentoring young oceanographers.

A slide show of the NH Line nomination nomination can be viewed [here](#).



Dr. Chul Park, left, and Dr. Hiroaki Saito posing with the 2017 POMA certificate and plaque dedicated to the Newport Hydrographic Line (NH Line).

PICES Ocean Monitoring Service Award recipients

- 2008 T/S *Oshoro-maru* (Japan)
- 2009 Dr. Bernard Megrey and Mr. Allen Macklin, leaders of the PICES Metadata Federation Project (USA)
- 2010 Station P/Line P Monitoring Program (Canada)
- 2011 Network of Serial Oceanographic Observations (Korea)
- 2012 California Cooperative Fisheries Investigations (USA)
- 2013 A-line Monitoring Program (Japan)
- 2014 Trans-Pacific Volunteer Observing Ship (VOS) Survey Program (Japan)
- 2015 TINRO-Centre Macrofauna Inventory (Russia)
- 2016 JMA 137°E Repeat Hydrographic Section (Japan)
- 2017 Newport Hydrographic Line (USA)

We congratulate the 2017 Award recipients, Dr. Suam Kim (Wooster Award), and Bill Peterson’s colleagues (POMA) for the Newport Hydrographic Line.

Call for Wooster Award, POMA, and PICES Chair Award nominations for PICES-2018

We are now soliciting nominations for the [Wooster Award](#) and the [PICES Ocean Monitoring Service Award](#). The closing date for Wooster Award and POMA nominations is **March 31, 2018**. Closing date for the [PICES Chair Award](#) is **July 30, 2018**. The awards will be presented during the Opening Session of PICES-2018 in Yokohama, Japan.

Send your nominations to the PICES [Executive Secretary](#) with the following information:

- nominee’s name and title,
- institution affiliation and address,
- CV, and
- statement of justification for the nomination.

Capacity building: PICES scientists reach out to the next generation of oceanographers in Vladivostok

by Harold (Hal) Batchelder

In a similar vein to the very successful visits by PICES scientists to grammar, middle and high schools during PICES-2015 in Qingdao, China, another set of lectures was given by scientists volunteering their time at two venues: one at the same location as the Annual Meeting – the Far Eastern Federal University (FEFU) on Russkyi Island campus – and one in downtown Vladivostok at the International Linguistics School. Lectures were geared towards two different cohorts.

To minimize speaker conflicts with PICES sessions, it was clear that the best option for public lectures for both events was after lunch on the Thursday of the Annual Meeting.

Once we knew when these lectures were needed, I worked with others at the meeting, especially Dr. Igor Shevchenko (TINRO-Center) to contact scientists who did not have presentation conflicts during Thursday afternoon. It was easy to recruit volunteers for these classroom lectures, as we had done similar outreach for three schools in Qingdao, China during the Annual Meeting in 2015. Interest then was so great that we had to decline a number of volunteers (see [page 11](#) in the 2016 winter issue of PICES Press (Vol. 24, No. 1). For the undergraduate lectures at FEFU, the three speakers were Dr. Steven Bograd (Co-Chair of the PICES Scientific Program on Forecasting and Understanding Trends, Uncertainty and Responses of North Pacific Marine Ecosystems “FUTURE” SSC), Mr. Peter Chandler (Co-Chair of the Working Group on the *Third North Pacific Ecosystem Status Report*), and Dr. Ryan Rykaczewski (FUTURE-SSC member, and Co-Chair (CLIVAR) of the Working Group on *Climate and Ecosystem Predictability*). Presenting at the International Linguistic School were Professor Emanuele Di Lorenzo (Chair of the Physical Oceanography and Climate Committee and Vice-Chair of PICES Science Board), Professor Keith Criddle (Chair of the Human Dimension Committee), and Dr. Thomas Therriault (Acting Co-Chair of the Advisory Panel on *Marine Non-indigenous Species* and Vice-Chair of the Marine Environmental Quality Committee).

The sequence of talks at FEFU began with Dr. Bograd introducing the audience to PICES, and then asking the question that was posed by Professor Warren Wooster (principal founder of PICES) in 1992 at the very first Annual Meeting, “*What is the nature of the subarctic Pacific ecosystem (or ecosystems) and how is it affected over periods of months to centuries by changes in the physical environment, by interactions of components of the ecosystem, and by human activities.*” Steven described the

early years of PICES, and provided details about its first integrative science initiative, the Climate Change and Carrying Capacity (CCCC) program, which lasted 15 years and focused on understanding how climate change and variability impact the structure of ecosystem, and the productivity at many trophic levels.

Steven then described the structure and components of PICES’ second integrative science program, FUTURE, where science investigation occurs in multiple independent working groups that have clear terms of reference and usual durations of 3 years, in contrast to the CCCC structure which had task teams with broad mandates for investigation and greatly extended durations.

Peter Chandler spoke next and presented the rationale and approach that PICES is using to produce a third version of the North Pacific Ecosystem Status Report (NPESR), which is one of the highest priority activities of PICES. He started by reviewing the process that was used to produce two earlier NPESR reports (which focused on conditions in increments of about 5 years, 1997–2002, 2003–2008). He noted that the basic approach of preparing the NPESR3 is similar to that used for the first two, but with an emphasis on collecting Environmental Time Series Observations (ETSOs) through an electronic submission process in advance of compiling the report. Submissions could be data, or graphical representations of data and are submitted with geographical coordinates and linked to one or more of the regional ecosystems defined in the report. As with the two previous versions, the important elements of NPESR3 are to (1) identify critical factors that cause changes in each of the 15 regional ecosystems of the North Pacific, and (2) to identify key questions and critical data gaps that inhibit regional understanding of cause and effect.



Steven Bograd checking slides before presenting to FEFU undergrad students.



(Top) Peter Chandler explaining PICES’ third version of the North Pacific Ecosystem Report, (middle) Ryan Rykaczewski listening to feedback during his lecture, (bottom) Igor Shevchenko (TINRO-Center) checking setup for presentations with FEFU students.

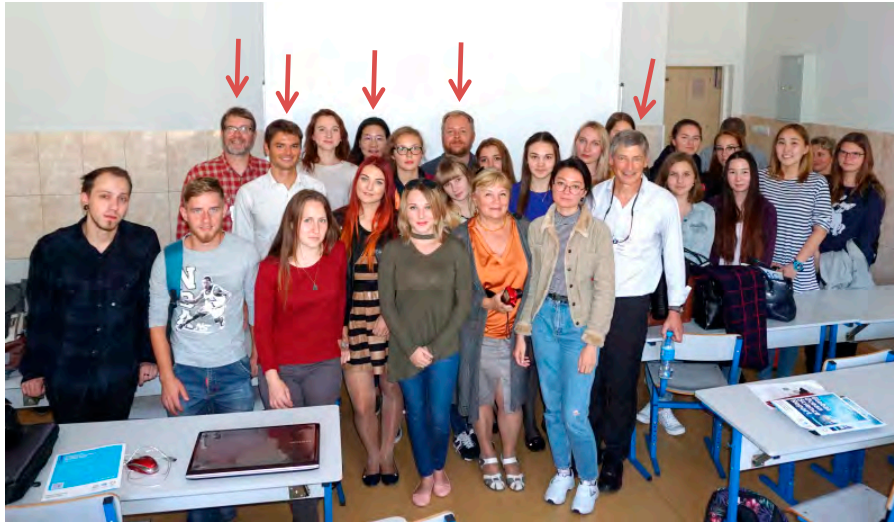
Peter went on to explain that for each regional ecosystem, there will be a lead author working with other contributing authors to summarize the status and, if possible, the changes or trends in individual ecosystem components (e.g., phytoplankton biomass, zooplankton composition and biomass, fish abundance, birds, mammals, pollutants, contaminants, etc.). After the regional reports have been written, reviewed externally, and revised, there will be a

Synthesis Workshop in the summer of 2018 to discuss the strategy for writing the basin-wide assessment of ecosystem status and changes in the North Pacific, from 2009–2014.

One student was interested in knowing how long the process of producing the ecosystem report would take, and when asked what she thought responded “about 5 years”. Appreciating the student’s thoughtful evaluation, Peter went on to explain that the lead authors started working on the Regional Assessments last summer and the plan was to have these reviewed and revised by February 2018, and to hold the Synthesis Workshop at least two months prior to the PICES Annual Meeting in October!

Publication of the regional chapters and synthesis overview are expected to be completed in late spring 2019. If that timeline is met, the time from implementing the new ETSO-based strategy and completing the regional and synthesis reports will be two years, which is not unreasonably long. Considering that many ETSOs spanning 2009 (or earlier) to 2014/15 will have been submitted and archived, subsequent updates of ETSOs might occur more regularly, which will aid in the delivery 5 years later of the NPESR4.

The final PICES speaker was Ryan Rykaczewski who started his talk by speaking in Russian, which delighted his audience but surprised me, as I was unaware that he spoke the language. After a few remarks, he switched to English for the remainder of his talk titled “Using numerical models and ecological relationships to predict future changes in fisheries”. This was a hope of both the CCC program (which was unable to make reliable forecasts of future ecosystem conditions) and of the current FUTURE program, for which the jury is still out on this objective. Ryan is involved in the PICES Working Group on *Climate and Ecosystem Predictability* (WG 40), which reports to FUTURE, and which hopefully will provide some reliable and verifiable short-term to decadal forecasts of ecosystem conditions based on the physical patterns and intensities of the ocean and atmosphere. This expert group includes international partners from other marine science programs or organizations—thus is a truly international effort to predict future marine ecosystems. The overall goal of the Working Group is to identify, diagnose and quantify predictable responses in North Pacific marine ecosystems that arise from regional-scale and large-scale climate processes. Predictions might be on changes in the size or distribution of populations of fish, seabirds and whales. Ryan took a few questions from the audience, some studious, but most of which were about how he learned to speak Russian.



From left, marked by arrows: Drs. Steven Bograd, Ryan Rykaczewski, (backups Sukyung Kang and Elliott Hazen), and Peter Chandler with FEFU undergrad students and their professor (front, centre).

Meanwhile, in the city, the International Linguistics School (ILS) gave a warm welcome to Drs. Criddle, Therriault, and Di Lorenzo. ILS is a pre-university school for students from grades 7 to 12 who are pursuing an International Baccalaureate. With this in mind, Drs. Criddle, Therriault, and Di Lorenzo needed to make some quick adjustments to their presentations. Keith, realizing he would be speaking to 12-year-olds rather than to university students, jettisoned his planned presentation (a modified version of his Science Board Symposium talk – *Durable entitlements and resilience in fishery social ecological systems*) and, instead, delivered a presentation on the common-pool resource dilemma using a case study of Lake Rudragasagar in Tripura, a sub-Himalayan state in northeast India. The 240-ha floodplain lake supports 40,000 households engaged in fisheries, aquaculture, agriculture, brick-making, and tourism services. Keith talked to the students about conflicts between user groups that imperil fish resources – expansion of agriculture through landfill (the lake was over 2,000-ha in 1947), eutrophication driven by nutrients from agricultural runoff and sewage, and overharvest. He used a Socratic learning approach – asking students to suggest ways to prevent an overharvest of fish stocks and preserve economic opportunity for fishery-dependent households. This led to active discussion with students on various management approaches and identifying shortcomings of those approaches. He provided examples from world fisheries where their suggestions had been applied and described the outcomes in those fisheries. Most of the students were attentive but only four or five were comfortable responding to his questions, although many more of their peers gave them ideas to share with him.

Keith found his audience to be a bright and engaging group. In give and take with them, Keith and the students explored the tragedy of open access fisheries, the advantages and disadvantages of limited entry, cooperative management regimes, and individual quotas, the impact of

technological change (increased gear efficiency), competition between common-pool fisheries and aquaculture, the effects of expanding populations, and the challenges of economic development in impoverished regions. Keith had fun in conversing with the students and they were able to gain an appreciation for some of the social and economic dimensions of fisheries and how those dimensions interface with ecological and environmental dimensions.



Keith Criddle in front of an attentive audience. Photo credits: International Linguistics School

Dr. Therriault also recognized that the intended audience was slightly younger than initially expected in the car ride to the school when it was confirmed the class he would be presenting to were 13- to 14-year olds. Luckily, he had a very graphic-laden presentation based on work that he had conducted as part of the PICES [ADRIFT \(Assessing the Debris-Related Impacts From Tsunami\) project](#). Tom first introduced the students to the issue of marine non-indigenous species and why countries are concerned, highlighting the role ships have played in re-distributing species around the world by pointing out examples visible from the classroom in Vladivostok harbour. He then explained the transport of Japanese species to North America and Hawaii *via* the catastrophic tsunami that

occurred in March 2011 following the Great East Japan Earthquake. Since a major goal of the ADRIFT project was to highlight potential risky species, Tom provided a number of examples of these and discussed each with the students. It was amazing how many of the students recognized these marine invaders, including ones that are native to Russian waters and others that are not. Overall, the audience was quite involved and willing to interact even though the subject matter might have been completely new to them. Tom found it quite rewarding and fun to engage with a much younger audience, one that is now familiar with some the threats non-indigenous species pose to North Pacific marine ecosystems and the societies that depend on them.



Tom Therriault during his lecture. Photo credits: International Linguistics School

Dr. Di Lorenzo presented a lecture on the impact of global climate change on the acidification of the oceans to about 100 students between the ages of 10–14. He explained how the carbon dioxide emitted in the atmosphere by human activities dissolves in ocean water lowering the pH of sea water (e.g., making the water more acidic). To further demonstrate this concept, the students participated in a live experiment in class. Manu passed around two vials of sea water, one containing acid (e.g., low pH) and the other regular sea water with a neutral pH. The students then took bivalve shells and inserted them into the vials to observe how the acid solution made the shell dissolve very fast.

This experiment helped to demonstrate how ocean acidification associated with a high level of carbon dioxide in the atmosphere contributes to the dissolution of the shell or skeleton of marine organisms. The students were quite engaged throughout the lecture and asked several questions.

“We are very pleased that the series of lectures was opened by serious scientists whose research makes a real contribution to improving the ocean waters and their inhabitants”, said Dr. Olga Shevchenko, Director of the International Linguistic School. She also remarked that the lectures managed to successfully combine both the acquisition of new knowledge and communication in English.

The students of the Far Eastern Federal University and the International Linguistics School were both very appreciative of PICES enthusiasm in delivering ocean science talks that provided a broader global perspective about activities, issues and concerns in the North Pacific Ocean. In all, a very good day for PICES scientists and the next generation of potential Russian oceanographers.

PICES is appreciative of the enthusiastic support for these lectures and for their arrangements by TINRO-Center and ILS.



Manu Di Lorenzo watching students perform an ocean acidification experiment. Photo credits: International Linguistics School.



Drs. Emanuele Di Lorenzo (holding the bag) and Keith Criddle, and Thomas Therriault (directly behind) with some of the students of the International Linguistics School in Vladivostok. ILS Director, Dr. Olga Shevchenko, is in front far right, and Ms. Ekaterina Kurilova (TINRO-Center, Khabarovsk Branch), assisting with PICES logistics, is to the left of Dr. Di Lorenzo. Photo credits: International Linguistics School.

A MONITOR/TCODE Workshop on “*The role of the northern Bering Sea in modulating the Arctic II: International interdisciplinary collaboration*”

by Matthew Baker, Kirill Kivva and Lisa Eisner

The northern Bering Sea is at the confluence of the North Pacific and Arctic Ocean. Physical processes in the northern Bering Sea link currents, productivity regimes, and species distributions and interactions in the North Pacific ecosystems and the Arctic. The processes in this dynamic region influence the state and ecosystem structure in the southern Chukchi Sea as well as flow and advection in the Arctic overall. While the Pacific Arctic region has received great attention during the past few years, scientific efforts in the Northern Bering–Southern Chukchi Sea region are mostly conducted at the national level. International collaboration and data integration remain limited. This workshop (W1), held on September 23 at PICES-2017 in Vladivostok, Russia, served as the second of two consecutive workshops to bring together researchers representing different scientific programs to synthesize knowledge, share analyses and data, and discuss opportunities for cooperation at the international level. The workshop built on themes addressed in a PICES-2016 workshop.

The workshop served to:

- 1) Inform participants and the greater research community on research developments, data access, completed and ongoing analyses, and future activities related to oceanographic and fisheries research in the region;
- 2) Share and disseminate results, provide access to past and ongoing analyses to facilitate broader citation of this work, and encourage collaboration among researchers of various institutional affiliations and national origins;
- 3) Provide information on a new data sharing platform and framework to facilitate future research collaboration and sharing of data, publications, and analyses;
- 4) Identify opportunities for collaboration (concrete initiatives) as well as discuss opportunities to facilitate data sharing and limitations to data sharing

The workshop included invited talks followed by individual researcher reports and discussion on the following themes:

- 1) Physical environment and chemical fluxes,
- 2) Plankton distribution and dynamics,
- 3) Fish populations and dynamics,
- 4) Recent modeling efforts in the region.

In the afternoon, a presentation was provided with information on a new data-sharing platform that allow interested participants to share published manuscripts, completed analyses and data in a password-protected online portal. This online platform is intended to archive relevant

information, serve as a contact base and communications system for interested researchers and, where appropriate, to allow researchers to share data and analyses and collaborate across national or institutional lines. This may also serve as a repository for materials that might be translated and shared to broader audiences.

Participants were asked to arrive at the workshop prepared to:

- 1) List identified publications, reports, and analyses appropriate to the region and available to share;
- 2) Identify new data, new analyses, new participants, and new research to include in this process;
- 3) Strategize specific opportunities for further data integration and coordinated analysis;
- 4) Determine opportunities for collaborative research.

Participants were asked to identify materials for inclusion in this online sharing portal and to contribute to a discussion on how to leverage this platform and coordinate collaborative research in the region. Suitable materials include published analyses and manuscripts, available public data and metadata, and potential new data streams including satellite observations, glider and mooring data, oceanographic cruise data, bottom, midwater, and surface trawl data, acoustic surveys, and bathymetric and multibeam data. The platform remains accessible and is intended to serve as a longstanding archive and forum for data exchange and collaboration.

This workshop and associated activities are intended to increase collaboration and build linkages and synergies among scientists and researchers on both sides of the northern Bering and Chukchi seas as well as among a diverse suite of national and international research efforts operating in this region. Data and results will be integrated with efforts relevant to the PICES-coordinated Third North Pacific Ecosystem Status Report. Results will be summarized in a report in PICES Press and, where appropriate, be made available to ongoing research efforts in the region. This workshop was supported by the North Pacific Marine Science Organization (PICES) and North Pacific Research Board (NPRB). The results of this workshop are relevant to PICES committees and expert groups including MONITOR, POC, BIO, FIS, TCODE, and S-CCME.



Photo: Jim Thompson

Kirill Kivva provided an introduction to the workshop and welcomed participants. Kirill provided an overview of the agenda and the intent of the afternoon discussions.

Maria Pisareva (Polar Oceanography Group, P.P. Shirshov Institute of Oceanology (IO) RAS, Russia) provided the first invited talk, entitled “*Flow of Pacific Water in the Chukchi Sea: Results from RUSALCA expeditions*” focused on Chukchi Sea circulation patterns and water masses, atmospheric forcing, conditions in the Bering Strait and the current state of the RUSALCA program. The talk introduced the Chukchi Sea as an important transition zone for Pacific water and Pacific summer water as a source of heat in the Pacific Arctic and a source of freshwater in the Beaufort Gyre, whereas Pacific winter water provides a source of nutrients in the Pacific Arctic and ventilates the halocline. Maria also introduced data station and transect information from the SBI and ICESCAPE programs as well as the 12 biophysical cruises and mooring deployments conducted by RUSALCA (www.arctic.noaa.gov/rusalca/; Figs. 1 and 2). Her talk discussed the current patterns, variation in water masses, wind stress and model outputs from a MITgcm primitive equation model.

Data and papers are available at the following sites:

<https://www.pmel.noaa.gov/rusalca>

<https://workspace.aos.org>

<https://rpickart.who.edu>

<https://psc.apl.washington.edu/HLD/Bstrait/bstrait.html>

The second invited speaker, Zhixuan Feng at the Woods Hole Oceanographic Institution, USA, was unable to participate in the conference. His research is focused on coupled hydrodynamic–ecological modelling in the northern Bering and Chukchi seas and his talk was entitled: “*Modeling the sympagic-pelagic-benthic coupling processes in the St. Lawrence Island Polynya region, northern Bering Sea*”.

Matthew Baker, presented recent research conducted with NOAA, entitled, “*Visualization of species distribution patterns in warm and cold phases to understand the transition between subarctic and arctic systems*”. His analysis used a series of successive multi-year warm and cold phases to provide insight on how individual species respond to climate forcing and how species might respond to directional shifts in climate (Fig. 3). The results

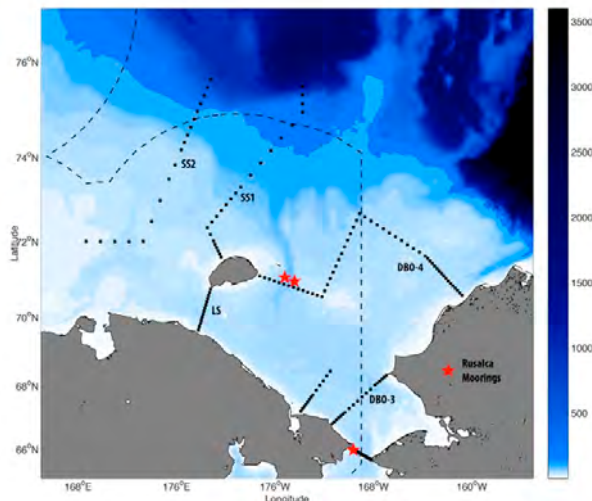


Fig. 1 Prospective RUSALCA cruises in the future.

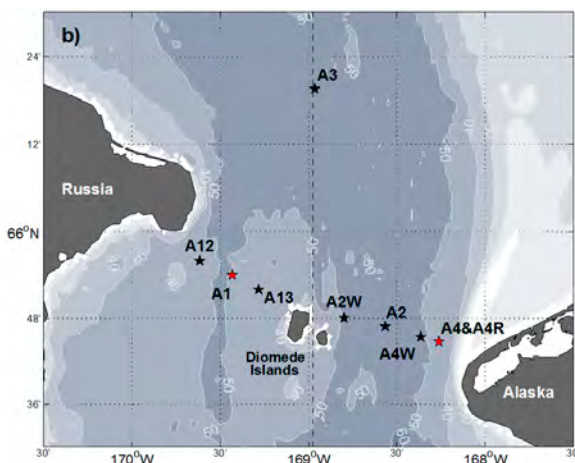


Fig. 2 Moorings deployed in the Bering Strait.

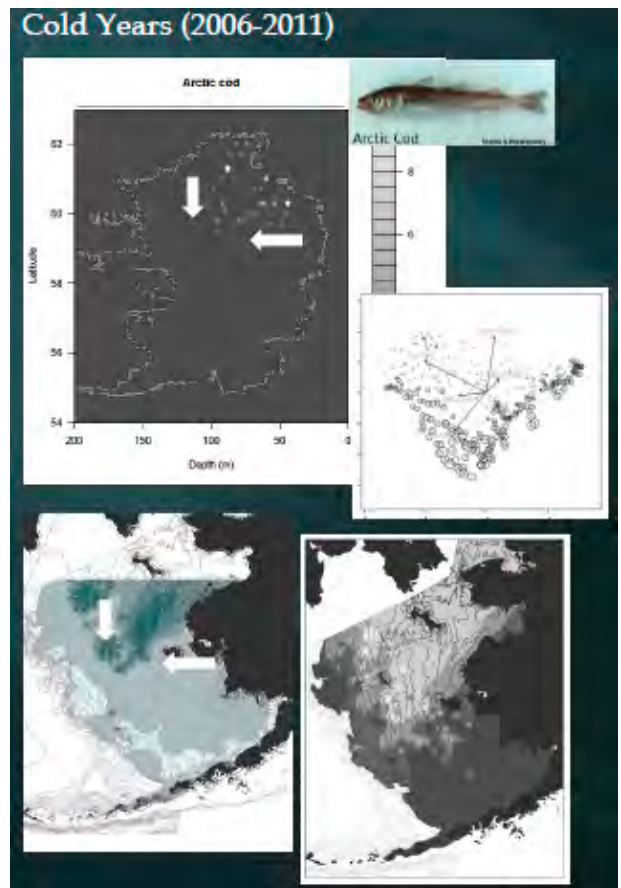


Fig. 3 Distribution and movement of Arctic cod in warm versus cold periods using survey data and extended forest models. Top graph shows direction of movement across latitude and depth gradients, inset show biplot of Arctic cod relative to physical gradients within the system and lower plot show relative abundance (lower left) and CV of abundance (lower right)

contrasted community variance and distribution patterns in demersal and pelagic piscivores, planktivores and benthivores to inform late summer biogeography in the eastern Bering Sea and northern Bering Sea, with a particular focus on movement and distribution patterns in warm (2000–2005) and cold (2006–2011) years.

As the Science Director for the North Pacific Research Board, Matthew Baker presented two talks, one on each component of the NPRB Arctic Program. The first was on Arctic Shelf Growth Advection, Respiration and Deposition, detailing survey data from June 2017 in the northern Bering and southern Chukchi region (Fig. 4). The survey included 26 scientists and covered 2,700 nautical miles, 120 bongo and vertical net tows for zooplankton abundance biomass and distribution, several 10-day onboard incubation, egg production and respiration experiments, results of demersal fish and epibenthic community biomass and abundance through beam trawls and pelagic midwater trawls, and multicore deployments to examine macro and meiofauna, chlorophyll and organic matter deposition, environmental DNA and sediment. Microzooplankton and phytoplankton were identified through FlowCam and flow cytometry analysis and experiments for microzooplankton grazing, total and size fractionated primary productivity were conducted. Samples were also collected for lipid and fatty acid analyses of phytoplankton and zooplankton. Hydrography was surveyed through 172 CTD water column profiles including water samples for nutrients and chlorophyll, 20 days of continuous measurements using a thermosalinograph, multibeam seafloor mapping and the deployment of six moorings.

Highlights of these results included:

Heat

- Early ice retreat, indications of an unusually warm year,
- Near-bottom temperatures were 5 standard deviations higher than the long-term mean,
- Surface waters off the Yukon River were 11–12°C.

Nutrient distributions

- More nitrate was found in near-surface waters,
- Nitrate available to fuel surface phytoplankton blooms.

Neocalanus copepods

- Higher densities than expected were observed,
- Possibly play a bigger role than previously appreciated.

Higher trophic levels

- Early arrival for sub-arctic marine mammals,
- Larval Arctic cod were present in coastal waters, especially at stations with ice melt signals,
- Low catches of older Arctic cod,
- Saffron cod were only caught on the southernmost survey line,
- More dead birds (murre, northern fulmar) than usual.

The second component of the NPRB program is the Arctic Integrated Ecosystem Studies project (Fig. 5), which conducted a summer survey in the Chukchi and Beaufort seas. Matthew Baker presented a talk developed by Ed Farley and Lisa Eisner on the survey and data collected in the northern Bering Sea in 2007 and in the Chukchi Sea in 2003, 2007, 2012, 2013 and 2017. The 2017 research effort featured extensive collaboration with Russian scientists and included Igor Grigorov (VNIRO, Moscow) and Alexey Somov and Natalia Kuznetsova (TINRO, Vladivostok). Russian collaboration focused primarily on Juday net sample processing for fish diet and fish identification.

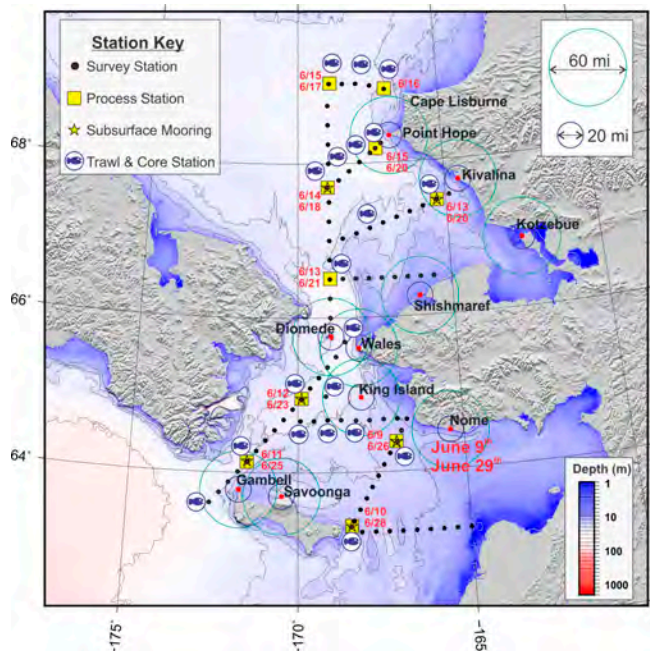


Fig. 4 NPRB Arctic Integrated Ecosystem Research Program process and survey stations, and moorings, June 2017

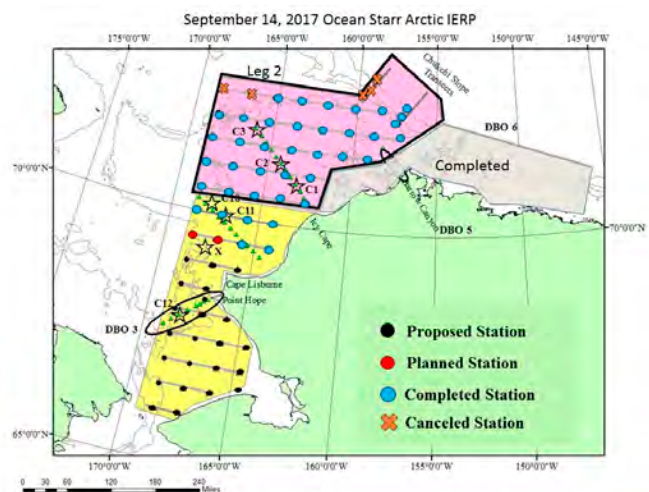


Fig. 5 NPRB Arctic Integrated Ecosystem Research Program stations, transects, August–September 2017.

Oceanographic hydrographic sampling included CTD casts for temperature, salinity, fluorescence, light, oxygen and Niskin water bottle sampling for nutrients, chlorophyll, phytoplankton production and microzooplankton. Zooplankton and ichthyoplankton were collected using Bongo and Juday nets. Large phytoplankton species were identified using a FlowCam (flow-through microscope with camera) and small phytoplankton with flow cytometry. Beam trawls were deployed to quantify fish and epibenthic community abundance and distribution. Acoustic trawl surveys were also conducted and three echosounder moorings were deployed to examine year-round distribution of Arctic cod. Seabird and marine mammal observations were also conducted.

Highlights of these results include:

- Increased sea temperatures and open water during summer months may increase phytoplankton and zooplankton abundance in the water column as a potential benefit to Bowhead whales and other zooplankton consumers.
- Loss of sea ice and warming summer sea temperatures could have a negative effect on Arctic cod and capelin, but a potential positive effect on saffron cod and Pacific salmon (depending on habitat usage). It is uncertain if there will be an impact to Beluga whales or others relying on fish for food.
- Pacific cod and walleye pollock are not expected to move north into the Arctic in the near future due to winter/spring sea ice cover in the northern Bering Sea and resulting “cold pool” of bottom water during summer.

More information and hundreds of social media postings are available at <https://blog.arctic.nprb.org>.

Kirill Kivva (Russian Federal Research Institute of Fisheries and Oceanography (VNIRO)) presented a talk on “Nutrient fields in the Bering Sea: available data and results”. Kirill integrated data from multiple sources including:

- WOD’13 (NODC, USA),
- JAMSTEC (R/V *Mirai*, Japan),
- BEST/BSIERP (USA)
- TINRO-Center (R/V *TINRO*, R/V *Kaganovsky* Russia),
- Hokkaido U. (R/V *Oshoro Maru*, Japan),
- BASIS (NOAA, USA).

The approach was to apply data collection methods in Ocean Data View [https://odv.awi.de/] and a global geodetic grid creation with package dggridR [https://github.com/r-barnes/dggridR] to arrange data in an Icosahedral Snyder Equal Area Aperture 3 Hexagonal Grid. Spatio-temporal averaging with Gaussian weighting function and truncation radius of 100 km was applied to fill the spatial and temporal gaps in data and results were schematically visualized (Fig. 6). As an example, Kirill presented a multiyear mean seasonal cycle of silicate for

three grid cells. In general, this approach was highlighted as a synergetic way to combine data and a potential approach for other data analysis.

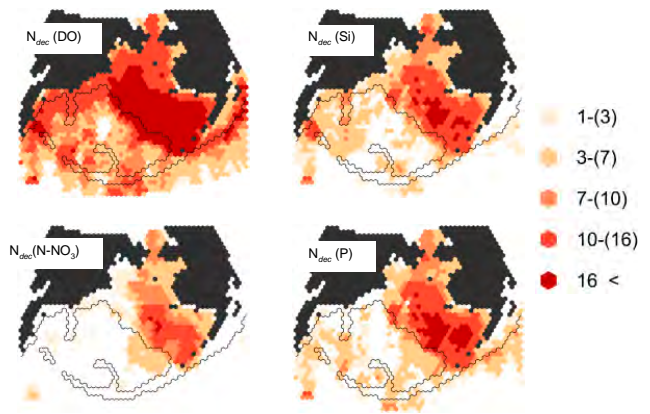


Fig. 6 Spatial data distribution: number of decades with data that entails >3 stations.

An online data portal and data sharing platform has been developed. Matthew Baker presented this platform, which is maintained by the North Pacific Research Board (Fig. 7). The intent is to serve as a repository for manuscript, datasets and contacts related to research in this region. Data relevant to the NPRB Arctic Integrated Ecosystem Research Program will be archived here as well as other relevant information and publications. Interested researchers are able to develop a profile and access and contribute to this [data repository](#).

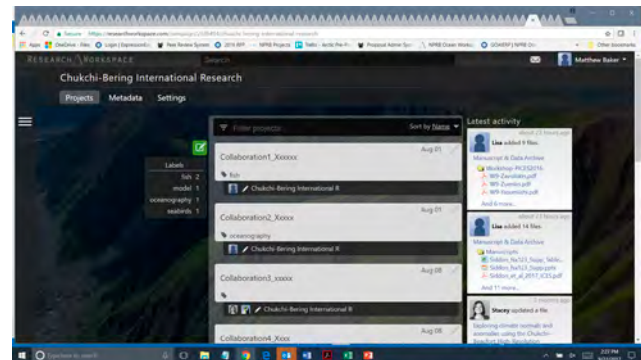


Fig. 7 Online data portal and collaborative platform for data and information sharing, exchange and analysis.

Data that is publicly available in the region includes: the Distributed Biological Observatory, Russian-American Longterm Census of the Arctic, Loss of Sea Ice program and Arctic Environmental Survey ASGAARD under the NPRB Arctic Integrated Ecosystem Research Program

For those interested in developing and maintaining ongoing collaborations, this site will also serve as a password protected repository for communication and data exchange among smaller groups of researchers. More information is available at NPRB, contact Matthew Baker

(Matthew.Baker@nprb.org) or Axiom Data Science, contact Will Koeppen (will@axiomdatascience.com) or Stacey Buckelew (stacey@axiomalaska.com). The site can be used to create projects, load data, invite collaborators, and can be used for demonstration purposes. Within the site, there are a couple of options for setting collaborator permissions. The most straightforward is to create projects within the site that are shared with all site members. Information for new members can be found at [#create-a-new-campaign](https://workspace.aos.org/help/ManagingCampaigns.html#create-a-new-campaign) and information about creating projects within the site can be found at <https://workspace.aos.org/help/ManagingProjects.html>.

In the afternoon, workshop discussions considered the following:

- List of new data, analysis and research,
- Discussion on limitations to data sharing,
- Discussion on opportunities for collaboration,
- Specific opportunities for further data integration.

Among the ideas discussed was the current US–Russia Research Coordination in the Arctic within the Intergovernmental Consultative Committee (ICC). More details are provided below on this exchange and collaboration:

- *Objectives:* Conduct a cooperative research program consisting of surveys and other ecosystem research activities to understand regional structure, function and ecology of indicator species of the northern Bering Sea and Chukchi Sea.
- *Areas:* Waters of the northern Bering Sea through Bering Strait and into the Chukchi Sea to the northern

extent of the respective EEZs of the Russian Federation and the U.S.

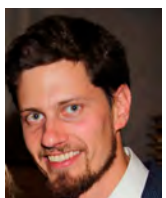
- *Species of interest:* Arctic cod, saffron cod, snow crab, Pacific salmon, capelin, and herring
- *Cruises:* Provide national plans for research in the northern Bering Sea and Chukchi Sea and coordinate research cruises for the years 2017–2019 to collect data and samples on the oceanography and key ecosystem components. Allow for collaborative exchange of scientific personnel to take part in surveys.
- *Data Management and Exchange:* Provide for formal exchange of samples and data collected during the surveys as much as possible.
- *Source:* 2016 US–Russia: A proposal for coordinated research in the Arctic within the ICC forum.



Bottom trawl samples of epibenthic communities in the northern Bering Sea.



Dr. Matthew Baker (Matthew.Baker@nprb.org) is the Science Director at the North Pacific Research Board and lecturer at the University of Washington Friday Harbor Laboratories. His research focuses on forage fish dynamics, habitat mapping and model development, and using analyses of biophysical interactions to parameterize multispecies models. Matt serves on the Steering Committee of the Arctic Integrated Ecosystem Research Program in the northern Bering and Chukchi seas. He formerly worked at the NOAA Alaska Fisheries Science Center and was a researcher in the NPRB/NSF Bering Sea Project. Within PICES he is a member of the Working Group on Third North Pacific Ecosystem Status Report (WG-NPESR3).



Dr. Kirill Kivva (Kirill.Kivva@gmail.com) is a Research Associate at the Federal State Unitary Enterprise Russian Research Institute of Fisheries and Oceanography (VNIRO). His expertise includes physical and chemical oceanography. His research focuses on hydrological structure and hydrochemical investigations in the Bering Sea, Sea of Okhotsk and Caspian Sea.



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

New leadership in PICES

Fishery Science Committee

At PICES-2017, Dr. Xianshi Jin (China) was elected Chair of the Fishery Science Committee (FIS), taking over from Dr. Elizabeth (Libby) Logerwell (USA) who completed two terms as FIS Chair. PICES extends its gratitude to Dr. Logerwell for her dedicated and competent service as FIS Chair since 2011. She will continue to contribute to PICES as a member of FIS.



Dr. Xianshi Jin is a senior fisheries biologist and general Director of the Yellow Sea Fisheries Research Institute, Chinese Academy of Fishery Science (CAFS), China.

He comes from the city that is the center of marine science and technology—Qingdao, China—and where three PICES

Annual Meetings have taken place. Dr. Jin attended his first PICES Annual Meeting as a doctoral student in 1995, when it was held in Qingdao. In 1996 he received his Ph.D. from the University of Bergen, Norway. He later became more involved in PICES activities serving as a member of FIS as well as several expert groups including CFAME, Working Group on *Ecosystem-based Management Science and its Application to the North Pacific*, PICES/ICES Working Group on *Forecasting Climate Change Impacts on Fish and Shellfish*, and the Implementation Panel Writing Team for FUTURE.

Dr. Jin's research is focused on stock assessment, fisheries ecology and fisheries management, and on long-term changes of species composition, population dynamics, stock enhancement and food web for the high trophic levels in the ecosystem of the Yellow Sea and Bohai Sea. He is active as Principal Investigator in many national and international programs and is a national fisheries science expert for China's Ministry of Agriculture. He was also one of the first candidates selected for China's New Century Talents project.

Human Dimensions Committee

At PICES-2016, the Section on Human Dimensions was disbanded and a new Scientific Committee on Human Dimensions was formed, bringing the number of Science Board Standing Committees to seven. As an ongoing administrative body, the Human Dimensions Committee (HD) is responsible to the Science Board for the planning, direction, and oversight of major themes within PICES' general scientific aims. The former Co-Chairs of the Section on Human Dimensions, Dr. Keith Criddle and Dr. Mitsutaku Makino, are now the Chair and Vice-Chair, respectively, of this permanent Standing Committee. Although Dr. Criddle is not new to PICES, we are introducing him here in his new position as HD Chair.

Dr. Keith R. Criddle is the Ted Stevens Distinguished Professor of Marine Policy at the University of Alaska Fairbanks Juneau Center for Fisheries and Ocean Sciences (2006–present).

Keith first participated in PICES in 2008 when he was invited to present a paper on the “*Management of coupled nonstationary dynamic bioeconomic systems*”. The breadth of topics considered during the sessions was interesting and he found the efforts towards interdisciplinarity very appealing. In 2011 Keith served as Co-Chair of the newly formed Section on *Human Dimensions*.

Keith is a third-generation academic (grandpa was a professor of Civil Engineering, dad was a professor of Biophysics); Keith's daughter is the fourth generation (a professor of Statistics).

Although Keith enjoyed his undergraduate work in Biological Conservation, he was unimpressed by the prescriptive policy recommendations that seemed to be predicated on omniscient, omnipotent, and selfless managers. General education electives in environmental economics suggested a more realistic perspective on the state of human knowledge, ability, and motivations. The Agricultural Economics (now Agricultural and Resource Economics) program at the University of California at Davis was, and is, noted for the strength of its training in quantitative modeling, statistics, and theoretical and applied resource economics. It was a great match for Keith's interests. His initial work was in aquaculture economics and production, and in 1989 he received his Ph.D. He then shifted to capture fisheries following a 1-year fellowship with the U.S. National Marine Fisheries Service in Seattle.

His experience includes previous appointments with the University of Alaska Fairbanks Department of Economics (1989–1998) and the Utah State University Department of Economics (1998–2006). His research explores the intersection between the natural sciences, economics, and public policy and is driven by an interest in the sustainable management of living marine resources. He directs graduate projects in bioeconomics, statistical inference, and policy analysis and teaches courses in resource and environmental economics, statistics, operations research and decision theory, fisheries law, policy analysis, and economic development for fisheries dependent communities.

Keith is a member of the National Academies Committee on Offshore Science and Assessment and previously served on the National Academies Ocean Studies Board. He has also served as president of the American Fisheries Society Socioeconomics Section and president of the Resource Modeling Association. He is an Associate Editor for *Natural Resource Modeling* and *Marine Policy*.

While most of Keith's work has focused on the bioeconomics, management, and governance of commercial

fisheries, he has also worked on subsistence and sport fisheries, aquaculture, water resource management, international trade, and management of marine debris.

Keith's research passion is personal recreational demand analysis, but sadly, funding for that important work is dependent on his household budget!



PICES Interns



We are pleased to announce that Mr. Alexey Khoruzhiy joined the Secretariat as PICES intern in August 2017. Alexey has lived in Vladivostok since childhood, and enjoys life in this beautiful seaside city very much. Upon graduating from the Far Eastern State University (now called Far Eastern

Federal University) as a biologist in 2008, he started work at TINRO-Center. In 2009 he began as a technician at the Laboratory for Applied Biocenology, but at the present time is doing research and is working on his PhD thesis titled “*The structure and compound of nekton community in upper pelagic layer of Northwestern Pacific*”. During his research he is studying composition, structure, trophic relations, and interannual and seasonal dynamics of nekton community elements, especially commercial species of fish and squids. He has taken part in several trawl surveys in the Far Eastern seas and Northwestern Pacific, collecting biological samples for analysis at the laboratory. Alexey participated in PICES Annual Meetings in 2011

(Khabarovsk), 2015 (Qingdao) and 2016 (San Diego) with poster and oral presentations. During his spare time he likes travelling out of town with his friends, hiking on the seashore and in the mountains, walking in the forest, and fishing.

We express our sincere appreciation to Mr. Minh Kang who completed his term as PICES intern in July 2017 and who returned to Busan, Korea, briefly to do some data analysis at Pukyong University before pursuing his doctorate. Minh provided valuable support in administrative activities at the Secretariat, and at PICES-2016 in San Diego, the PICES/ICES-sponsored Symposium on “*Drivers of small pelagic fish resources*” in Victoria, and at the PICES/ICES Early Career Scientist Conference in Busan. We wish him the very best in his academic career and look forward to seeing him at future PICES events.



An unusual gelatinous plankton event in the NE Pacific: The Great Pyrosome Bloom of 2017

by Richard Brodeur, Ian Perry, Jennifer Boldt, Linnea Flostrand, Moira Galbraith, Jacquelynne King, James Murphy, Keith Sakuma and Andrew Thompson

In the winter of 2016, and continuing into summer 2017, people exploring the open ocean beaches of northwestern North America were surprised and puzzled to find strange gelatinous creatures littering the shoreline. These creatures turned out to be colonies of the pelagic tunicate *Pyrosoma atlanticum* (Fig. 1). This species is common in warm open ocean waters throughout the tropics, but along the west coast of North America it has been common only as far

north as southern California, and is rarely seen north of the state. However, in the past year these tropical tunicates were highly abundant in the waters from Oregon to British Columbia, and occurred in scientific samples as far north as the Gulf of Alaska. In this report, we examine the magnitude and extent of this anomalous event in the NE Pacific, suggest possible causes, and describe some potential ecosystem implications of this bloom.



Fig. 1 A) Close-up of pyrosomes caught in the Gulf of Alaska; B) a large catch of pyrosomes from a pelagic survey off Oregon, C) pyrosomes on a beach off Oregon in November 2017, and D) medusafish (Icichthys lockingtoni,) found in the body cavity of a pyrosome caught in pelagic surveys off California.

What are pyrosomes?

Pyrosomes (Greek for “fire bodies” because of their bioluminescence) are a small group of pelagic tunicates, of which eight species in three genera have been described worldwide. They are colonial, with each colony comprising thousands of individual clones encased in a rigid gelatinous ‘tunic’ that is open at one end (Hirose *et al.*, 2001). Individuals draw water from the outside surface and release water into the hollow core of the colony. This provides the colony with a type of hydrostatic ‘skeleton’ and the means for jet propulsion. Although individual pyrosomes are small (mm in size), their colonies can reach lengths of several meters; the species of this NE Pacific event is known to reach over 80 cm in length. Colonies undertake diel vertical migrations, sometimes over 700 m depth (Anderson and Sardou, 1994), and have among the highest phytoplankton clearance rates of any zooplankton grazer (Perissinotto *et al.*, 2007). It has been suggested that internal lipid accumulation by pyrosomes is limited, with colonies instead using their food intake to drive high biomass turnover (Perissinotto *et al.*, 2007).

The 2017 Pyrosome event in the NE Pacific

Over the past three decades, *P. atlanticum* had occurred regularly in offshore midwater trawl surveys off southern California, but in 2012 there was a notable increase in their numbers coincident with large abundances of salps (another pelagic tunicate) (Wells *et al.*, 2017). While their numbers in 2013 were much reduced, pyrosome abundance dramatically increased in 2014 and 2015 resulting in them being the dominant organism collected off the shelf break of California (Sakuma *et al.*, 2016). Starting in June 2014, they occurred in pelagic trawl surveys in offshore waters of southern Oregon, moving progressively northward in the summer of 2015 and 2016, but still in waters off the shelf break. Collections were made using near-surface or midwater trawls from research surveys conducted by the National Marine Fisheries Service (NMFS), NOAA and Fisheries and Oceans Canada (DFO) from May through September of 2017 from southern California to the northern Gulf of Alaska (Fig. 2). *Pyrosoma atlanticum* was found at most sampled stations in these surveys, including high catches on the continental shelf and close to shore. Densities in some trawls were extraordinary, exceeding 60,000 kg/km³ at locations off Oregon, over 200,000 kg/km³ off Vancouver Island, and over 150 kg/km³ off SE Alaska (Fig. 2). Catches were often so high that research nets were ripped open due to the high biomass, and some stations easily sampled in previous years had to be aborted in 2017. The varying catch rates demonstrate that the distributions of pyrosomes were not continuous along the continental shelf, but that they tended to occur in clusters, possibly associated with specific oceanographic conditions (currently under investigation).

Routine plankton surveys along the continental shelf of Vancouver Island began to collect pyrosome individuals (less than 5 mm in length) and small colonies (greater than 4 cm in length) in spring and summer 2016. By February 2017, plankton surveys were catching pyrosome colonies up to 15 cm in length from the continental shelf along the west coast from Oregon to Vancouver Island. By late spring and summer 2017, the pyrosome event was in full bloom, with very high abundances and large colonies occurring from California to Alaska and into the central NE Pacific, including over open ocean seamounts.

Potential implications of this pyrosome event

The causes of this extraordinary event are unknown. Individuals may have been advected into the NE Pacific during the marine heat wave of 2014–2015 and the strong El Niño in early 2016. They may have found an environment in transition between these very warm conditions and a return to normal conditions in 2017, which provided sufficiently warm temperatures and ample food for their growth and reproduction to accelerate. The causes of this event remain under investigation but recent (November 2017) observations of small pyrosomes washing up on west coast beaches similar to those seen in the winter of 2016/2017 suggest that conditions may be favorable for another bloom in the summer of 2018 (Fig. 1).

Pyrosome colonies were visible at the surface, and coated oceanographic sampling gear and clogged fishing nets and hooks throughout this region. Substantial negative impacts have been reported on many different commercial and sport fishing operations from Oregon to SE Alaska, including salmon troll, shrimp and fish bottom trawl gear (Fig. 3A). Estimates of the economic impact of this bloom on lost or spoiled fisheries are not available but anecdotal reports suggest that they may have a substantial negative impact to coastal fisheries of the NE Pacific.

The impacts of this event to the marine ecosystems of the NE Pacific are also being studied. Such a high biomass of easily captured prey has obvious potential for marine predators and integration into the food webs of high trophic levels. However, the low accumulation of lipid stores in pyrosomes (Perissinotto *et al.*, 2007) suggests that they may be a sub-optimal prey item. Studies of pyrosomes in their normal tropical habitats show that numerous fishes, seabirds, and marine mammals can consume pyrosomes (Harbison, 1998). Fishers along the west coast of North America during the peak of this event reported finding pyrosomes in the stomachs of Pacific halibut, rockfishes, sablefish, and other demersal fish species, and in juvenile and adult Pacific salmon and other pelagic forage fishes (Brodeur *et al.*, in press). A beached fin whale in Washington State had numerous pyrosomes in its stomach (Fig. 3C). Pyrosomes have also been observed in the NE

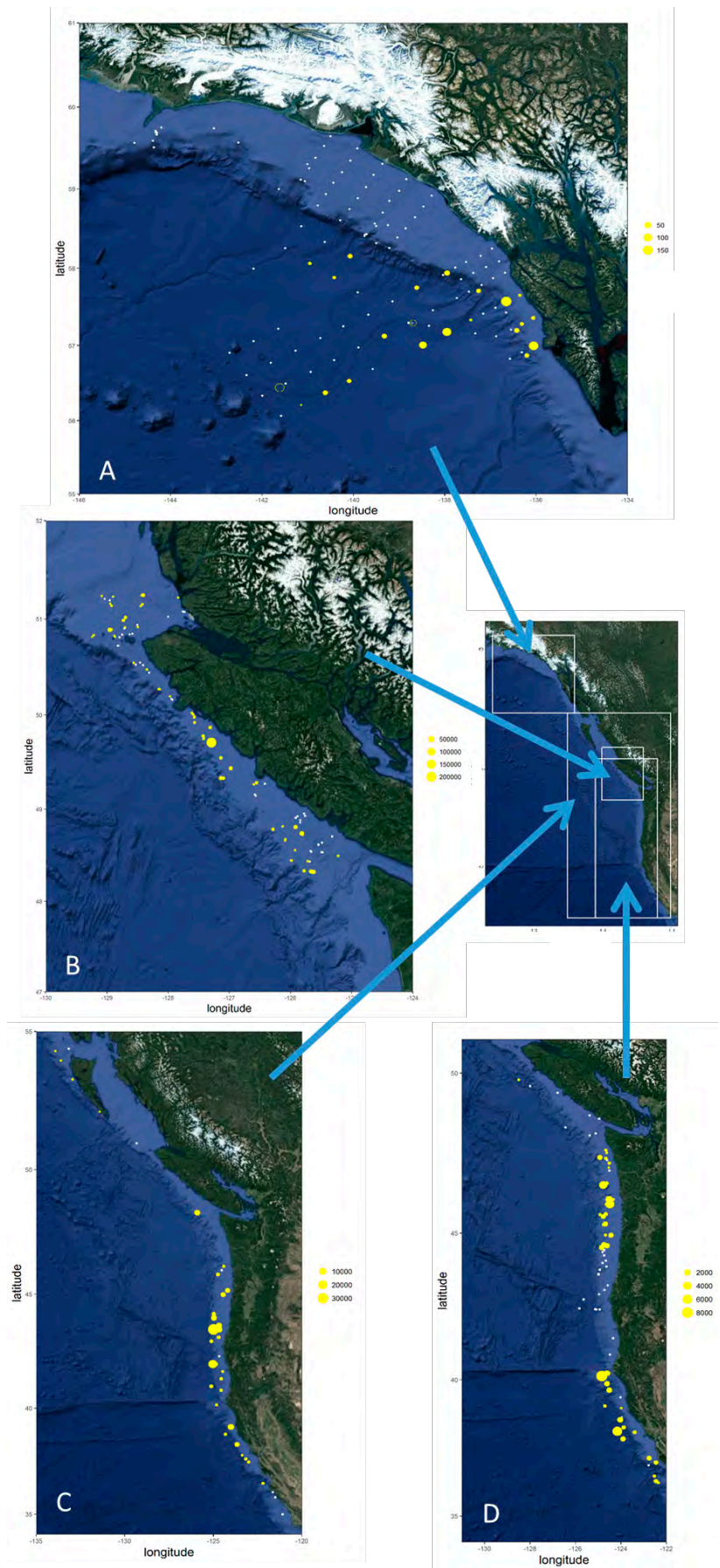


Fig. 2 Distribution and density (kg km^{-3}) of pyrosomes from A) NMFS Gulf of Alaska surveys during summer of 2017 (July 4–August 16, 2017). B) DFO integrated pelagic ecosystem survey (July 19–August 2, 2017), C) NMFS coastal pelagic fish survey (June 25–August 9), and D) NMFS coastwide Pacific hake survey (June 26–September 6, 2017; data courtesy of NWFSC FEAT group). Inset shows relative locations of the panels in the Northeast Pacific Ocean. White dots depict samples without pyrosomes and yellow circles are scaled by pyrosome density (note that the scale differs in each plot). In panel A, solid circles are from surface trawls and open circles from midwater trawls.

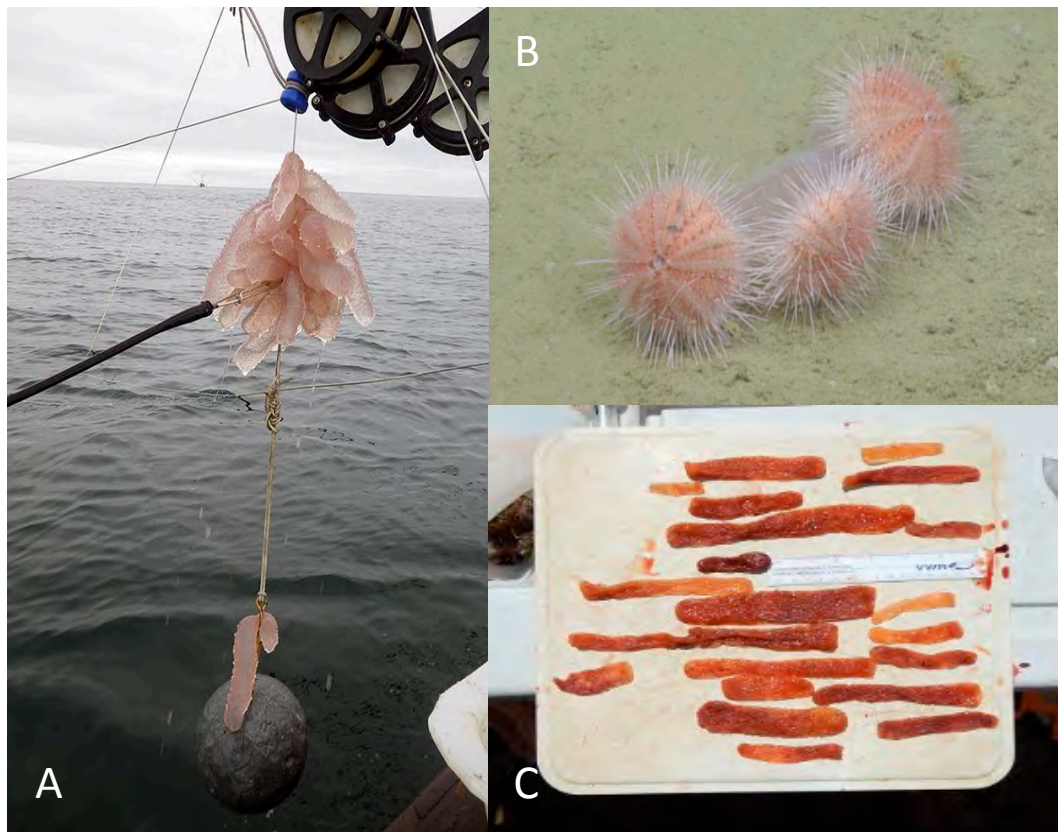


Fig. 3 A) Pyrosomes caught on salmon fishing gear off British Columbia, B) pyrosomes being consumed by sea urchins (photo taken by ROV Hercules in Quinault Canyon, off Washington State, courtesy of Ocean Exploration Trust), and C) pyrosomes taken from stomach of fin whale (courtesy Jessie Huggins, Cascadia Research, Olympia, WA).

Pacific being eaten by benthic animals such as sea anemones, crabs, sea urchins and sea stars (Archer *et al.*, in Press), even at bottom depths of several hundred meters (Fig. 3B). The impacts of these very high biomasses of pyrosomes that die and sink to the bottom, drawing down oxygen concentrations as they decompose, is unknown, but the die-off of these blooms has the potential to provide a substantial input of carbon to the benthic food web (Lebrato and Jones, 2009). An additional positive effect has been the observation that some pelagic fishes (medusafish and juvenile rockfish) have been seen living inside the tubes of pyrosomes and potentially consuming part of the pyrosomes in coastal waters (Fig. 1D), thus providing a possible pelagic refugium from predation and source of food for these fishes (Janssen and Harbison, 1981).

Previous work on the feeding of *P. atlanticum* in tropical waters has found a preference for phytoplankton cells greater than 10 μm in diameter (Perissinotto *et al.*, 2007). The diet composition of this species in the more productive coastal waters of the NE Pacific is unknown but several studies are underway to examine this. The very high filtration rates may also reduce phytoplankton biomass locally when abundances of pyrosomes are very high (Drits *et al.*, 1992), although how extensive this grazing pressure may have been in 2017, and its implications for coastal productivity during the NE Pacific event, are presently

unknown, but warrant further investigation.

Conclusions

In the past few years, anomalous ocean conditions in the NE Pacific, including the marine heat wave (Bond *et al.*, 2015; Di Lorenzo and Mantua, 2016), have been accompanied by unusual occurrences of species (Perry *et al.*, 2017). Some of these occurrences were isolated events (*e.g.*, first ever record of a Pacific angel shark in British Columbia waters in 2016; Perry *et al.*, 2017); whereas, others are broad both spatially and temporally, such as the extended toxic algae blooms and consequent marine mammal deaths in 2015 (McCabe *et al.*, 2016). The 2016-2017 bloom of pyrosomes was also a large-scale event and is expected to last into 2018. Both positive and negative impacts of the pyrosomes are expected to occur, however, the cumulative impacts of this event are not known but are presently being investigated in different laboratories along the west coast of North America. There is more to learn about how ocean conditions are linked to these events and the implications of these blooms on the trophodynamics of the Northeast Pacific marine ecosystems. Projected climate change in the coming decades may lead to anomalous events such as the pyrosome bloom becoming more common in the future, requiring continuing monitoring to assess its impacts.

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Dr. Ian Perry (Ian.Perry@dfo-mpo.gc.ca) is a Research Scientist with Fisheries and Oceans Canada at the Pacific Biological Station in Nanaimo and the Institute of Ocean Sciences in Sidney, BC. His research expertise includes the effects of the environment on finfish and invertebrates; the structure and function of marine ecosystems; ecosystem-based approaches to the management of marine resources; the human dimensions of marine ecosystem changes; and scientific leadership of international and inter-governmental programs on marine ecosystems and global change. Within PICES Ian is a member of the FUTURE Scientific Steering Committee.



Dr. Jennifer Boldt (jennifer.boldt@dfo-mpo.gc.ca) is Research Scientist with Fisheries and Oceans Canada at the Pacific Biological Station in Nanaimo, British Columbia. Her research interests are pelagic forage fish ecology, including responses to biological and environmental drivers, as well as ecosystem indicators and reporting. In PICES, she chairs the MONITOR Committee and is a member of Working Group (WG 36) on Common Ecosystem Reference Points across PICES Member Countries.



Linnea Flostrand (Linnea.Flostrand@dfo-mpo.gc.ca) is a biologist with Fisheries and Oceans Canada at the Pacific Biological Station in Nanaimo, British Columbia. Her responsibilities and research interests support efforts to monitor pelagic ecosystems and forage fish populations with an emphasis on herring, eulachon and sardine.



Moira Galbraith (Moira.Galbraith@dfo-mpo.gc.ca) is an invertebrate taxonomist specializing in zooplankton, on the west coast Canada, in particular. She works at the Institute of Ocean Sciences in Pat Bay, British Columbia.



Dr. Jacquelynne (Jackie) King (Jackie.King@dfo-mpo.gc.ca) is the Program Head of Basin and Coastal-scale Interactions program with Fisheries and Oceans Canada. Her research investigates linkages between coastal-scale ecosystems and basin-scale processes and ecosystems include climate forcing, large-scale oceanographic processes, connectivity in large marine ecosystems and the exchange of energy, between coastal areas and the north Pacific. She collaborates in integrative pelagic field studies along the continental shelf, with her primary focus on understanding the factors controlling the abundance, distribution, and production of salmon and associated species in marine ecosystems. She is also the lead for the Canadian Pacific Shark Research Program; responsible for all Canadian Pacific elasmobranch research and conservation. Within PICES she is Vice-Chair of the Fishery Science Committee, Co-Chair of the Section on Climate Change Effects on Marine Ecosystems, and a member of the FUTURE Scientific Steering Committee.



Jim Murphy (jim.murphy@noaa.gov) is a Fisheries Research Biologist at NOAA's Alaska Fisheries Science Center, and is currently a member of the Salmon Ocean Ecology and Bycatch Assessment team at the Auke Bay Laboratories, in Juneau, Alaska. His research has focused on the marine ecology of Pacific salmon and other pelagic fish species in the northern Bering Sea and Southeast Alaska. Current research includes the application of juvenile abundance to salmon run forecasts models, and life-history classification and diversity in Yukon River Chinook salmon. Jim is a member of the US/Canada Joint Technical Committee of the Yukon River Panel.



Keith Sakuma (keith.sakuma@noaa.gov) is a Research Fisheries Biologist at NOAA Fisheries' Southwest Fisheries Science Center, Fisheries Ecology Division, in Santa Cruz, California. He is the Chief Scientist on the Groundfish Analysis Team's annual Rockfish Recruitment and Ecosystem Assessment Survey, which conducts midwater trawls and CTD casts along the entire coast of California during the spring upwelling season. His research interests include early life history and taxonomy of marine fishes as well as examining the oceanographic factors that affect recruitment strength.



Dr. Andrew Thompson (andrew.thompson@noaa.gov) is a Research Fisheries Biologist at NOAA's Southwest Fisheries Science Center in La Jolla, CA. At present, his research primarily focuses on using larval fish and oceanographic data collected by the California Cooperative Oceanic Fisheries Investigations (CalCOFI) program to elucidate causes of dynamics of fish distributions and population sizes in the California Current Ecosystem. He also supervises 3 postdoctoral researchers who are using CalCOFI data to 1) develop Next Generation Sequencing methods to rapidly identify fish species that are present in plankton samples; 2) assess feeding condition of larval anchovy and sardine using bulk and compound-specific stable isotopes and 3) understand if larval condition quantified through otolith characteristics impact rockfish recruitment success. Previously he used field studies, mathematical modelling and genetics to better understand processes affecting the ecology and evolution of mutualistic gobies and shrimps on coral reefs, stream fish in the Appalachian Mountains and southern California, and lizards in the Coachella Valley, California.

Building international partnerships to enhance science-based ecosystem approaches

By Robin Brown

27 - 28 November 2017
Cape Town, South Africa



Several United Nations agencies (Global Environment Fund (GEF), United Nations Development Program, United Nations Environment, the Intergovernmental Oceanographic Commission of UNESCO and the Food and Agricultural Organization) organized an invitation-only meeting in Cape Town, South Africa in November, 2017 on the subject of “*Building international partnerships to enhance science-based ecosystem approaches in support of regional ocean governance*”. PICES was invited to provide a representative to this meeting, based on our extensive experience with regional science collaborations. The meeting provided an opportunity to share examples and best practices for science-based collaborations in support amongst the complex network of programs and organizations in support of a wide range of ecosystem-based management issues including Marine Protected Areas, Marine Spatial Planning, Integrated Coastal Management, Fisheries Management and Climate Change Adaptation. This meeting was a follow-on from the June 2017 Sustainable Development Goals Conference in New York. Some of our key partners (ICES, IOC, FAO, North

Pacific Fisheries Commission) also attended the Cape Town workshop, but most of the participants were unfamiliar with PICES activities.

It was clear from the presentations that the most mature and successful collaborations were those focused on scientific issues. Collaborations involving shared management of ocean spaces and resources were less evolved, although there were some promising examples from the GEF-funded large Marine Ecosystem Ecosystem (LME) initiatives.

PICES can expect to receive more invitations to participate in such discussions. PICES supports the IOC-UNESCO led-initiative for a UN Decade (2012–2030) of Ocean Science for Sustainable Development which was adopted by the UN General Assembly on December 5, 2017. There is much work to be done to develop a comprehensive Implementation Plan for this activity and PICES has a lot of expertise and experience to offer.

Robin Brown is the Executive Secretary of PICES.



Participants of the workshop on “Building international partnerships to enhance science-based ecosystem approaches in support of regional ocean governance”, November 2017, Cape Town, South Africa.

The Bering Sea: Current status and recent trends

by Lisa Eisner

Climate and oceanography

The Bering Sea experienced moderate conditions during April–September 2017, relative to the anomalous warmth that prevailed from 2014 into early 2017. A map of the SST anomaly for April–September 2017 (Fig. 1a) shows that conditions were still mostly warmer than normal. Anomalies exceeded 1°C across much of the northern portion of the Bering Sea, with +2 °C anomalies for some coastal areas. The southeastern shelf was only slightly warmer than normal. The anomalous warmth on the shelf was confined to a shallow layer near the surface. In particular, the depth-averaged temperatures at Mooring 2 (57°N, 164°W) were actually slightly cooler than normal, in part because the mixed layer was only about 10–15 m thick during much of the summer of 2017 (P. Stabeno, pers. comm.). The cooler water on the shelf as compared with the previous 3 years can be attributed in large part to the greater sea ice coverage during the preceding winter, again compared with recent years. Wintry weather that occurred in early April 2017 helped to cool and completely mix the waters over much of the southeastern shelf; the result was a cold pool during the summer in the middle shelf that extended much farther southeast than during the previous three summers.

The atmospheric forcing during the spring and summer of 2017 is summarized in terms of the mean sea level pressure (SLP) anomaly map shown in Figure 1b. This map indicates lower than normal SLP over the entire region of interest, with the weakest anomalies over the Gulf of Anadyr in the northwestern Bering Sea. More negative anomalies surrounded that location, with the most negative anomalies observed in a band from central Alaska to the western Gulf of Alaska. This distribution brought about mean wind anomalies of about 1 m s⁻¹ from the north over the eastern Bering Sea shelf. Since the climatological winds during this time of the year are from the south, the consequence was lower than normal wind speeds in an overall sense. Relatively light winds were especially common over the shelf during July through September 2017; this resulted in reduced wind-induced mixing and may help account for the thin upper mixed layer that was observed at Mooring 2.

In summary, in many respects it appears that the period of April–September 2017 may represent a transition from a multi-year period of warmth to more normal conditions. On the other hand, anomalously warm water in the Chukchi Sea and northern Bering Sea at the end of summer typically serves to delay the onset of sea ice in the Bering Sea (except in coastal areas), as has been observed in late 2017. It therefore seems more likely than not that much of the Bering Sea will continue to be warmer than normal into the first part of 2018.

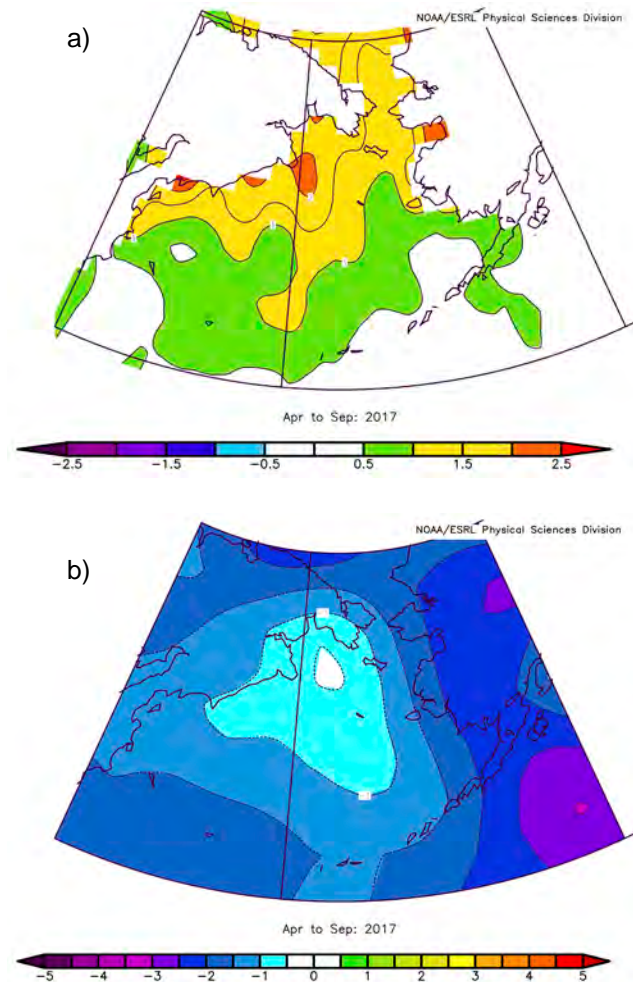


Fig. 1 (a) Mean sea surface temperature (SST, °C) anomalies and (b) mean sea level pressure (SLP, mb) anomalies from the NCEP/NCAR Reanalysis for April to September 2017. Anomalies are deviations from 1981–2010 climatology. Figures courtesy of Nick Bond, PMEL.

Poor reproductive success for seabirds in the Pribilof Islands

The U.S. Fish and Wildlife Service (USFWS), Alaska Maritime National Wildlife Refuge has monitored seabirds at colonies around Alaska since the early- to mid-1970s. Time series of annual breeding success and phenology are available for colonies in the eastern Bering Sea at St. Paul and St. George islands (Fig. 2). Here, we focus on cliff-nesting, primarily fish-eating species: black-legged kittiwake (*Rissa tridactyla*), red-legged kittiwake (*R. brevirostris*), common murre (*Uria aalge*), thick-billed murre (*U. lomvia*) and red-faced cormorant (*Phalacrocorax urile*). Reproductive success is defined as the proportion of active nest sites (nests with eggs or just eggs for murre that do not build nests) that fledged a chick.

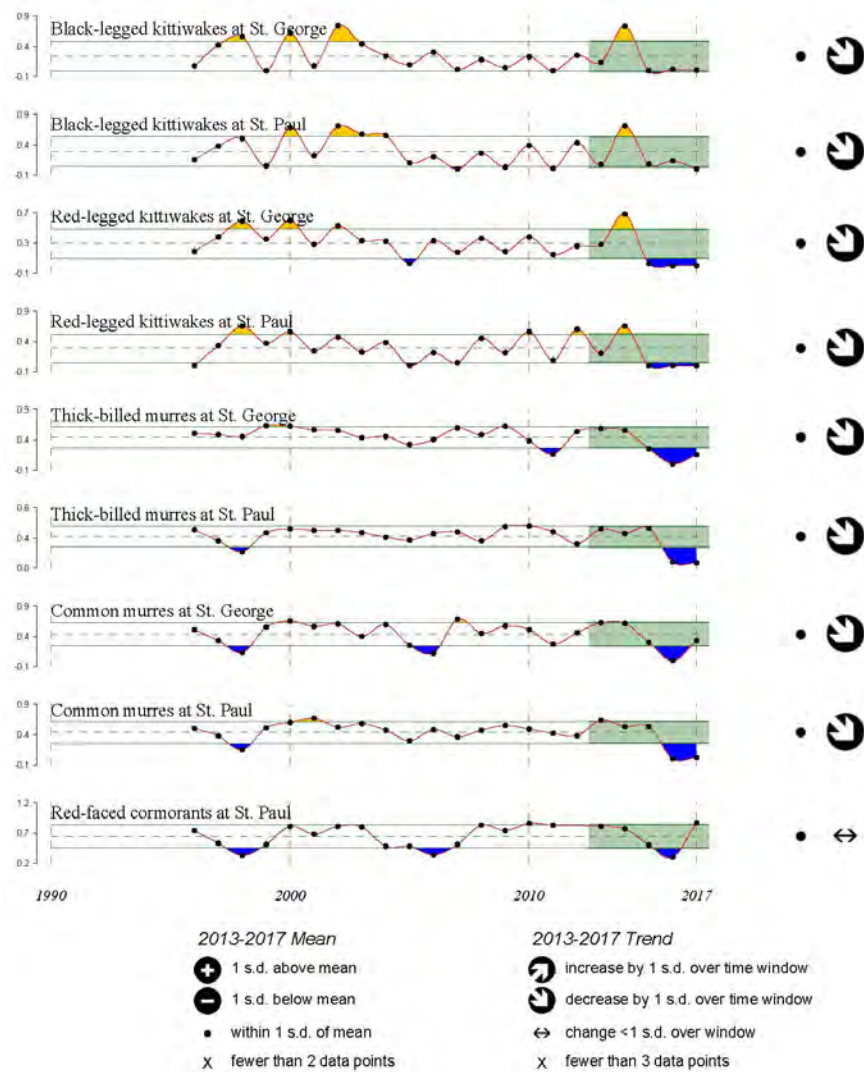


Fig. 2 Reproductive success of five seabird species at St. George and St. Paul islands, 1996–2017. Figure from the Alaska Marine Ecosystem Report, <https://access.afsc.noaa.gov/reem/ecoweb/index.php> with assistance by Elizabeth Siddon, AFSC, and Marc Romano, Alaska Maritime National Wildlife Refuge.

Cliff-nesting seabirds showed overall poor reproductive success in 2017 at both islands, with the exception of nearshore-feeding red-faced cormorants. This was the third consecutive year of poor reproduction for both black-legged and red-legged kittiwakes, and the second year of poor reproduction for both common and thick-billed murres. Mean hatching dates were late across the board for those species that hatched any chicks. In general, these species appear to have had negative responses to the marine heat wave in the NE Pacific of the past few years, with widespread reproductive failures, die-offs, and low attendance at breeding colonies. Kittiwakes began to fail during the first year of the heat wave in 2015, while the murres did not show negative responses until 2016. This pattern may reflect differences in natural history, with murres able to buffer reproductive success in poor conditions to some degree. Kittiwakes fail to fledge chicks

about one in six years in the Pribilof Islands, whereas for murres complete reproductive failure is unprecedented before 2016.

Reproductive activity of central-place foraging seabirds can reflect ecosystem conditions at multiple spatial and temporal scales. For piscivorous species that feed at higher trophic levels, continued reduced reproductive success may indicate that the ecosystem has not yet shifted back from warm conditions and/or there is a lagged response of the prey. Despite environmental changes returning back to more neutral conditions, seabird foraging conditions do not appear to have recovered in the eastern Bering Sea. In contrast, the improvement in attendance and minimal reproductive activity among murres in the Gulf of Alaska during 2017 indicates some improvement in foraging conditions for those species in that adjacent ecosystem.

Dead and dying seabirds

During June to September 2017, the USFWS received reports of dead and dying seabirds from the Bering and Chukchi regions – from Point Hope south to Bristol Bay (Fig. 3). Responders at Deering, Gambell, Nome, Point Hope, Shishmaref, Unalaska, Unalakleet, St. George, St. Paul, and other coastal areas have counted nearly 1600 beached seabird carcasses since early June 2017, including northern fulmars, shearwaters, and kittiwakes. Murres, auklets, gulls, and puffins have also been reported. The USFWS coordinated with the Coastal Observation and Seabird Survey Team (COASST) to monitor several beaches. Twenty-one carcasses were examined by the US Geological Service (USGS) National Wildlife Health Center, USGS Alaska Science Center, and the National Oceanic and Atmospheric Association (NOAA) Laboratory in Beaufort, North Carolina.

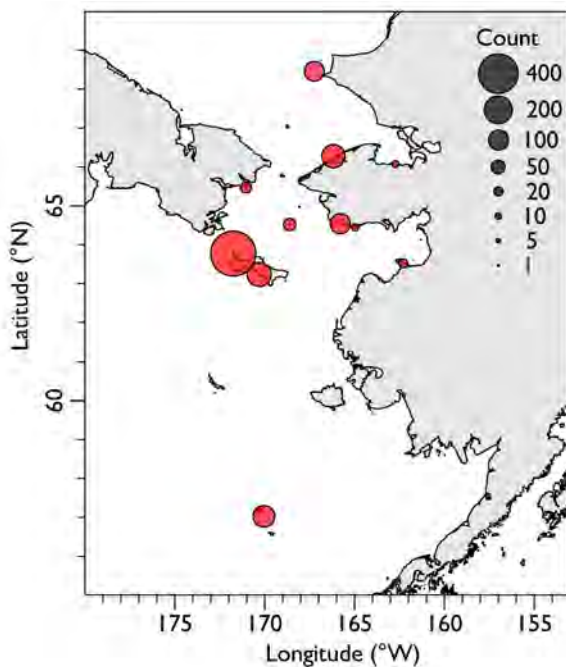


Fig. 3 Dead birds counted on shore in 2017. Figure courtesy of Tim Jones, COASST.

Seabird carcasses from Point Hope, Shishmaref, Gambell, St. George and St. Paul islands indicated death by drowning and starvation. There was no evidence that the deaths were caused by an infection. Saxitoxin is a biotoxin naturally produced by phytoplankton that can affect the mammalian nervous system if ingested in high concentrations. Saxitoxin was detected in the intestinal contents and livers of five northern fulmars from Shishmaref, Gambell, St. George and St. Paul islands. All samples were below human consumption limits for shellfish (80 µg/100 g); however, potential impacts of algal toxins on birds are unknown. Domoic acid, which is also associated with phytoplankton, was not detected in any

samples. We do not have evidence of acute toxicity as a direct cause of seabird deaths, but it is possible that exposure to saxitoxin may have been a contributing factor. The phytoplankton species that produces saxitoxin, *Alexandrium* spp., was observed in the Chukchi Sea during August and September 2017 (L. Eisner, pers. comm.).

In addition, USFWS and University of Washington (UW) biologists at sea observed more than 70 dead birds in the northern Bering and eastern Chukchi seas during surveys from June through early September (Fig. 4). In previous years of at-sea seabird surveys, only a few dead birds have been observed in this region.

For contact information or to report unusual numbers of sick or dead birds in the eastern Bering Sea, see: https://www.fws.gov/alaska/pdf/BeringSea_DieOff_Info_Ver3_DEC2017_Final.pdf.

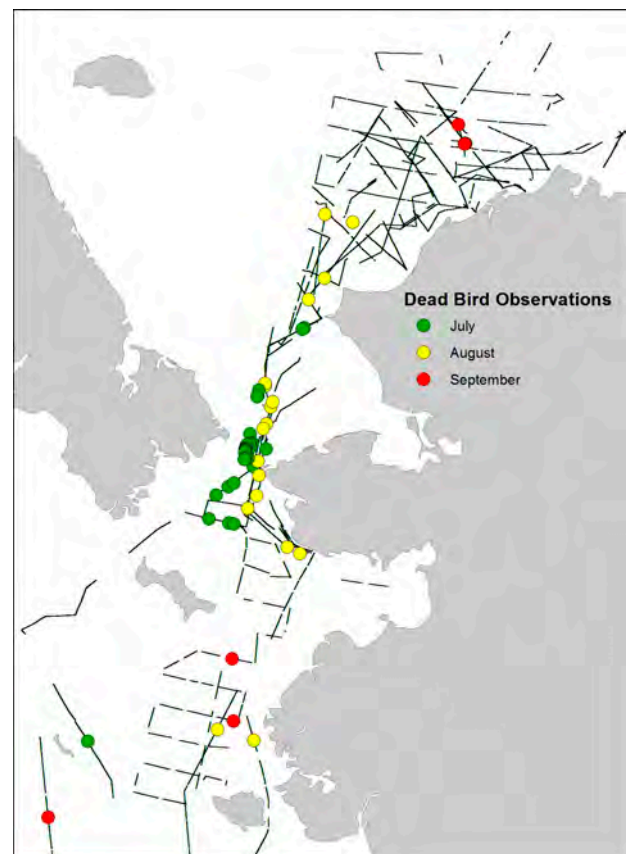


Fig. 4 Dead birds counted at sea in 2017. Black lines are track lines surveyed for seabirds. Figure courtesy of USFWS.

Northern extension of the eastern Bering Sea bottom trawl survey

In 2017, the eastern Bering Sea shelf bottom trawl survey conducted by the NOAA Alaska Fisheries Science Center (AFSC), was extended northward in the northern Bering Sea (NBS) to include 144 additional stations (Fig. 5).

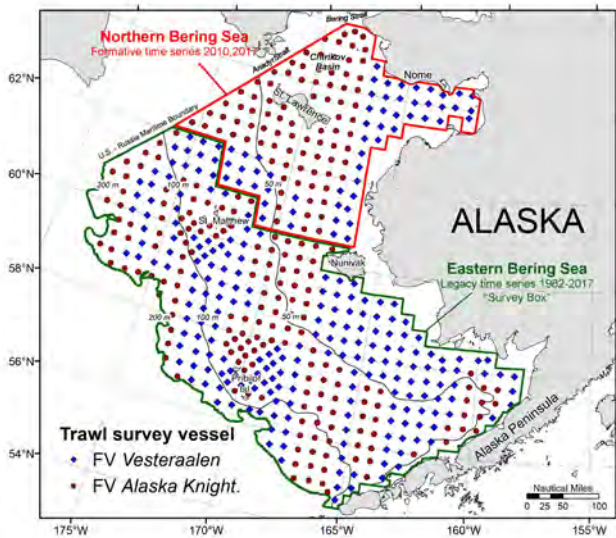


Fig. 5 Sampled survey stations in 2017. Enclosed within the green line are eastern Bering Sea stations sampled annually since 1982. Enclosed within the red line are the northern Bering Sea stations.

The 2017 survey was the second snapshot in a formative NBS time series that began in 2010, with intent to continue the time series biennially, contingent on funding. Environmental conditions varied between years. The cold pool (< 2°C bottom water) was more extensive in 2010 than in 2017 and was composed of colder water that impinged on Chirikov Basin, Nunivak Island, and the Alaska Peninsula (Fig. 6a), potentially restricting east–west and north–south movements of demersal fauna. The cold pool in 2017 extended to within 50 km of the Alaska Peninsula, but bottom temperatures along the entire length of the inner shelf from Bristol Bay up to Chirikov Basin were relatively warm (> 3°C, Fig. 6b). Although east–west

movement of demersal fauna over much of the shelf may have been limited by the 2017 cold pool, the inner shelf was certainly an open corridor for north-south movement, especially between Nunivak Island and Chirikov Basin where bottom temperatures exceeded 6°C.

Between 2010 and 2017, total survey biomass in the NBS increased 59% from 2.9 to 4.6 million metric tons (mt). The percent change in biomass varied by fish and invertebrate taxon or taxonomic group. There were increases in biomass for 27 taxa (23 groups shown in Table 1), decreases for 13 taxa, and no change for one taxon (not shown). The two most dramatic increases were Walleye pollock (*Gadus chalcogrammus*) and Pacific cod (*G. macrocephalus*). The NBS survey biomass of pollock alone increased over six-thousand percent from 0.02 million mt in 2010 to 1.3 million mt in 2017, and for NBS Pacific cod, biomass increased by an order of magnitude from 28,425 mt to 286,310 mt.

Research topics arising from the comparison of 2010 and 2017 survey results include understanding the effects that such large-scale changes in distribution and abundance have on reorganizing the ecosystem community structure and on the subsistence harvest of coastal communities in the NBS. More needs to be known about the population structure and distribution patterns for taxa straddling the survey boundaries, how biological and environmental processes affect alongshelf, cross-shelf, and transboundary movements, and how climate and variability in the interannual cold pool may drive these large scale changes. For more information please see Hot Topics in the eastern Bering Sea Alaska Marine Ecosystems Considerations report, <https://access.afsc.noaa.gov/reem/ecoweb/Index.php>.

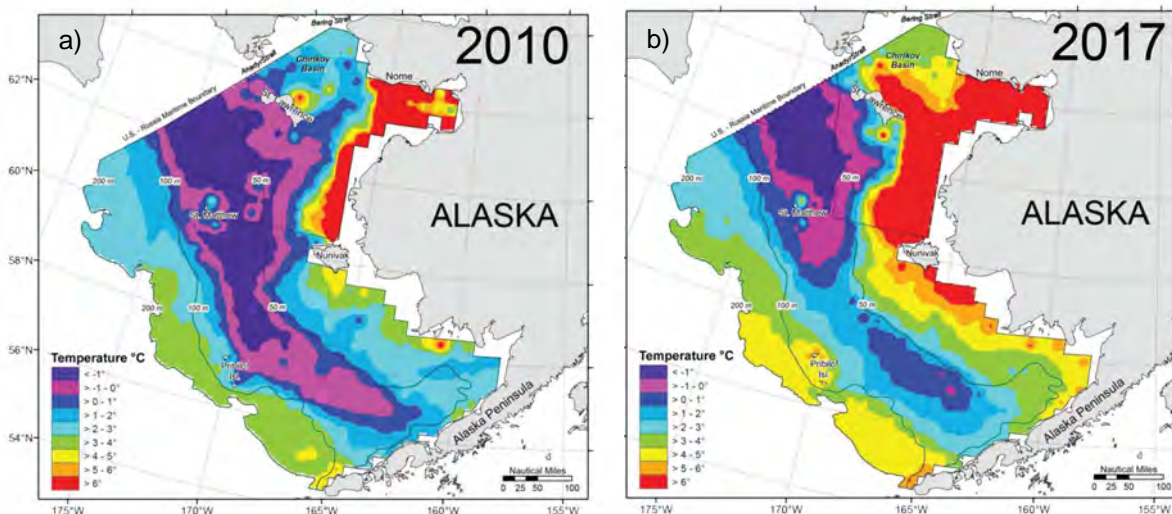


Fig. 6 Survey bottom temperatures for (a) 2010 and (b) 2017.

Table 1 Biomass of fish and invertebrate taxa or taxonomic group in metric tons (mt) in 2010 and 2017. The percent change in biomass between survey years is shown for 23 species/groups that increased most between 2010 and 2017 surveys.

Common name	Taxon	2010	2017	Change (%)
Walleye pollock	<i>Gadus chalcogrammus</i>	20,977	1,312,620	6157
Pacific cod	<i>Gadus macrocephalus</i>	28,425	286,310	907
Jellyfishes	Scyphozoa	13,112	66,166	405
Poachers	Agonidae	422	2,040	384
Green sea urchin	<i>Strongylocentrotus</i> sp.	49,263	164,277	233
Blue king crab	<i>Paralithodes platypus</i>	1,940	5,795	199
Shorthorn sculpin	<i>Myoxocephalus scorpius</i>	38,172	108,753	185
Bryozoans	Bryozoa	2,747	7,463	172
Northern rock sole	<i>Lepidopsetta polyxystra</i>	21,379	56,093	162
Other flatfishes	Pleurinectidae	3,549	8,715	146
Pricklebacks	Stichaeidae	1,553	3,609	132
Sea anemones	Actinaria	9,381	21,330	127
Clams	Bivalvia	2,531	5,374	112
Starry flounder	<i>Platichthys stellatus</i>	15,319	31,103	103
Other snails	Gastropoda	27,102	54,963	103
Pacific herring	<i>Clupea pallasii</i>	22,289	35,365	59
Bering flounder	<i>Hippoglossoides robustus</i>	12,661	20,022	58
Neptune whelk	<i>Neptunea heros</i>	115,325	178,443	55
Snailfishes	Liparidae	3,316	4,842	46
Plain sculpin	<i>Myoxocephalus jaok</i>	28,338	36,819	30
Hermit crabs	Paguridae	134,417	162,475	21
Purple-orange sea star	<i>Asterias amurensis</i>	298,087	353,314	19
All shrimps		3,777	4,462	18

Autonomous vehicles in the Bering Sea and Arctic

Saildrones and Oculus gliders are two innovative technologies tested in Alaskan waters this past summer by NOAA's Pacific Marine Environmental Lab (PMEL) and collaborators (Fig. 7). Pushing observational boundaries, the saildrone missions completed several firsts; first transit through Bering Strait, first Arctic Basin observations, 7 NM from sea ice edge, and farthest north an autonomous surface vehicle has traversed. The Oculus dive data show turbulent chimneys; these are being further investigated in summer 2018. To learn more about the technologies and U.S. Arctic missions, visit <https://www.pmel.noaa.gov/itae/>.



Fig. 7 Saildrones launched in Dutch Harbor, Alaska. Figure courtesy of Heather Tabisola, PMEL.

(continued on page 36)

The state of the western North Pacific during the 2017 warm season

by Toshiya Nakano

The western North Pacific during the 2017 warm season exhibited above-average sea surface temperatures (SSTs) in July and August through most of the region (Fig. 1). In

particular, above-average SSTs were observed in the Bering Sea throughout the season. SSTs in June and September were below average in the seas east of Japan.

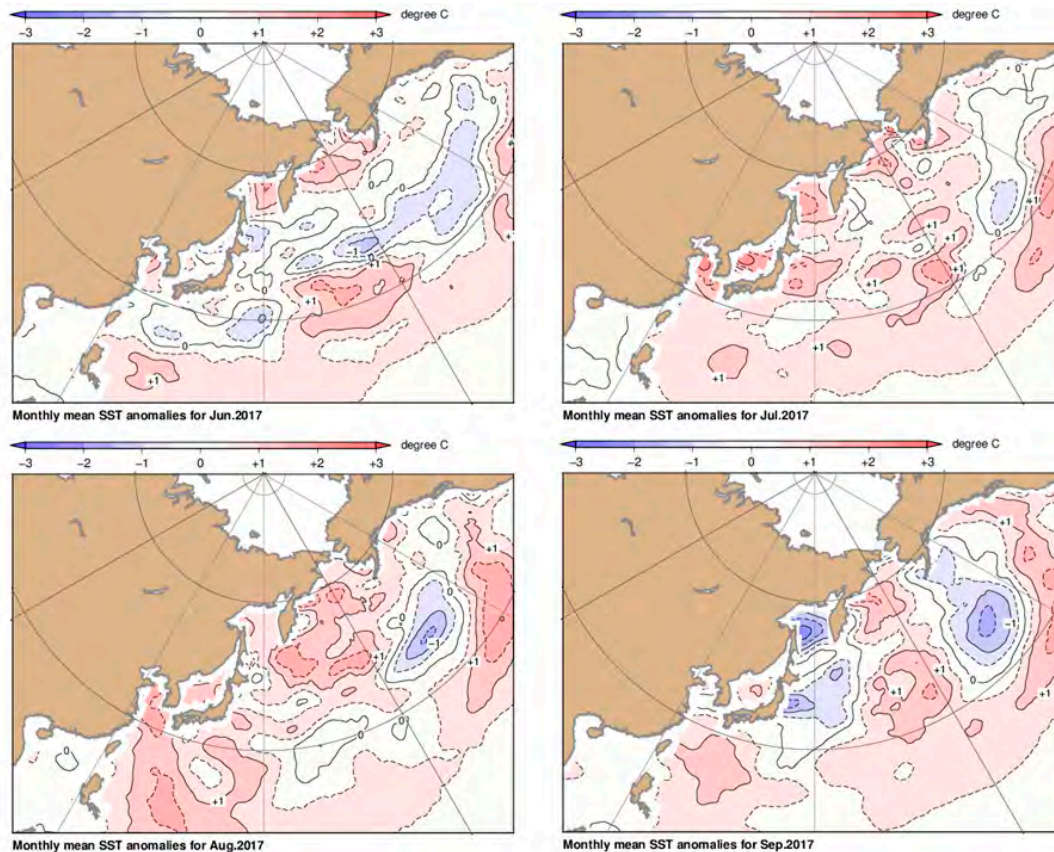


Fig. 1 Monthly mean sea surface temperature anomalies for June, July, August, and September 2017. Monthly mean SSTs are based on JMA’s COBE-SST (Centennial in situ Observation-Based Estimates of variability of SST and marine meteorological variables). Anomalies are the deviations from the 1981–2010 climatology.

Ocean acidification and carbon dioxide uptake in the global ocean

by Toshiya Nakano and Yosuke Iida

The ocean acts as a large sink for anthropogenic carbon dioxide (CO₂), and the continuous oceanic uptake of CO₂ has changed the chemical properties of the seawater. Increasing ocean acidification is a particular concern because it reduces the ocean’s capacity for CO₂ uptake, which accelerates global atmospheric warming and affects marine ecosystems by disturbing plankton growth. The Japan Meteorological Agency (JMA) has reconstructed surface ocean carbonate system parameters including monthly sea surface pH and oceanic CO₂ sink after 1990

based on a global oceanographic observation database, SOCAT V5 (Bakker *et al.*, 2016) and GLODAPv2 (Olsen *et al.*, 2016). The results reveal a clear trend of pH decrease in the global ocean, and decadal variability in CO₂ sink of weakening in 1990s and strengthening after 2000 (Figs. 2 and 3). The gridded datasets and graphical maps (2-dimensional and sphere mapping) of reconstructed values of surface ocean carbonate system parameters and sea-air CO₂ flux are distributed via JMA website.

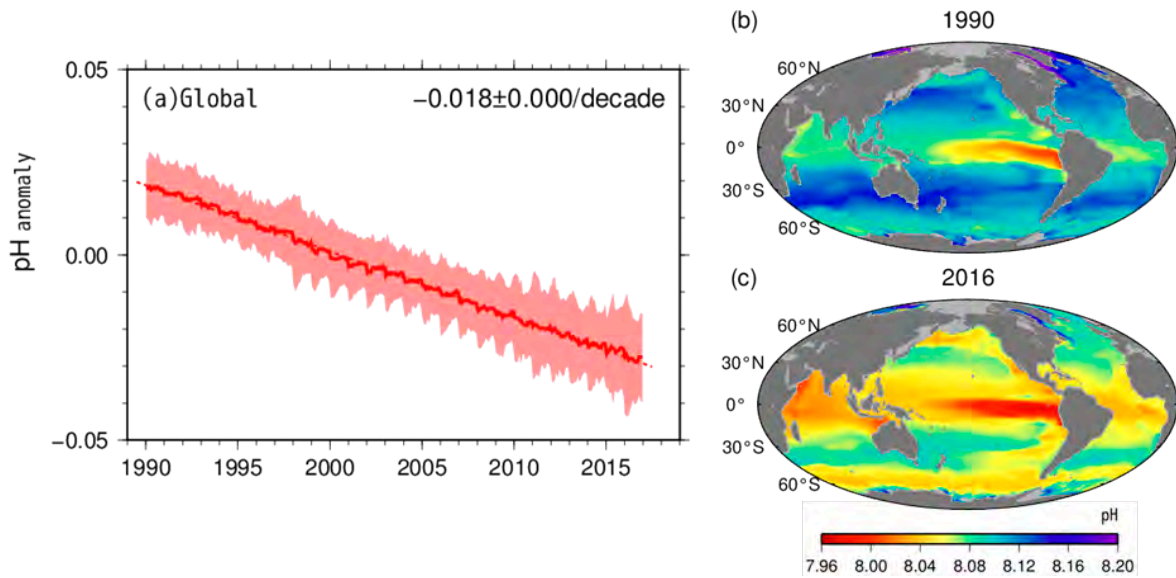


Fig. 2 Long-term trend of global surface ocean pH (a) and distribution of pH in 1990 (b) and 2016 (c). The solid line in (a) is a time-series representation of the pH anomaly from the 1990–2010 average, the shaded area indicates the standard deviation range ($\pm 1\sigma$), and the dotted line represents the long-term trend. The ‘ \pm ’ symbol indicates a 95% confidence interval. The light grey area in (b) and (c) shows the border of the region analyzed.

For more details and gridded datasets download, see JMA websites:

http://www.data.jma.go.jp/gmd/kaiyou/english/oa_global/oceanacidification_global_en.html

and

http://www.data.jma.go.jp/gmd/kaiyou/english/co2_flux/co2_flux_data_en.html.

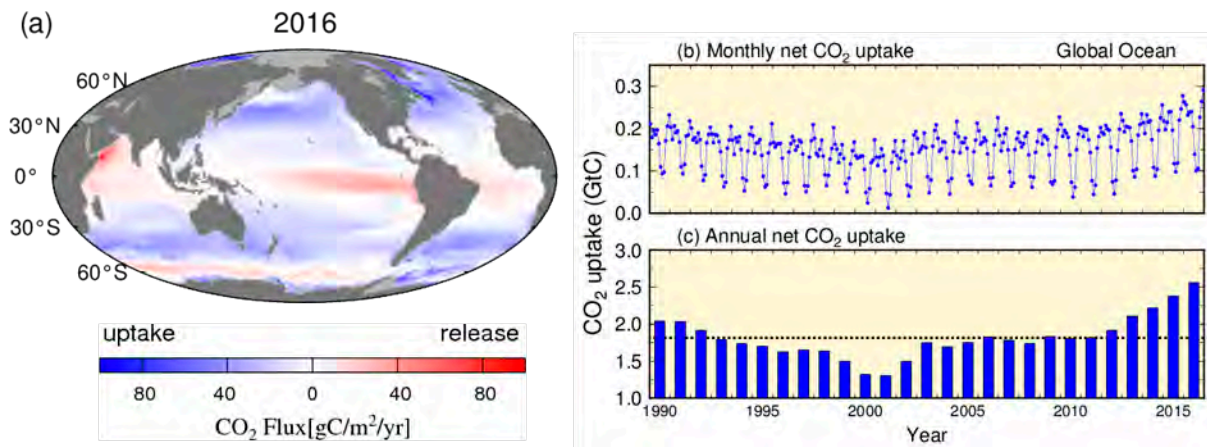


Fig. 3 Distribution of global ocean CO₂ uptake/release for 2016 (a) and time-series representations of monthly (b) and annual (c) CO₂ uptake from 1990 to 2016. The blue/red area in the map on the left (a) indicates oceanic uptake/release of CO₂ from/into the atmosphere. The light grey area in (a) shows the border of the region analyzed. The dotted line in (c) shows the 1.8 GtC average for the period from 1990 to 2016.

For more details and gridded datasets download, see JMA websites:

http://www.data.jma.go.jp/gmd/kaiyou/english/co2_flux/co2_flux_en.html

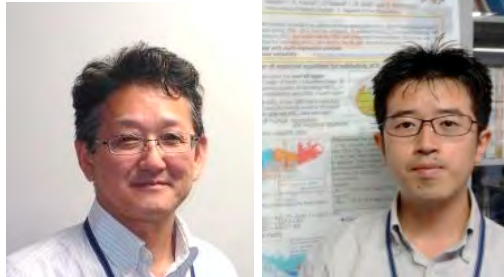
and

http://www.data.jma.go.jp/gmd/kaiyou/english/co2_flux/co2_flux_data_en.html.

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Bakker, D. C. E. *et al.* 2016. A multi-decade record of high quality fCO₂ data in version 3 of the Surface Ocean CO₂ Atlas (SOCAT). *Earth Syst. Sci. Data*, 8, 383–413, doi:10.5194/essd-8-383-2016.

Olsen, A. *et al.* 2016. The Global Ocean Data Analysis Project version 2 (GLODAPv2) – an internally consistent data product for the world ocean, *Earth Syst. Sci. Data*, 8, 297–323, doi: 10.5194/essd-8-297-2016.



Dr. Toshiya Nakano (nakano_t@met.kishou.go.jp) is Head of the Marine Environment Monitoring and Analysis Center, Marine Division at the Japan Meteorological Agency. His group is tasked with issuing with tracking and reporting on long-term variations of the marine environment including the state of the ocean climate such as ocean heat content, ocean structure and water properties, and carbon cycle such as carbon uptake, carbon inventory and ocean acidification.

Mr. Yosuke Iida (iida-ysk@met.kishou.go.jp) is also with the Marine Environment Monitoring and Analysis Center, Marine Division at the Japan Meteorological Agency where he assists with providing information on variations of the marine environment including state of the ocean climate such as ocean heat content, ocean structure and water properties, and carbon cycle such as carbon uptake, carbon inventory and ocean acidification.

(continued from page 33)

Upcoming Bering Sea surveys

- PMEL and AFSC, NOAA will deploy moorings and conduct their annual spring oceanography and plankton survey on board the NOAA Ship *Oscar Dyson* on the southeastern shelf, April 29–May 10, 2018;
- AFSC, NOAA will conduct ichthyoplankton surveys on board the NOAA Ship *Oscar Dyson* on the southeastern shelf, May 13–June 1, 2018;
- The University of Alaska Fairbanks and the University of Washington with guest collaborators from Hokkaido University and the USFWS will conduct an oceanographic, fisheries, seabird and marine mammal survey on the R/V *Sikuliaq* in the Northern Bering and Chukchi seas, June 2018.

Upcoming Bering Sea meeting

- Alaska Marine Science Symposium, 22-26 January 2018, Anchorage Alaska.

Acknowledgements: Many thanks to the scientists who helped create this report: Dr. Nicholas Bond and Heather Tabisola at NOAA, PMEL; Drs. Robert Lauth and Elizabeth Siddon at NOAA, AFSC; at USFWS, Dr. Kathy Kuletz and Robb Kaler at Migratory Bird Management, Marc

Romano and Heather Renner at Alaska Maritime National Wildlife Refuge, and Dr. Julia Parrish, Dr. Tim Jones and Hillary Burgess at UW/COASST.



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

In remembrance of Dr. William T. Peterson

By Hal Batchelder

Dr. Bill Peterson passed away on August 12, 2017 after having bravely faced cancer for the past three years. Bill was an oceanographer, marine biologist and climate scientist for NOAA, who most recently (since 1995) worked at the NOAA lab located in the Hatfield Marine Science Center complex (Newport, Oregon) as a senior scientist for more than 20 years. Prior to that, he worked for NOAA in Silver Spring, Maryland, where he was the Program Manager of the US GLOBEC Program and Director of US GLOBEC Interagency Program Coordination Office. In 2016 he was awarded a Distinguished Career Award by NOAA and was the recipient of NOAA’s Bronze Award three times (2004, 2005, 2008) for outstanding contributions in management that increase the efficiency and effectiveness of an operating unit.



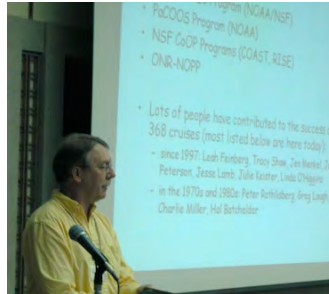
marine and freshwater zooplankton community world-wide knew Bill through his attendance at many of the International Zooplankton Production Symposia (ZPS)—Bill having attended all of the ZPS from #2 (1994, Plymouth, UK) through #5 (2011, Pucón, Chile). Bill served on the Scientific Steering Committee of the 3rd ZPS (2003, Gijón, Spain) and was an editor of the published *ICES Marine Science Symposia*, Vol. 220 (*The role of Zooplankton in Global Ecosystem Dynamics: Comparative Studies from the World Oceans*). At the 4th ZPS (2007, Hiroshima, Japan), Bill

co-convoked a 1-day workshop titled “*Krill research: current status and its future*” with So Kawaguchi (Australia) which resulted in publication of a special issue of *Deep-Sea Research Topical Studies in Oceanography* on Krill Biology and Ecology. Unfortunately, Bill was too ill to attend the Bergen, Norway Symposium (#6, 2016). Bill served leadership roles for efforts other than “zooplankton”. A prime example is when he served as the PICES Convener for the first PICES/ICES/IOC Symposium on the “*Effects of climate change on the world’s oceans*” in 2008 (Gijón, Spain) in what is now a regular series. This was the first of this title. It has been followed by two others (2012, Yeosu, Korea; 2015, Santos, Brazil) and a fourth is planned for June 2018 in Washington, DC, USA.

Bill had been engaged in PICES since 1998 when he attended his first Annual Meeting. He was a member of the PICES-GLOBEC International Program on Climate Change and Carrying Capacity and served as Co-Chair of the Program’s REX Task Team. He was also a long time member (1999–2017) of the Biological Oceanography Committee and Co-Chaired the Working Group on *Comparative Ecology of Krill in Coastal and Oceanic Waters Around the Pacific Rim* (WG 23). Many in the



3rd ZPS, 2003, Gijón, Spain, with Peter Wiebe.



4th ZPS, 2007, Hiroshima.



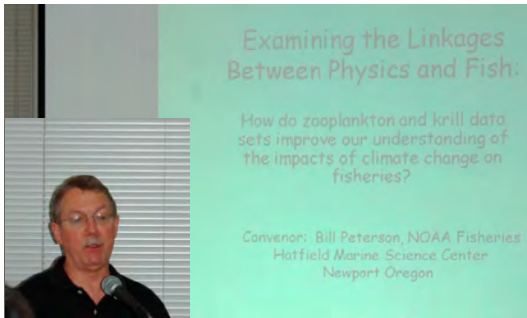
5th ZPS, 2011, Pucón, Chile; Bill with his Newport clan of technicians, collaborators and mentees.



Bill (PICES), Luis Valdés (ICES) and John Church (IOC). Conveners of 1st Climate Change Symposium, 2008, Gijón, Spain.



2nd International Effects of Climate Change Symposium, 2012, Yeosu, Korea. Bill and Nick Bond.



Climate Change Effects on Fish and Fisheries Symposium, 2010, Sendai, Japan.

While in Newport, Bill had an appointment as an Adjunct Professor at the nearby Oregon State University (OSU) which enabled him to engage regularly with graduate students and early career marine scientists—mentoring young scientists was a task that he relished. He served on numerous OSU graduate student committees, and helped develop joint NOAA-OSU research projects.

In more recent years, Bill followed through with a long burning desire to learn to play the bagpipes. He did this with two of his colleagues at NOAA (Kym Jacobson and Bob Emmett). All three practiced nearly daily and Bill attended several bagpipe camps to improve his skill. It was common for him to play the bagpipes for visitors to his home, which was located rather remotely in the woods. He was also a long time avid birder. No word on what the birds and other wildlife thought of his efforts. But to me, his piping sounded pretty good. He also played public events with other pipers. Unfortunately, during his illness he did not have the energy for the pipes.



Admiring fan, Hongbo Li, listening to Bill play the pipes at the host country's sport event, curling, during the PICES Annual Meeting in Victoria, Canada, 2007. Here, Bill was wearing a mask since the event was on Halloween.



Science Board Chair, Kuh Kim, and Bill's wife, Mary, cheer Bill on after a successful rock throw in the curling event.

PICES Annual Meetings



1998, Fairbanks. From left: Bill Percy, Beth Turner and Bill.



2000, Hakodate.



2004, Honolulu. From left: Cara Wilson, John Stein, Bill, Liz Tirpak and Laura Richards.



2005, Vladivostok.. Bill receiving Best Presentation Award in the Science Board Symposium from Science Board Chair, Kuh Kim.



2006, Yokohama. Bill with Shin-ichi Saito



2006, Yokohama



2007, Victoria. Bill with Tracy Shaw.



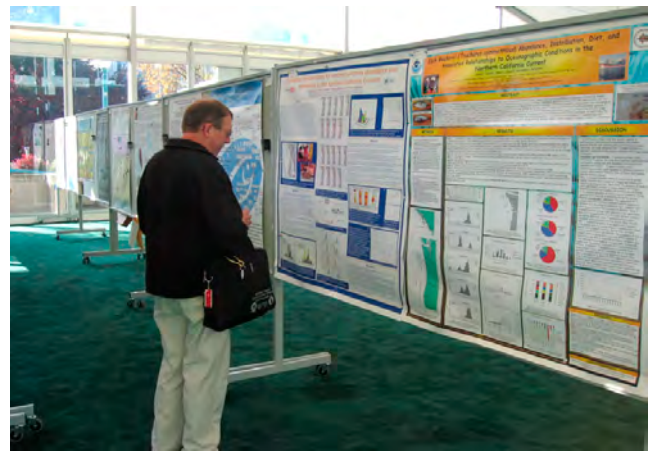
2008, Dalian.



2011, Khabarovsk. Bill with Mike Dagg.

Upon learning of Bill's passing, I posted the following notification of this event on my Facebook page. Below my notice are responses received from colleagues and friends of Bill. They illustrate the impact that Bill had on so many people so widely distributed across the globe.

Hal Batchelder August 14, 2017: Bill Peterson, my best and dearest friend in science passed away this past weekend due to prolonged battle with cancer. Besides being my colleague, he was my mentor when I switched specialization from intertidal ecology to zooplankton ecology in graduate school. One of the all-time best ever. His intelligence, humor and friendship will be so missed by all who knew him well.



Jenny Ann Huggett (science colleague from Bill's time in South Africa and later): So devastated by this news. He was my mentor too and a wonderful man in so many ways. RIP Barnacle Bill. 🍆🍷💖🍷🍷💙🍷🍷🍷

Rick Spinrad (Retired from Oregon State Univ): Just seeing this now. I'm so sorry to hear of Bill's passing. I first met him in 1975, and always found him engaging, smart, well-meaning, and all-around nice. I will miss Bill.

Cheryl Brown (Scientist at EPA lab in Newport, Oregon): Ohhh, I'm so sad to hear this. An amazing scientist, a kind soul, and such a fun man 💖 His zest for life and science is what I think of when remembering Bill. I loved hearing him play the bag pipes in the hut on the HMSC nature trail.



Jamie Pierson (Scientist at Horn Point Lab, Maryland) Bill was a great guy, and I learned a lot from him over the years. I will really miss seeing him and hearing him speak at conferences and meetings.

Ricardo M Letelier (Professor at Oregon State Univ): He was a great friend and example to all of us. He will be missed!

Linda O'Higgins (former technician with Bill; now researcher in Ireland): Oh gosh, this is such sad news. Bill was my mentor too and like so many others, I found him to be the friendliest, most dedicated, knowledgeable, insightful and above all, encouraging research scientist whom I've yet to meet the measure of. So sad to hear of his passing. Please send my condolences to his wife and family.

Michael Harte (Professor at Oregon State): We should name a stop light after Bill near a creek full of salmon...

Maria Kavanaugh (OSU researcher): I was so sad to hear this news. He gave such the good fight and was always so positive. We lost one of the great ones: scientist, mentor, and friend.

Marnie Jo Zirbel (OSU seagoing technician): Bouncing around on a tiny research boat, Bill would look up from the microscope with a petri dish of pregnant krill, and start counting and recording albatrosses. He could see the big picture even when it would have been easier not to. Such a generous and brilliant man.  

Hiroaki Saito (Univ of Tokyo Marine Biologist): It's so sad news. He is so kind for everyone. I remember his letter replying me, at that time we did not meet each other but only I know him on his papers. His answer on my question on gut fluorescent method on his paper was so kind and detailed. It was 28 years ago... I'm so sorry for Bill's wife and family.

Leah Renee Feinberg (long term plankton and seagoing technician with Bill; now in Maryland): Thanks for posting this image uncle Hal. This is how I want to remember Bill. I feel him so strongly in everything I see around me, after all...he had a hand in so much of it!

Peter Franks (Professor of Oceanography, Scripps Institution of Oceanography; formerly a postdoc at OSU): I'm sorry for your loss, Hal. We have all lost a wonderful friend and colleague.

Susan Voss (Sister of Bill Peterson): I'm filled with joy as I read the marvelous comments about my brother. My brothers and myself so appreciate each and every one of you being a part of his life. He spoke often about his fellow researchers and staff that were his "other" family. Looking forward to meeting all of you when we celebrate his life, in the near future.

Hal Batchelder: Susan, he was universally loved and admired for his science acumen and his integrity in conducting science. Your brother impacted the lives of many and will be missed greatly.

Ricardo M Letelier: Susan, as Hal just stated, your brother was a great example of integrity and humility to all of us. From a personal perspective, he always made me feel welcomed and relevant.

Ramiro Riquelme Bugueño (visiting scientist with Bill; assistant professor Univ of Concepcion, Chile): It was a privilege to meet him. I had an unforgettable research stay in his lab (2010) and two years ago we had a very nice conversation... I will always remember him with gratitude, respect and admiration. From Chile, my deepest condolences to his family and friends.

Sonia Batten (zooplankton colleague and friend; Nanaimo, Canada): Such an amazing man, he had a big influence on my career too. Will be very much missed, and always remembered.....

William R. Crawford (physical oceanographer, retired from Institute of Ocean Sciences, Sidney, Canada): Bill Peterson was a wonderful person in every way.














GaBy Mayorga Adame (PhD student at OSU; now postdoc at UK National Oceanography Center): very sad news, me with you and Bill's family...

Enrique Curchitser (colleague from GLOBEC & PICES; Professor at Rutgers Univ): His science and person will be deeply missed.

Andrew Thomas (colleague; Univ of Maine): So sorry. My best to Mary. Bill was a wonderful colleague; positive, humorous, insightful, always helpful.

Oleg Katugin (friend from PICES; squid ecologist at TINRO, Vladivostok): Sad news! Bill was a great and very intelligent man! My deep condolences to the family. We will miss him...

Cynthia Suchman (former associate at Newport Lab; presently at the NSF): Bill's enthusiasm for his science was infectious, and his drive to get solid long term data taught us all so much.

Susan Voss (sister to Bill) October 15, 2017: I want to thank the many friends, family and colleagues of my brother, Bill Peterson, who came to celebrate his life yesterday at the Hatfield Marine Science Center. To have so many "scientists" sharing their memories of the work they were involved in with my brother, the reasons their paths crossed, and accomplishments because of him, was truly amazing. All of you provided my brothers and I with a better understanding of what a day in the life of my brother was truly about. We always thought we knew   Hal Batchelder, a special thanks for your words about my brother. His legacy will definitely live on..... Bill, it was the day you wanted, amazing colleagues, friends and family gathering in celebration. The pipes will continue to play in your name.           



Call for Papers

William Peterson Commemorative Issue

Progress in Oceanography

Bill was widely admired by those that knew him. He was particularly enthusiastic about engaging with young scientists at various meetings (especially during poster sessions), including AGU Ocean Science Meetings, PICES Annual Meetings, and various serial (Climate Effects on the World's Oceans; Zooplankton Production) symposia or one-off themed meetings. We are pleased to inform you that there will be a special issue of Progress in Oceanography dedicated to Bill Peterson. There must be a minimum of 12–15 papers to justify a special issue, but PICES expects to double or triple that as a truly “special” issue that celebrates Bill Peterson’s science and his impact on the ocean science community at large.

In thinking about the types of papers that Bill published and most relished, five themes have been identified to comprise this special issue. They are:

- 1) zooplankton rate measurements (molting, growth, production, maybe even death rates) [**RATE MEASUREMENTS**],
- 2) the importance of zooplankton species composition and distribution in informing about ocean conditions and advective processes [**ZP COMPOSITION AND DISTRIBUTIONS**],
- 3) using ocean ecology, including lower trophic indices, and local- to basin-scale physical indices for forecasting future Pacific salmon and higher trophic level (birds/mammals) conditions [**OCEAN ECOLOGICAL FORECASTING**],
- 4) observing and documenting climate events and anomalous conditions and responses of the California Current ecosystem [**CLIMATE EVENTS AND CC ECOSYSTEM RESPONSES**], and
- 5) investigations of the ecology, abundance, and behavior of krill (euphausiids) [**KRILL ECOLOGY**].

Those named in Bold Text below have agreed to serve as handling editors on the named topic. Those whose names are in *italics* have agreed to serve as an alternate handling editor, if needed.

- 1) **Rate Measurements: Hans Dam** (hans.dam@uconn.edu); Alternate: *Se-Jong Ju* (sjju@kiost.ac.kr)
- 2) **Zooplankton Composition and Distributions: Eric Bjorkstedt** (eric.bjorkstedt@noaa.gov), Alternate: *Sonia Batten* (sonia.batten@sahfos.ac.uk)
- 3) **Ocean Ecological Forecasting: Skip McKinnell** (mckinnell@shaw.ca)
- 4) **Anomalous Climate Events and Responses of the California Current to Climate Forcing: Sam McClatchie** (sam.mcclatchie@noaa.gov)
- 5) **Krill Ecology: So Kawaguchi** (so.kawaguchi@aad.gov.au)

For more details contact Hal Batchelder (hbatch@pices.int).

Global Ocean Observing System – Biology and Ecosystems Panel report

By Sanae Chiba and Sonia Batten

The Global Ocean Observing System (GOOS) is closely aligned with the purpose of PICES, as stated in Article III of the PICES Convention:

The purpose of the Organization shall be:

- To promote and coordinate marine scientific research in order to advance scientific knowledge of the area concerned and of its living resources, including but not necessarily limited to research with respect to the ocean environment and its interactions with land and atmosphere, its role in and response to global weather and climate change, its flora, fauna and ecosystems, its uses and resources, and impacts upon it from human activities;
- To promote the collection and exchange of information and data related to marine scientific research in the area concerned.

The three GOOS panels (Physics and Climate, Biogeochemistry, and Biology and Ecosystems) have worked to define global requirements for a robust ocean observing system and develop Essential Ocean Variables (EOVs) to measure at a global scale. Drs. Sanae Chiba and Sonia Batten (MONITOR) have been long-serving members of the GOOS Biology and Ecosystems Panel, which has been hard at work defining biological EOVs based on:

1. Their relevance in helping to solve science questions and addressing societal needs;
2. Their contribution to improving management of marine resources;
3. Their feasibility for global measurement in terms of cost and available technology.

The GOOS Biology and Ecosystems Panel has issued its Highlights Report “GOOS Biology and Ecosystems – The

Evolution 2017 – From draft to craft” in [report](#) and graphical [form](#).



Drs. Sanae Chiba and Sonia Batten are members of the GOOS Biology and Ecosystems Panel. Within PICES, Dr. Chiba is Vice-Chair of the Technical Committee on Monitoring (MONITOR) and is a member of the Working Group on the Third North Pacific Ecosystem Status Report (WG 35), and Dr. Batten is SAHFOS ex officio member of MONITOR.

OceanObs’19 – An Ocean of Opportunity, call for Community White Paper abstracts open



OceanObs’19 will be held September 16–20, 2019 in Honolulu, Hawaii, USA. This is the third in a series of Ocean Observation Conferences held every 10 years. OceanObs’99 resulted in an internationally coordinated system for physical climate and ocean carbon observations. OceanObs’09 expanded the range of communities working together to undertake more comprehensive and sustained ocean observations and led to the Framework for Ocean Observing.

The main goals of the conference will be to further develop effective strategies for a sustained, multidisciplinary and integrated ocean observing system, and to better connect user communities and observers. End user communities include operational users, national and local authorities as well as researchers, from the public and private sectors. Engagement with international user communities can take diverse forms, including closer interaction to better target their needs for ocean observing networks and derived products while better informing management decisions.

OceanObs'19 will continue the tradition of building the vision of ocean users and observers.

The call for abstracts for OceanObs'19 Community White Papers is now [active](#). Based on the contributed abstracts, the OceanObs'10 Program Committee will solicit full Community White Papers. The Community White Papers should promote international collaboration and large-scale sustained ocean observing efforts and should address one or more of the seven (anticipated) themes (Discover, Ecosystem Health and Diversity; Climate Variability and Change; Water, Food and Energy Security; Hazards and Maritime Safety; Blue Economy) and two cross-cutting themes on data information systems and ocean observing governance topics. The Program Committee may recommend that authors of particular abstracts collaborate and merge the concepts described in separate abstracts to develop a joint Community White Paper.

The closing date for Community White Paper abstract submission is March 15, 2018, and full Community White Papers to be submitted by the end of September 2018. The resulting papers will be peer-reviewed and published in an open access journal before the conference.

For further information, see the [OceanObs'19 website](#).

Calendar of events

[NPFC/FAO Workshop – Protection of Vulnerable Marine Ecosystems in the North Pacific Fisheries Commission Area: applying global experiences to regional assessments](#)

March 12–15, 2018, Yokohama, Japan (co-sponsored by PICES)

[6th International Marine Debris Conference](#)

March 12–16, 2018, San Diego, USA (co-sponsored by PICES)

[SOLAS Workshop – Remote sensing for studying the ocean–atmosphere interface](#)

March 13–15, 2018, Potomac, USA

[PICES/CIBNOR/CICIMAR International Symposium – Understanding changes in transitional areas of the Pacific](#)

April 24–26, 2018, La Paz, Baja California Sur, Mexico

[PICES/ICES/IOC/FAO 4th International Climate Change Symposium – Effects of climate change on the world's oceans](#)

June 4–8, 2018, Washington, DC, USA

[2018 PICES Summer School – Coastal ocean observatory science](#)

July 9–13, 2018, Victoria, Canada

[7th International SOLAS Summer School](#)

July 23–August 4, 2018, Cargèse, Corsica, France (co-sponsored by PICES)

[ICES Annual Science Conference 2018](#)

September 24–27, 2018, Hamburg, Germany

[PICES-2018 – Toward integrated understanding of ecosystem variability in the North Pacific](#)

October 25–November 4, 2018, Yokohama, Japan

[OceanObs'19 – An ocean of opportunity](#)

September 16–20, 2019, Honolulu, USA

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