



PICES accomplishments during 2020 — Note from the Science Board Chair

Vera Trainer



Photo: Sonia Batten

The recent months have been a time of great introspection and challenge for scientists. I am inspired and excited, as your new Science Board Chair, by the platform for change that PICES collaborative science provides. The beginning of the United Nations Decade for Ocean Science for Sustainable Development (UNDOS) in 2021 is the time for big ideas, ocean solutions, and transformative science of PICES to be shared with the world.

The 29th Annual Meeting (PICES-2020) was held virtually from October 26-30, 2020 across many time zones. 502 scientists from 17 countries took part in the business meetings as well as the science sessions and workshops. All PICES Expert Groups held their meetings between September and November. The dedication of all of the members of the Secretariat is greatly appreciated in facilitating a very successful PICES Annual Meeting: Dr. Sonia Batten, Dr. Hal Batchelder, Dr. Alex Bychkov, Ms. Christina Chui, Ms. Julia Yazvenko, Ms. Susan Hannah, Ms. Saeseul Kim, Ms. Rosalie Rutka, Ms. Lori Waters and Mr. Robin Brown (retired).

The virtual format of this year's sessions necessitated by the global pandemic helped give us a sense of how well the online meeting format works for us, and it also provided an unprecedented opportunity for PICES to document carbon emission savings gained through virtual meeting formats for meetings with varying numbers of participants. For example, the Inter-session Science Board meeting (ISB-2020) alone saved over 70 tonnes of CO₂ emissions, while the smaller Advisory Panel on

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CREAMS for the East Asian Marginal Seas (AP-CREAMS) meeting realized a savings of nearly 9.5 tonnes of CO₂. With the added carbon emission savings of nearly 690 tonnes of CO₂ from PICES-2020, PICES realized cumulative emission savings in 2020 of 768.85 tonnes of CO₂, which is the

equivalent of taking 166 vehicles off the road for one year, or of planting more than 1000 acres of US forest in one year. More information on [PICES carbon reduction initiatives](#) is available on the PICES website.

Many of you completed the survey sent by the PICES Secretariat following PICES-2020. The majority (74%) acknowledged that some combination of virtual and in-person meetings should be part of the PICES vision for the future. While we want to lead through example by reducing our carbon footprint, we also want to continue the PICES tradition of developing trust by visiting one another's countries, realizing that there is no replacement for in-person meetings. In summary, there was good support for advance virtual business meetings and a shorter face-to-face Annual Meeting in the future (71%). [Moving forward, PICES' Science Board has recommended that Expert Groups meet virtually at least once per year.](#) More information on the results of the survey are contained in the Executive Secretary's message in this issue of PICES Press.

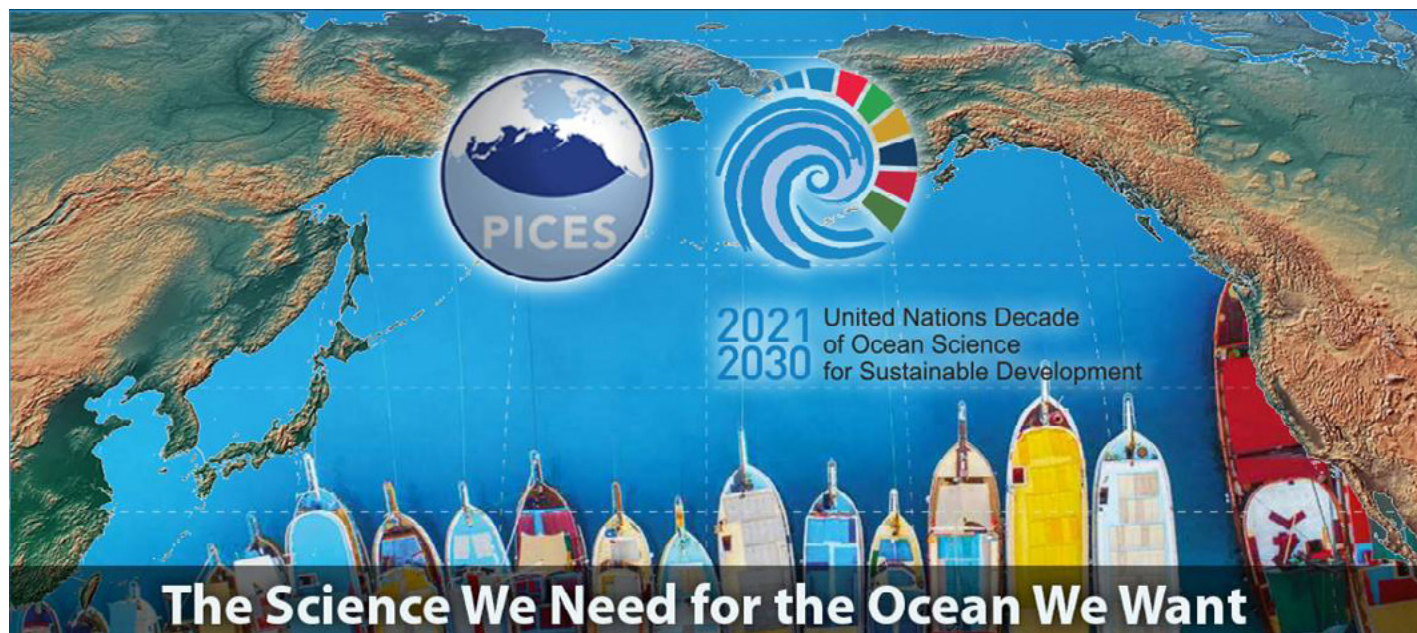
In keeping with this year's PICES-2020 theme of "How does 30 years of research on changing North Pacific ecosystems inform the UN Decade of Ocean Science for Sustainable Development Goals?," topic sessions and workshops during PICES-2020 specifically addressed [UNDOS](#) priorities and included subjects and key questions of the decade, as

relevant to PICES member countries. These include:

1. What are the greatest issues of concern regarding the status and health of the North Pacific Ocean?
2. Are there critical science issues for Ocean Sustainable Development Goals that PICES is not addressing? and
3. What kind of blueprint is necessary to facilitate the coordinated ocean observation, prediction and ecosystem and social service systems for the North Pacific so that the diverse interests of PICES significantly contribute to the goals and objectives of the UNDOS?

In the PICES Science Board Symposium opening presentation, Dr. Steven Bograd presented ideas for how the UNDOS will benefit from PICES involvement. Dr. Pengbin Wang – our Zhu-Peterson Award recipient – presented the results of an Early Career Ocean Professional (ECOP) workshop held during PICES-2020, and proposed some ideas for ECOP involvement in PICES.

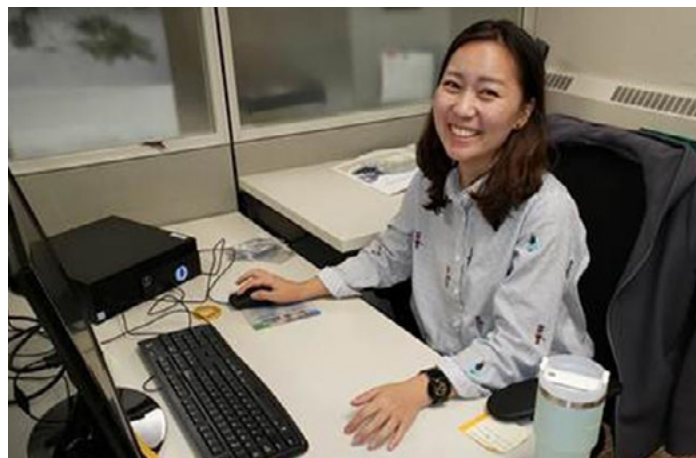
Several topic sessions were delayed until 2021, but those that were held virtually this year included presentations on the use of eDNA to assess and manage non-indigenous species in the North Pacific, the implementation of a high seas survey program to determine climate mechanisms that affect salmon and other pelagic fishes, and microbial community responses to atmospheric nutrient deposition. Many speakers showed their great versatility and commitment to connecting with their colleagues by sharing their science virtually. I extend my thanks to all the presenters. Over the next year, we will continue to have discussions about how 30 years of research on changing North Pacific ecosystems informs the UNDOS, and will celebrate our findings at PICES-2021.



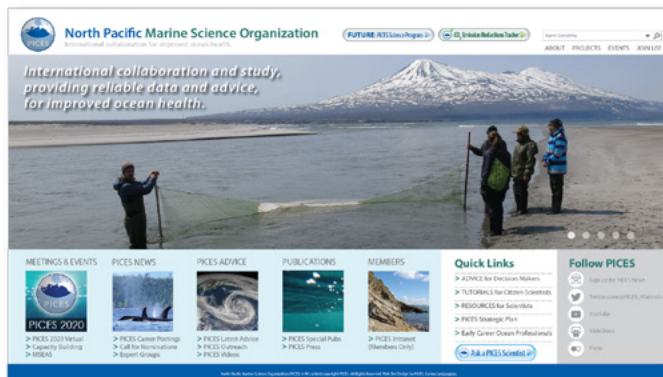
For several years, PICES has provided support for the participation of ECOPs in PICES-sponsored workshops and symposia and has recognized the excellence of presentations by ECOPs at its Annual Meetings. Now we are working on efforts to take this engagement to the next step – by explicitly defining the role of ECOPs as an integrated part of PICES to ensure its lasting legacy. The success of PICES relies on the inclusion of ECOPs, who through the PICES mentorship and capacity-building activities, build the essential skills and relationships they will need in the future to develop and expand PICES scientific contributions, ensuring sustainability of PICES marine research.

A new [Study Group on ECOP](#) engagement within PICES was established at PICES-2020 to ensure that valuable institutional knowledge will be retained, new generations will have a greater sense of shared ownership and buy-in of scientific initiatives, and solutions will be crafted with the innovation that comes with a diversity of perspectives. ECOPs will help PICES play a leading role in the UNDOS by bringing fresh ideas, relevant contributions, and diverse perspectives to the next chapter of scientific discovery. PICES members are urged to please consider including ECOPs in their new Expert Groups, and ECOPs are also encouraged to participate in PICES capacity-building activities.

Just before the COVID-19 shut down limited worldwide travel, PICES sponsored the 2020 Pacific Ecology and Evolution Conference as part of our ongoing support for capacity building in ocean sciences. Organized by and held for early career scientists at the Bamfield Marine Sciences Center, British Columbia, in February, this successful conference is aimed at encouraging the next generation of marine scientists.



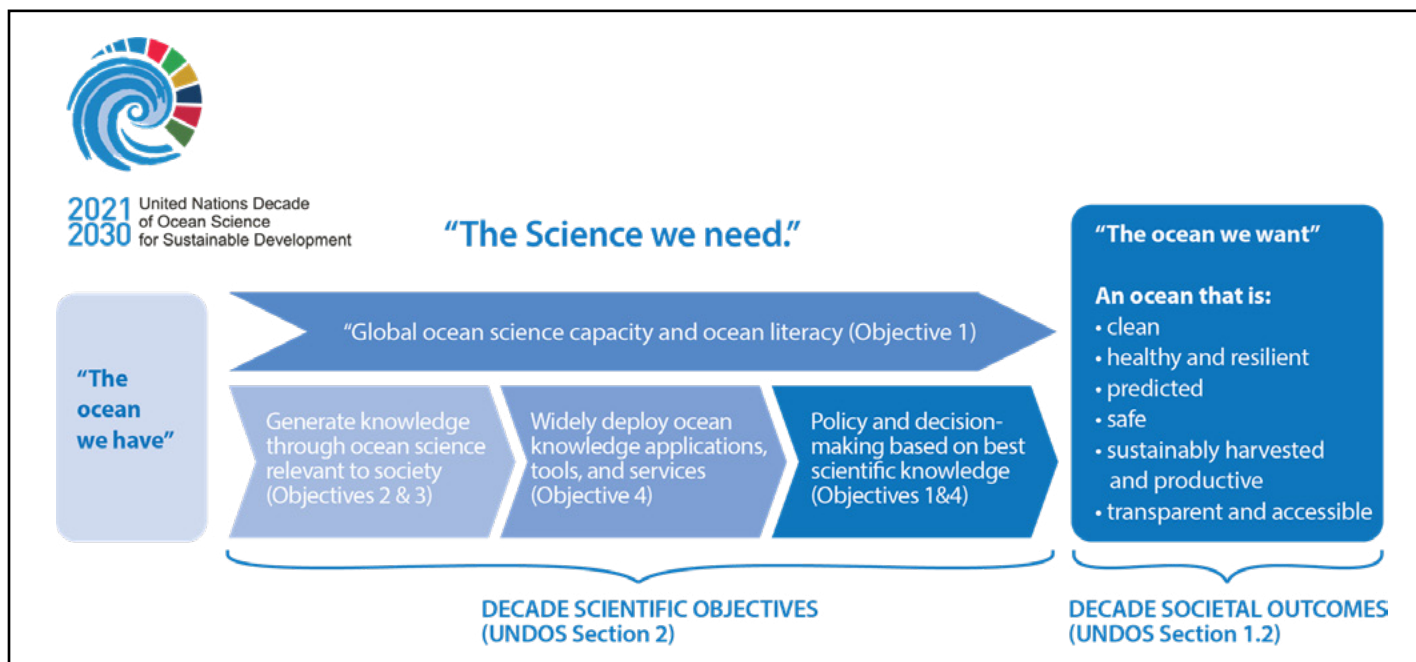
Another aspect of capacity building is the wonderful PICES intern program. To date, 20 interns have received training and assisted the PICES Secretariat. Saeseul Kim (shown here) has been the PICES intern since 2019 and will stay until 2021.



Proposed idea for a new PICES front page - by Lori Waters

In an era of increasing need for collaboration, PICES aims to ensure that we communicate our key and important scientific findings to the global community, including scientists and policy makers from a wide range of disciplines, and the general public. Our vision in communicating PICES science to laypeople is that it will facilitate healthy change for our oceans by empowering the public through a deepened awareness of the great science that PICES does. Through the leadership of a newly established Study Group on Science Communications ([SG-SciCom](#)), we will create a new [website landing page that invites the world](#) to learn more about our transformative science. Another goal of the SG-SciCom is to discuss how PICES can work toward carbon neutrality over the next few years. Please feel free to [share your ideas with this new Study Group](#) on how to better communicate our science.

The overarching Science Program of PICES is [FUTURE, Forecasting and Understanding Trends, Uncertainty and Responses of North Pacific Marine Ecosystems](#). As FUTURE begins Phase III of its Science Program, we are increasingly envisioning increased collaborations – between PICES' own Expert Groups, and PICES with other organizations. PICES embraces the fact that our science is no longer a single discipline working in isolation, but is wholly integrated into a [Social-Ecological-Environmental Systems \(SEES\) approach](#). As part of this approach, we look forward to engaging in scientific challenges through PICES engagement in the UNDOS. This includes working closely with ECOPs, and under-represented communities to strengthen our science. During the recent meeting of the FUTURE Scientific Steering Committee, we brainstormed ideas to transition PICES from the ocean we have – to the ocean we want. I encourage each of you to [share your vision for the ocean we want](#). Together, we can begin to implement these changes through PICES science. More details about the next generation of FUTURE can be found in a companion article in this issue of PICES Press. We look forward to engaging more on these topics as we look towards the next FUTURE Open Science Meeting, now delayed until 2022.



The UNDOS begins in 2021 with a clear request to marine science organizations across the globe to design programs and projects that will help prevent further degradation of marine ecosystems. UNDOS states that: *“Through stronger international cooperation, the Decade will bolster scientific research and innovative technologies to ensure science responds to the needs of society:*

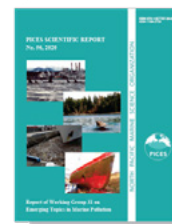
1. *A clean ocean where sources of pollution are identified and removed*
2. *A healthy and resilient ocean where marine ecosystems are mapped and protected*
3. *A predictable ocean where society has the capacity to understand current and future ocean conditions*
4. *A safe ocean where people are protected from ocean hazards*
5. *A sustainably harvested ocean ensuring the provision of food supply*
6. *A transparent ocean with open access to data, information and technologies*
7. *An inspiring and engaging ocean where society understands and values the ocean.”*

The uniqueness of the [PICES SEES approach](#) places us in an ideal position to find solutions to facilitate change. It also provides an unprecedented opportunity to strengthen and expand the collaborative science between PICES and partner organizations. Working together, we will continue to develop science in areas such as: climate change effects on marine ecosystems; fisheries and ecosystem-based management; the human dimension; as well as capacity building to develop and implement ocean solutions. Our science will promote climate justice that includes underserved communities. FUTURE will play a key role in defining the PICES role within the UNDOS and will work

closely with the newly formed joint [PICES/ICES Study Group for UNDOS](#). PICES will submit a regional proposal to UNDOS for the 15 January 2021 deadline, with the aim of becoming a key partner to help define the UNDOS roadmap and influence societal outcomes.

During the [Opening Session](#) of PICES-2020, [awards were presented](#), including the Wooster, Zhu-Peterson, and POMA awards. This year’s Wooster Award was presented to Dr. Hiroaki Saito (Japan) for his sustained excellence in research and teaching of marine science in the North Pacific. A tribute video documenting Hiroaki’s many achievements was assembled by Dr. Emanuele (Manu) Di Lorenzo with contributions from many of Hiroaki’s colleagues, friends, and family. The first ever Zhu–Peterson Early Career Scientist Award was presented to Dr. Pengbin Wang (China), currently the Co-Chair of the Section on Ecology of Harmful Algal Blooms in the North Pacific (S-HAB). This award is given in honor of the late Professor Mingyuan Zhu, First Institute of Oceanography, Ministry of Natural Resources, China, and the late Dr. Bill Peterson, Northwest Fisheries Science Center of NOAA, USA, two esteemed PICES marine scientists who strongly encouraged early career scientists to become engaged in PICES. Finally, the PICES Ocean Monitoring Service Award (POMA), which aims to recognize organizations, groups and outstanding individuals that have contributed significantly to the advancement of marine science in the North Pacific through long-term ocean monitoring, data management, and innovative advances in ocean monitoring, was awarded to the La Perouse Program (Department of Fisheries and Oceans, Canada). Details about the awards can be found in this issue of PICES Press. I extend my heartfelt congratulations to all the award recipients!

- 32 Special Issue papers (Primary literature)
- 2 Outreach brochures
- 38 PICES Press articles
- 1 Special Publication
- 6 Scientific/Technical reports



PICES Publications 2020

This year, several important PICES publications were approved, and are posted on the PICES website or in the peer-reviewed literature. Please read these interesting scientific communications when you have the opportunity. The Section on Harmful Algal Blooms (S-HAB) has recently published, as [PICES Scientific Report No. 59](#), entitled “*GlobalHAB: Evaluating, Reducing and Mitigating the Cost of Harmful Algal Blooms: a Compendium of Case Studies*”. This series of 7 chapters resulted from a 2½-day Marine Environmental Quality Committee (MEQ) workshop on HABs and Economics that was held at [PICES-2019](#). The workshop organizers invited some unique collaborators from the reinsurance industry, economists and fish aquaculture specialties who also contributed to the report. The workshop was co-sponsored by the Scientific Committee on Ocean Research (SCOR), the International Society for the Study of Harmful Algae (ISSHA), Northwest Pacific Action Plan Coastal Environmental Assessment Regional Activity Centre (NOWPAP CEARAC), Grieg Seafood Ltd., the Intergovernmental Oceanographic Commission of UNESCO, GlobalHAB, and AXA XL Reinsurance.

A Special Issue of Harmful Algae on [Climate Change and Harmful Algal Blooms](#) from January 2020 included 2 papers led by PICES scientists, entitled “*Future HAB science: Directions and challenges in a changing climate*” by Mark Wells and co-authors and “*Pelagic harmful algal blooms and climate change: Lessons from nature’s experiments with extremes*” by Vera Trainer and co-authors.



Other recent PICES Scientific Reports are those of WG 28 on [Development of Ecosystem Indicators to Characterize Ecosystem Responses to Multiple Stressors](#), published as PICES Scientific Report No. 55; WG 31 on [Emerging Topics in Marine Pollution](#), published as PICES Scientific Report 56; and WG 32 on [Biodiversity of Biogenic Habitats](#), published as PICES Scientific Report No. 57. Two Working Group 37 new publications on Zooplankton Production Methodologies, Applications and Measurements in PICES Regions are: “[Evaluation of trade-offs in traditional methodologies for measuring metazooplankton growth rates: Assumptions, advantages and disadvantages](#)

for field applications” by Toru Kobari and co-authors in *Progress in Oceanography* and Chapter Four: [Advances in biochemical indices of zooplankton production](#) by Lidia Yebra, and co-authors in *Advances in Marine Biology*.

Other recent PICES publications include an informative brochure by Working Group 30 on [Assessment of Marine Environmental Quality of Radiation around the North Pacific](#), which looked at the impact on the marine environment of the 2011 Fukushima Dai-ichi Nuclear Power Plant accident, and [ICES Scientific Report Vol. 2 Issue 79](#) by the PICES Working Group 39: ICES/PICES/PAME Working Group on Integrated Ecosystem Assessment (IEA) for the Central Arctic Ocean.

PICES North Pacific Ecosystem Status Report 3 (NPESR3) Synthesis Report is in its final stages of editing and is being prepared for printing in spring 2021 as a PICES Special Publication, in addition to the online publication of regional chapters. This report will provide an integrated view of the status and trends in North Pacific marine ecosystems, and the vulnerability and resilience of these ecosystems to pressures from climate change and human activities. Intended for anyone interested in the science of climate and marine ecosystems of the North Pacific Ocean, the report will be useful for governments dealing with North Pacific ecosystem policy and management issues.

Many of the issues facing our oceans are too big to tackle by one organization or one country, making collaborations essential. Especially with the initiation of UNDOS in 2021, it is important for PICES to collaborate with other organizations and programs. PICES-2020 was attended by 80 observers, including 37 representatives of international and regional organizations. Several partners (ICES, NPFC, Future Earth, and APN) were invited presenters at the Science Board meeting, which facilitated discussions regarding ongoing and future collaboration with PICES. Our collaboration with ICES is strengthened by our relationship with them in several PICES and ICES joint Expert Groups. The new [SG-UNDOS](#), jointly led by PICES and ICES is a testament to this important partnership. All PICES Expert Groups that were newly formed in 2019 are joint with ICES and include: [WG 43: Joint PICES/ICES Working Group on Small Pelagic Fish](#), [WG 44: Joint PICES/](#)

ICES Working Group on Integrated Ecosystem Assessment for the Northern Bering Sea - Chukchi Sea, [WG 45](#): Joint PICES/ICES Working Group on Impacts of Warming on Growth Rates and Fisheries Yields (GRAFY), and [WG 46](#): Joint PICES/ICES Working Group on Ocean Negative Carbon Emissions (ONCE). PICES and ICES have sponsored joint expert groups since 2008 and co-sponsor many symposia, sessions, workshops and capacity development activities such as the PICES/ICES Early Career Scientist Conference series.

At PICES-2020, Governing Council approved two new Working Groups and three new Study Groups. These new groups (with parent committees shown in parentheses) are: [WG-47](#) (BIO): Ecology of Seamounts, [WG-48](#) (BIO): Towards Best Practices Using Imaging Systems, [SG-ECOP](#) (FUTURE): Early Career Ocean Professionals, [SG-UNDOS](#) (FUTURE): United Nations Decade of Ocean Science, [SG-SciCom](#) (HD): Science Communications. All requests for Working Group extensions were approved, as GC recognized how challenging it has been this year to complete planned activities.



L-R: FishGIS, Ciguatera, and SEAturtle Projects.

PICES is often requested to provide scientific and technical expertise to special projects dealing with marine issues in countries outside of the PICES region. One such project is the “[Building capacity for coastal monitoring by local small-scale fishers](#)” project, or “FishGIS” for short, funded by Ministry of Agriculture, Forestry and Fisheries (MAFF), of Japan. FishGIS concluded this year and the final report has just been published as [PICES Scientific Report No. 58](#). A summary of this project also appears in this issue. A new follow-up MAFF project began in 2020 to build upon FishGIS smartphone-based technology. It will build local warning networks to assess, detect, and prevent human ingestion of Ciguatera fish poisonin in Indonesian communities, as this poisoning is a threat to the safe harvest of seafood due to the difficulty of detecting this seafood toxin. Both of these PICES–MAFF projects work with local coastal communities in Indonesia to monitor environmental conditions and fisheries using smartphone-based technology, with the aim of enhancing the data collection capacity of the Indonesian government, to improve management practices. Another project with a goal of sharing knowledge, data, and information within the PICES research community and beyond is the “SEAturtle” (Sea turtle ecology in relation to

environmental stressors in the North Pacific region) special project funded by the Ministry of Oceans and Fisheries of Korea. The aim of this project, which will end in 2022, is to research the endangered sea turtle populations in the Northwest Pacific, with a focus on Jeju Island, Republic of Korea, in order to understand the threats to their habitat and ecology in relation to anthropogenic activities, by using Iridium satellite-tracked tags to track their migration routes.

At the conclusion of PICES-2020, Dr. Carmel Lowe (Canada) completed her tenure as Chair of PICES F&A Committee, and Dr. Chul Park (Korea) completed his term as Chair of PICES. I sincerely thank them for their valuable contributions and dedication to PICES. Dr. Igor Shevchenko (Russia) was re-elected for a second 1-year term as Vice-Chair of Science Board, Dr. Wongyu Park (Korea) agreed to a term extension to 3 years as Vice-Chair of the BIO Committee, Dr. Xianshi Jin (China) was re-elected for a second 3-year term as Chair of the FIS Committee, Dr. Jackie King (Canada) was re-elected for a second 3-year term as Vice-Chair of the FIS Committee, Mr. Peter Chandler (Canada) agreed to a 1-year extension as Vice-Chair of TCODE, and Dr. Kirsten Holsman (USA) was elected as a new Co-Chair of S-CCME (PICES/ICES Section on Climate Change Effects on Marine Ecosystems), replacing Dr. Jackie King.

We said goodbye to three of our PICES leaders who passed away in 2020. Dr. Paul LeBlond was the Chair of the POC Committee from 1995-1998, Chair of WG 7 on Modeling the Subarctic North Pacific Circulation, a lead organizer of the 1999 International Conference “Beyond El Nino” and a Wooster Award recipient in 2004. Dr. Douglas McKone was the first Executive Secretary of PICES from 1993-1998. Dr. Richard John Marasco was a US delegate, F&A Chair from 1998-2004 and the first recipient of the PICES Chair Award in 2016. We will miss these friends.

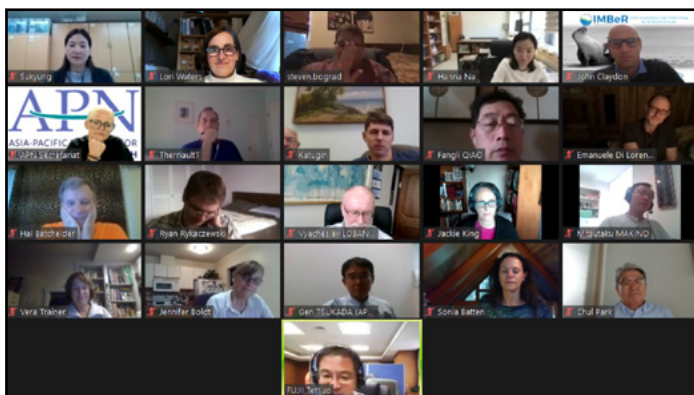
With regard to sessions and speakers at PICES-2021, we request your patience as no firm plans can be made at this time. Many topic sessions and workshops will be held over to the 2021 Annual Meeting which we currently plan to hold in the fall of 2021 in Qingdao, China. There also were several proposals for new sessions and workshops at PICES-2021 which will be reviewed during ISB-2021. Stay tuned for decisions about the PICES-2021 program, recognizing that some sessions may need to be deferred or held virtually.

In closing, I am hopeful that we will meet in person in 2021. I am truly grateful to be part of such a visionary international science organization. As we look to the future, let us work toward greater diversity and inclusion, collaboration with underrepresented communities and their people, and clear and concise communication of our science with the world!



Highlights from the FUTURE SSC's 2020 Annual Meeting

Sukyung Kang and Steven Bograd



The FUTURE Scientific Steering Committee (SSC) held its 6th annual meeting since 2014. **FUTURE**, (**F**orecasting and **U**nderstanding **T**rends, **U**ncertainty and **R**esponses of North Pacific Marine **E**cosystems) is PICES' second integrative Science Program, which was launched at PICES-2009. This year's meeting was 'virtual' and took place October 4–7, 2020. The 3-day affair was led by FUTURE SSC Co-Chairs Steven Bograd and Sukyung Kang, and was attended by all 15 SSC members, in addition to 6 invited guests, the Chair of PICES, the Chair of Science Board, and personnel from the PICES Secretariat, who hosted the online meeting.

Review of 2020 activities

The SSC reviewed activities since our last meeting at PICES-2019 in Victoria, BC, Canada, including membership changes. Ian Perry (Canada), Toyomitsu Horii (Japan) and Sinjae Yoo (Korea) have stepped down from the SSC and were thanked for their excellent service to the Program over the past several years. New members were introduced, including: Hanna Na (Korea) replacing Sinjae Yoo; Jennifer Boldt (Canada) replacing Ian Perry; and Tetsuo Fujii (Japan) replacing Toyomitsu Horii. The SSC also revised its liaison table, which shows the lines of communication between SSC members and PICES Expert Groups, to reflect both the changes in SSC membership and the commencement or completion of Working Groups.

The SSC discussed its new **Early Career Researcher Social-Ecological-Environmental Systems (SEES) Award**, (approved at PICES-2019) which is designed to advance the SEES approach in PICES and engage early career researchers in conducting their studies within PICES. The award provides travel support, an invited speaking slot and a certificate to an early career scientist(s) who proposes the best SEES approach to their work. As PICES did not have an in-person Annual Meeting this year, we were unable to select a recipient for this award. We anticipate selection of the first FUTURE SEES award next year.

The SSC is continuing to plan for a FUTURE Open Science Meeting which seeks to highlight and synthesize accomplishments of the FUTURE Phase II (2014-2020) Science Program and related activities, including from other international organizations. The meeting will also feature the application of the SEES approach within the framework of UN Decade of Ocean Science for Sustainable Development (UNDOS; 2021-2030). Due to travel constraints and delays related to the COVID-19 pandemic, FUTURE has postponed the target date for this meeting to Spring 2022 and has tasked a small group of SSC members to work with the PICES Secretariat to plan the logistics for this meeting.

Following on discussions at PICES-2019 and ISB-2020 (PICES Press, Summer, 2020, Vol. 28, No. 2), FUTURE examined the strategy for continuing PICES integrative science. Phase II (2014-2020) of the FUTURE Science Program will be completed this year, and FUTURE will embark on Phase III of the FUTURE Science Program with revised Science and Implementation Plans. During Phase II, the SSC implemented a **SEES framework** to promote multi-disciplinary marine research and facilitate synergies amongst PICES Expert Groups (see Bograd et al., 2019 and PICES Press, Vol. 26, No. 2). A FUTURE Phase II Final Report, including a searchable Product Matrix, will be completed in early 2021. During Phase III, FUTURE will build upon the SEES approach, outline significant engagement with UNDOS, and emphasize a renewed commitment to communication and outreach to a variety of stakeholders. The new **FUTURE Phase III Science and Implementation Plans** were approved by Science Board and Governing Council at PICES-2020.



PICES engagement with the UN Decade of Ocean Science for Sustainable Development (UNDOS)

A key objective of the SSC annual meeting, as with the 2020 inter-sessional meeting (PICES Press, Summer, 2020, Vol. 28, No. 2), was to conceptualize ways in which FUTURE, and PICES more generally, can engage with and provide leadership to the UN Decade of Ocean Science. The SSC reviewed the decade objectives, processes and timeline of UNDOS given by Dr. Fangli Qiao, who is a member of the UNDOS Executive Planning Group. Dr. Qiao notified the SSC that the Intergovernmental Oceanographic Commission (IOC) will release its first Call for Decade Actions in October, with proposals due in January 2021.

Dr. Bograd updated the SSC on the work of the ad hoc group of ICES and PICES members who have been discussing strategies for joint activities that these organizations can undertake as part of UNDOS. The group met in person at PICES-2019 and organized a series of calls in the first six months of 2020. Three products have emerged from these meetings:

1. A letter to the PICES Governing Council and ICES Science Committee describing a strategy for joint UNDOS activities;
2. A draft Strategic Plan of joint PICES-ICES UNDOS activities, still under development;
3. Joint comments on the draft UNDOS Implementation Plan. To formalize and better organize these collaborations, a new joint PICES-ICES Study Group on the Ocean Decade (SG-UNDOS) was proposed and was approved by Science Board and Governing Council at the Annual Meeting. The FUTURE SSC had lengthy discussions on the scope of this new SG and noted the need to coordinate efforts with the FUTURE SSC as well as with SG-ECOP (see below) and S-CCME.

FUTURE and PICES engagement in UNDOS has naturally led to planning for development of new PICES Expert Groups. The FUTURE SSC supported two proposed new Expert Groups: [SG-UNDOS](#) and [SG-ECOP](#) a Study Group for Early Career Ocean Professionals (also approved by Science Board and Governing Council). SG-UNDOS will consolidate a strategic plan to bring about transformational science during UNDOS by building upon our long history of successful partnerships in advancing marine science. The SG will also facilitate broader participation from PICES, ICES, and other partners to expand organizational reach. SG-ECOP will solicit input from the PICES community, through workshops and surveys, and develop an engagement plan for ECOPs in PICES and within the context of relevant partner organizations and international processes, such as the Ocean Decade. The SSC also expressed support for potential new Expert Groups on Science Communications and Coastal Impacts of Climate Extremes.



Two invited international organizations participated in the FUTURE SSC Annual Meeting: [IMBeR \(Integrated Marine Biosphere Research\)](#), a large global research project focused on ocean sustainability in the context of global change, and [APN \(Asia-Pacific Network for Global Change Research\)](#), an intergovernmental network of 22 countries working towards an Asia-Pacific region that successfully addresses the challenges of global change and sustainability.

Dr. John Claydon (Executive Director, IMBeR) introduced the structure of IMBeR, its science plan, and 2016-2025 implementation strategy in conjunction with UN Decade of Ocean Science. He presented a cost-benefit analysis of IMBeR's involvement in UNDOS and encouraged future cooperation with PICES. Dr. Linda Anne Stevenson (Head of Knowledge Management, APN) introduced the recent activities of APN and its direction during 2020-2024. The FUTURE-SSC considered potential participation of APN in a joint UNDOS proposal with PICES and a Pacific-wide approach that would include participation from the Southern Hemisphere.

FUTURE 2021 Action Plan

The FUTURE SSC's Action Plan for the coming year, includes:

1. Finalizing and distributing a FUTURE Phase II Product Matrix and Final Report;
2. Finalizing the logistics for a 2022 FUTURE Open Science Meeting;
3. Participating in the new SG-UNDOS and SG-ECOP, and continuing to advance PICES engagement in the UN Ocean Decade;
4. Facilitating development of new Expert Groups to advance FUTURE objectives and UNDOS activities, along with ways to provide greater synergy amongst existing Expert Groups.

Endnote: FUTURE inter-sessional meeting participants

FUTURE Co-Chairs:

Steven Bograd (USA)
Sukyung Kang (Korea)

FUTURE Members:

Jennifer Boldt (Canada)
Emanuele Di Lorenzo (USA)
Tetsuo Fujii (Japan)
Oleg Katugin (Russia)
Jackie King (Canada)
Vyacheslav Lobanov (Russia)
Mitsutaku Makino (Japan)
Hanna Na (Korea)
Fangli Qiao (China)
Ryan Rykaczewski (USA)
Thomas Therriault (Canada)

Guests/Observers:

Linda Anne Stevenson (APN)
Gen Tsukada (APN)
John Claydon (IMBeR)
Fang Zuo (IMBeR)
Erin Satterthwaite (NCEAS,
Future Earth, ECOP)
Sung Yong Kim (MONITOR)

PICES:

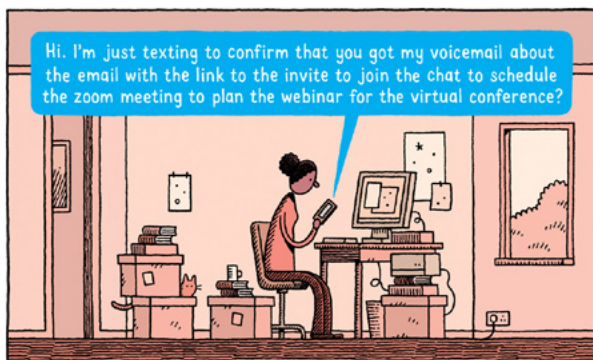
Chul Park (PICES Chair)
Vera Trainer (SB Chair) Harold
(Hal) Batchelder
Sonia Batten
Alex Bychkov
Lori Waters

Looking back on PICES-2020 — Our first entirely virtual meeting!

Sonia Batten

The highlight of the PICES year is the Annual Meeting held each autumn. Despite the challenges of 2020, that was still true this year, with much-appreciated opportunities to meet (even if virtually) with our colleagues and discuss marine science and the new opportunities and challenges. Much of the scientific progress and highlights are presented elsewhere in this issue so here I will focus on the resilience shown by PICES members and the strong efforts expended to make the meeting as productive as possible. I would also like to offer my congratulations to the PICES-2020 award recipients, featured in this issue, each of whom thoroughly deserved this recognition. We look forward to more great contributions to PICES over the next few years! Nominations are now open for 2021 awards (closing date is March 31 2021), so please see the [PICES website](#) for more details.

Expert Groups (EGs) held virtual business meetings from September 1 through to early October (27 groups in total, with meetings for each spread over 1 to 3 days). Scheduling them to avoid conflicts for scientists who are members of more than one EG, and trying to make sure as much as possible that their parent Committee(s) met after them was a logistical challenge and we didn't always have the perfect outcome (some days life in the Secretariat felt very much like this cartoon!)



Cartoon reproduced with permission, courtesy of Tom Gauld <https://www.tomgauld.com/>

However, all EGs that needed a meeting held one and participation was higher than normal. Typically, PICES member countries are able to send 25–73% of their EG members annually. However, participation in virtual EG meetings this year was higher for all countries, ranging from 44–87%. Post-meeting discussions and results of the feedback survey circulated showed that while some face-to-face time for EGs is important, many people felt that substantial progress on a Group's goals can still be made using a virtual meeting platform, and that it may offer a valuable opportunity to "meet" more regularly throughout the year, as well as reducing the length and intensity of a typical PICES Annual Meeting. So, some of the challenges

we've faced this year may actually help us move the Organization forward, and we received some good practical suggestions towards that goal. To enable EGs to meet online more frequently, the PICES Secretariat will provide access to a Zoom hosting account for any Chairs who do not have their own virtual meeting licence. (Please contact sonia.batten@pices.int for more information).

In total, the PICES Secretariat hosted 37 virtual workshops and business meetings hosted in September 2020, 20 virtual meetings in October 2020, 3 virtual Governing Council meetings in November 2020, and numerous meetings with collaborating organizations, sometimes at 4am local time! Although the number of workshops and science sessions was much reduced compared to a typical Annual Meeting, we still attracted many participants. There were 502 participants joining from 17 countries. Participation during the previous 6-year rotation of member countries (2014-2019) ranged from 328 to 649, so 2020 was in the middle. Thank you to everyone who offered a presentation or joined a meeting or science session, and thank you to all who participated in our post-meeting survey.

In all, we had 63 responses to our survey. The majority (74%) of the responses were complimentary, 10% mentioned that they missed face-to-face meetings and 34% contained a "could do better" message. Many participants liked the option of listening to recorded presentations at their convenience. The chat function was seen as an advantage as many participants could see the questions clearly written, and notes of encouragement were often written in the chat. The majority of survey participants felt that advance virtual business meetings, followed by a shorter duration in-person Annual Meeting that includes workshops, topic sessions, and perhaps brief follow-up business meetings (for idea sharing as a follow-up to knowledge sharing from sessions/workshops) would be desirable. To summarize, there was good support for advance virtual business meetings and a shorter face-to-face Annual Meeting in the future (71%). Certificates have been sent to three survey participants, drawn at random, for free registration to PICES-2021.

I received feedback from many about how much the chance to talk over coffee or dinner was missed, and it is likely that opportunities to collaborate and develop new joint projects were much reduced. We will only see the full effects of the reduced in-person contact in subsequent years. However, I also received comments that some people were able to join a PICES meeting for the first time because of the virtual platform. With the reduction in CO₂ emissions too, there are some tangible benefits to take away from the ups and downs of 2020! Thank you everyone for participating during this challenging year.

Congratulations to PICES-2020 Award Recipients

PICES-2020 Wooster Award



In 2000, PICES Governing Council approved the **Wooster Award**, named in honour of **Professor Warren S. Wooster** (shown at left), a principal founder and the first Chairman of PICES, and a world-renowned researcher and statesman in the area of climate variability and fisheries production. The Award selection criteria 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.

PICES-2020 Wooster Awardee: Hiroaki Saito (Japan)



At PICES-2020, it was announced that Prof. Hiroaki Saito (The University of Tokyo, Japan) was the recipient of the 20th Wooster Award. The presentation ceremony took place virtually on October 26, 2020, during the PICES-2020 Opening Session and was conducted by Drs. Chul Park (PICES Chair) and Vera Trainer (PICES Science Board Chair). Dr. Trainer introduced the Wooster Award and a [video](#) outlining Dr. Hiroaki's significant career contributions, and containing congratulatory messages from PICES members and Prof. Hiroaki's family. The following text is excerpted from the video script.

Dr. Hiroaki Saito graduated from Tohoku University in 1986 and started his scientific career at Hokkaido National Fisheries Research Institute, Japan Fisheries Agency studying squid in the Western North Pacific. In 1990, he moved to the Biological Oceanography Section and started biological and ecological studies of copepods. In 2001, he moved to Tohoku National Fisheries Research Institute and later in 2014 he joined the Atmosphere and Ocean Research Institute at the prestigious University of Tokyo as a Professor.

It is said that when Hiroaki was a small boy, his grandfather presented him an encyclopedia, which Hiroaki always kept with him to read. His father also recalls that Hiroaki was a poor university student. He was always eating cheap crusts of bread, so he was very thin at the time. However, according to the other sources of information (Hiroaki's wife), this was because he spent all the money sent from his father on fine parties and drinking. It turns out that this was money well spent, as Hiroaki is well known and famous among his colleagues for his rich knowledge of wines, gastronomy, fine arts, and luxury cars. In fact, he is known as the "James Bond" of the University of Tokyo.



Armed with his intellectual and his acquired life skills, Hiroaki has shown strong leadership in several national and international scientific programs. Below is a list of the many projects that Hiroaki has been involved in as a member and as a leader.

- BIOCOSMOS project (1990-1998)
- Co-Founder, A-line Monitoring, Oyashio Region (1990-)
- Subarctic Gyre Experiment (SAGE) (1997-2002)
- VENFISH northwestern Pacific (1998-2002)
- Core Member, SEEDS (2001-2004)
- Project Leader, Deep-Sea Ecosystem and Exploitation (DEEP) (2002-2006)
- Project Leader, Population Outbreak of Marine Life (POMAL) (2007-2012)
- Leader, Study of Kuroshio Ecosystem Dynamic for Sustainable Fisheries (SKED) (2011-2021)

Dr. Hiroaki Saito also has worked tirelessly for several professional organizations. Most notably IGBP/SCOR, IMBER, CLIVAR, Science Council of Japan, and, of course, PICES. He served terms as a member of the Science Steering Committee of IGBP/SCOR IMBER. He was on the Editorial Board of the journals *Progress in Oceanography* (2003-2010), *Plankton and Benthos Research* (2005-2011), *Fisheries Oceanography* (2007-2013) and *Journal of Oceanography*

(2011-2019). Currently, Dr. Saito sits on the editorial board of *Frontiers in Marine Science* (since 2014). Throughout this journey, he has interacted with fellow scientists, such as Ian Perry, who wish to share their thoughts:

"I first met Hiroaki about 15 years ago now when I was on the GLOBEC international committee and Hiroaki was a member of the IMBER international steering committee. He was a bio-geochemist, pretty focused on the cycling of nutrients and such in the world oceans. But in the 15 years that I've known him, Hiroaki has expanded in his expertise and his disciplinary breadth so much now, that he's truly like what one might call an interdisciplinary oceanographer, which includes from physics, all the way up to human dimensions of the marine ecosystem. And it has been spectacular to see how he has been able to grow from this bio-geochemistry core to this fully-fledged internationally respected oceanographer." ~ Ian Perry, Science Board Chair (2001-2004)

Hiroaki is known to work hard, and to make his students work hard. However, when the time comes, Hiroaki knows how to enjoy his well-deserved breaks. He is also known to work in style, and has impressive taste in clothing. He shares this passion with his beloved partner in crime, his dog Rosso, who has an impressive wardrobe himself.

Dr. Hiroaki Saito's outstanding achievements cover a broad spectrum of a scientist's career and his contributions to PICES are equally impressive and sustained over many years. It is difficult to provide a comprehensive account, but here are a few more words from some of his colleagues and friends:

"I've known Hiroaki from the early days of FUTURE when we were Advisory Panel chairs and thrown into Science Board. I've always appreciated his wide range of views and opinions on a number of marine science issues. And I can't think of anybody who is more deserving of this year's award." ~ Thomas Therriault, Science Board Chair (2010-2012)

"Hiroaki was a key architect of the FUTURE Science Program. And he was instrumental in implementing the social ecological, environmental approach in PICES. I've known Hiroaki for many years, and I've always been impressed at how much he enjoys that interdisciplinary, and multi-national nature of PICES." ~ Steven Bograd, Co-Chair FUTURE SSC

In recent years, Hiroaki has continued to play a pivotal role in advancing the work of the FUTURE Scientific Steering Committee, including his invaluable help with the recording of the PICES FUTURE video. Online as part of Hiroaki's award video, you will find some "behind the scenes" uncut video clips of those wonderful days in Yokohama during the recording.



In 2013 Hiroaki began his work as Vice-Chair of Science Board, and he was elected Chair in 2016, serving through 2019. Under his leadership, PICES has made major advances in understanding the processes and mechanisms of the marine ecosystem response to climate. During this time as Science Board Chair he touched the lives of many PICES scientists, including our current SB Chair Vera Trainer who has a few memories to share.

"I remember sharing a taxi cab with Hiroaki on my way to the 2017 PICES Annual Meeting in Vladivostok. He was a great listener and was truly interested in what I had to say. Little did I know that his advice would be invaluable as I transitioned to the Science Board Chair position of PICES. He has been generous with his time, forward thinking and has guided me with his experience in the PICES family. Congratulations, Hiroaki, on your well-deserved winning of the Wooster Award." ~Vera Trainer, Science Board Chair

Parallel to Hiroaki's leadership is his kind heart. This is reflected in his love for nature and flowers for anyone who has access to his Facebook account. In the Atmosphere and Ocean Research Institute (AORI), Hiroaki is known as being very good at growing plants; they say he has a "Green Thumb". Sometimes, weak plants in other labs are brought to Hiroaki, to be revitalized by him. He extends his green thumb ability to his students and has a marvelous ability to supervise and inspire students.

Throughout his leadership, Dr. Saito has always shown a strong commitment to advance and educate Early Career Scientists and students.

"Along with the immense leadership that Hiroaki has brought to PICES, his kind and caring nature has created an encouraging and collaborative atmosphere for all PICES scientists, particularly, students and Early Career Professionals. So, congratulations Hiroaki-san on your well-deserved Wooster Award." ~ Jackie King, FUTURE SSC

Throughout his time in PICES, Hiroaki has built long-lasting friendships and always prioritized the Human Dimension. In moments of difficulty, Hiroaki is able to observe the world through a special lens. In fact, some people say he maintains a secondary laboratory devoted to chemical analysis and distillation of the finest whisky.

Hiroaki has contributed to making PICES a family for many of us. There are no better words to express our appreciation of Hiroaki's contribution as a scientist and human being than the words from his immediate family members.



"Good job, my son. You have been working very hard, and I know you will keep doing so steadily. Make your best possible efforts for the international science cooperation and education. Most importantly, take care of your health and never forget the feeling of gratitude towards your wife, Emiko." ~ from Hiroaki's Father

"Congratulations, Dad! I am very proud of you. This award would be a big milestone for you, and please keep chasing the secret of the ocean." ~ Takayuki (Elder son)

"Congratulations, Dad! When I was a boy, you always gave me a big hug after coming back from research cruises. Next time, I will give you a big hug." Shin-ya (Younger son)

"Do you remember, when I was a small child, I asked you to take me to the Tokyo Disney Land, but you rejected by simply saying "I hate Mickey Mouse." I was very shocked at that time. By the way, Congratulations, Dad!" ~ Fumika (Daughter)

"I am worrying about your eyes, because I know you are overusing them by doing research. Do you remember? Some time ago, you asked me that if you become blind in the future, you want me to read a book aloud to you. In my opinion, it is not a good idea. Manage it by yourself. By the way, congratulations, my dear husband!" ~ Emiko (Wife)

Lastly, from one Wooster Award winner to another:

"So Hiroaki, from one Wooster Award winner to another, it's my heartfelt congratulations to you. It's a well-deserved award, and it's been my very great pleasure to have known you and worked with you over these many, many years, congratulations!" ~ Ian Perry

PICES wishes hearty congratulations and a big toast to our friend and colleague, Hiroaki.

Prof. Hiroaki Saito's acceptance remarks

"I am really honored to receive such a prestigious award. I have no idea how you were able to get my photos and comments from my family members. I am so surprised. Anyway, I am very happy to receive the PICES Wooster Award. I learned a lot from PICES activities by discussing with my friends working with Secretariat members, Science Board, FUTURE SSC, and other Expert Group members. PICES has especially taught me how to be a good scientist, and how to contribute to a society as a natural scientist. It is very unfortunate that I cannot not thank all of you directly, but through Zoom, I want to provide a message of acknowledgement to everyone. Thank you very much."

PICES-2020 Zhu-Peterson Award



The Zhu-Peterson Award was developed and recommended by Science Board, and established by PICES Governing Council in 2019, and is the most recent PICES award. The

award is named in honor of the late Professor Minguan Zhu (Left), formerly of the First Institute of Oceanography, State Oceanic Administration (now Ministry of Natural Resources), China, and the late Dr. William Peterson (Right), formerly of the Northwest Fisheries Science Center of NOAA, USA. Professor Zhu and Dr. Peterson were strong advocates for encouraging early career marine scientists to become actively engaged in PICES. This ECS Award may be given annually to an individual who has performed innovative research at the frontier of science relevant to the PICES mission, as set out in the PICES Convention. Professor Zhu trained many graduate students and ECS, who carry on his legacy of honest enthusiasm for cooperative approaches to marine science research. Dr. Peterson was cherished by his students, technicians, and PICES ECS who regarded him as a “great teacher, and a fun, humble and inspiring mentor”. Zhu and Peterson passed away far too early in their prime, while still actively engaged in their scientific interests. PICES honours the memories of their contributions with this Award.



The first-ever Zhu-Peterson Award for Early Career Scientists was awarded this year, to Dr. Pengbin Wang, an Associate Professor at the Second Institute of Oceanography in Hangzhou, China. Dr. Wang received his PhD from Hanyang University (South Korea) in 2016. He is the co-chair of the PICES Section on Harmful Algal Blooms (since 2019). Beyond PICES, he is a member of the Scientific Steering Committee of the UNESCO-IOC-WESTPAC Harmful Algal Bloom Program, and a SSC member of EASTHAB. He serves as an editor of [Ocean Science Journal](#). Congratulations to Dr. Wang on being the inaugural recipient of the Zhu-Peterson Award.

Dr. Pengbin Wang's acceptance remarks

“I am very honored to be able to get this award and this is the first time. Just now, thanks very much for providing this introduction of my work and also saying something about this award. Though I am not the student of the Professor Zhu, I knew him well as he was a member of the PICES S-HAB. And, every time we met at the meeting, we chatted much actually. He gave me many suggestions and much guidance earlier, when I was a Masters and PhD student. Even now I can clearly remember him, on the day he passed away, seven years ago when we were in Nanaimo, Canada. Actually, Professor Zhu and I had coffee break together, during the tea time of the S-HAB meeting that day. We also met at the eating club. (For those who don't know about eating club, in our S-HAB, everyone knows we have a gathering one night at the annual meetings, to eat local delicious food). Just that day, we were supposed to meet at a great café to eat some delicious food. However, that night, he didn't come and I was very sad for we lost a very great teacher. Here I wish I could also be a good teacher and as good a scientist as Professor Zhu, and also Dr. Peterson. I also wish I can encourage early career scientists later to engage in PICES leadership. I also thank my family for a long time to support my work. Also, thank you to my supervisors and mentor's guidance, like Vera and others who sit here. Lastly, I thank my friends and colleagues in PICES and also in my work. Thank you very much. I will try my best. Thank you very much.”



PICES-2020 Zhu-Peterson Awardee: Pengbin Wang (China)

PICES-2020 PICES Ocean Monitoring Service Award (POMA)



Progress in many aspects of marine science is based on ocean observations, monitoring, and the management and dissemination of the data provided by these activities. Long-term monitoring observations are particularly critical to detecting and understanding ecosystem changes. Monitoring activities are often taken for granted or even targeted for budget cuts

when organizations experience financial constraints. With this in mind, PICES created the POMA. This is its 12th presentation.

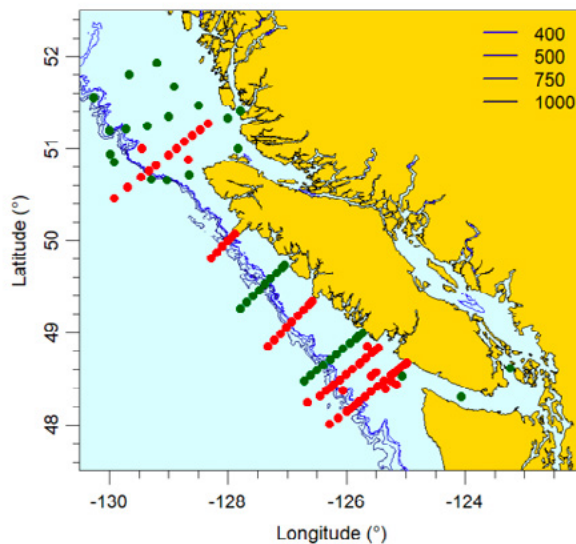
The POMA aims to recognize organizations, groups and outstanding individuals that have contributed significantly to the advancement of marine science in the North Pacific through long-term ocean monitoring, data management, and innovative advances in ocean monitoring. The award also strives to enlighten 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 not so much in the limelight: “to promote the collection and exchange of information and data related to marine scientific research in the area concerned.”

In 2020 there were three submissions for the POMA Award, all of them from the eastern North Pacific. The recipient of the POMA for 2020 is the La Perouse Program of Fisheries and Oceans Canada.

PICES-2020 POMA Awardee: La Perouse Program, Fisheries and Oceans Canada.



The La Perouse Program was initiated in 1979 by Dr. David Mackas of Fisheries and Oceans Canada’s Institute of Ocean Sciences, located in Sidney, BC. The sampling consists of two to four shipboard surveys each year, with between 10 to 30 stations sampled from each of four



regions that circumnavigate Vancouver Island, as shown above. The Program has always included a full suite of physical and biological observations. All physical data are archived in the Fisheries and Oceans Canada water properties database, and are searchable through the web (Waterproperties.ca). Zooplankton data are archived by the Ocean Ecology Group at the Institute of Ocean Sciences, and are freely available through the Canadian data Geoportal at <https://open.canada.ca>.

The survey cruises often include training experiences for students and early career scientists. Since 1979 over 60 students and ECS have participated in the surveys of the La Perouse Program.

Zooplankton data from the La Perouse Program is contributed to both the NOAA COPEPOD database, and the IOC-UNESCO International Group for Marine Ecological time Series (IGMETS) project (<http://igmets.net/>).

There are at least 98 publications from research done on the La Perouse surveys. Twenty-three additional reports have provided contributions to the West Coast of Canada State of the Pacific Ocean Reports.

The recognition that the La Perouse Survey Program is receiving through this PICES award is very well deserved, and PICES congratulates and thanks all participants of this important Program, and for the 41 years of surveys that they have accomplished since 1979.

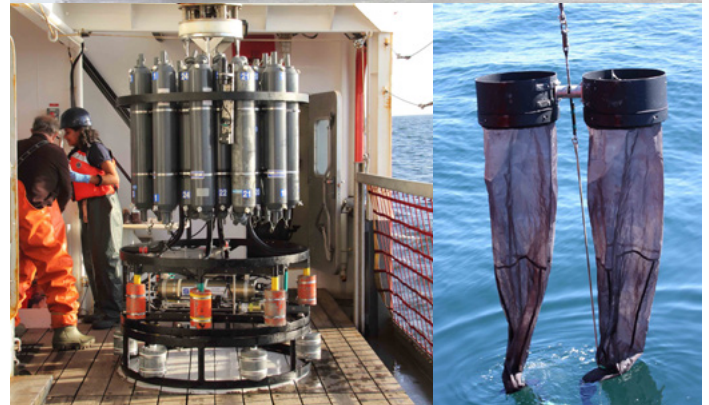


Key personnel associated with the program since 1979 include Dr. David Mackas, Mr. Rod Forbes, Mr. Douglas Moore, Mr. Douglas Yelland, Ms. Moira Galbraith, Ms. Kelly Young, Ms. Nina Nemcek, Ms. Marie Robert, Dr. Ian Perry, Dr. Angelica Peña, Dr. Ken Denman and many others too numerous to mention. Dr. Akash Sastri is currently responsible for leading the La Perouse surveys.

Congratulations to all of the participants of the La Perouse Program for the POMA. Dr. Ian Perry provided a few words of acceptance on behalf of the Program.

Dr. Ian Perry's POMA acceptance remarks

"Thank you very much, Vera, PICES, the MONITOR and TCODE Evaluation Committees, and Science Board for this amazing award. I am not sure if Akash Sastri is also on the Zoom panel today, but he is the current head of the La Perouse Program. There have been many, many people who have made this possible over the years. Of course, Vera already mentioned Dr. Mackas, who has since retired; however, the program has continued. Yelland was in charge of the Program for many years, and Marie Robert has been our chief scientist for several years. I have to mention our key zooplankton people, Moira Galbraith, Kelly Young, and our key phytoplankton people, Melisa Henakis and Nina Nemcek. The problem, of course, with so many people being involved is that I can't mention them all. I do want to certainly congratulate the administration of DFO for supporting this Program since 1979. Those of you involved in monitoring Programs know how difficult it is to keep a Program going beyond about 10 years. However, the scientific leadership at the Institute of Ocean Sciences and in fact throughout DFO in the Pacific region and Ottawa have been very supportive of this Program. This PICES award just shows how much this Program has contributed to the science in the North Pacific and more broadly. Thank you very much. "



Smartphone-based tools to enhance fishery sustainability for coastal communities in developing nations: The PICES–Japan MAFF FishGIS project

Mitsutaku Makino, Mark Wells, Shion Takemura, Shigeharu Kogushi, Naoki Tojo, Charles Trick, Suhendar I Sachoemar, Vladimir Kulik, Chang-an Xu and Joon-Soo Lee

Introduction

Many coastal communities depend on fisheries as their primary source of food and livelihood, so coastal environmental degradation and ecosystem changes have had substantial adverse effects on their well-being over the past decades. One of the crucial tasks for marine researchers is to scientifically assist coastal communities in adapting to ecological and social changes in ways that maintain or enhance their sustainable livelihoods and well-being. This perspective was the motivation for PICES (North Pacific Marine Science Organization) to accept a request to undertake a project entitled “Building capacity for coastal monitoring by local small-scale fishers” (acronym: FishGIS). The project was funded by the Ministry of Agriculture, Forestry and Fisheries (MAFF) of Japan, through the Fisheries Agency of Japan (JFA), from the Official Development Assistance (ODA) Fund, and ran from November 2017 to March 2020.

The overall goal of the FishGIS project was to enhance the capacity of local small-scale fishers and aquaculture farmers to monitor coastal ecosystems and coastal fisheries in Pacific Rim developing countries. The project focused on developing smartphone-based technology and evaluating and implementing its use for citizen-science observations and reporting by local community members on aspects of environmental quality and fisheries status in coastal waters. Towards this end, PICES began working with Indonesian government scientists and representatives, and in close collaboration with four local coastal communities (Figure 1), using the Transdisciplinary Research Concept of Future Earth (Makino and Wells, PICES Press Vol. 26, No. 2, pp. 20–24).

The guiding questions for the project were:

- How may enhanced capacity for monitoring activities by local fishers help to improve fisheries management in coastal areas? And can this monitoring become sustainable?
- How do global changes in climate and economy affect coastal ecosystems?

This article summarizes the 3-year activities of the project and considers the path forward. The full scientific report, which covers the project background, organization, meetings and events, products, and the membership of the Project Science Team (PST), can be found on the project webpage (<https://meetings.pices.int/projects/FishGIS>).



Figure 1. Coastal communities (yellow pins) participating in the FishGIS project: Muara Gembong (Sub-District), Pabean Ilir (Indramayu District), Pelabuhan Ratu (Sukabumi District) of West Java Province, and Karangantu (Serang District) of Banten Province.

Technologies developed in the project

Several workshops were organized to seek support and input from local communities and to involve community members in the co-design of the project framework and objectives. Through this collaboration, the local issues essential for their well-being were identified, and plans were outlined for what monitoring could be done by developing smartphone-based technologies. The keystone parameters selected for monitoring are summarized in Figure 2 and included: (1) water quality, (2) toxic phytoplankton (i.e., red-tides or harmful algal blooms (HABs)), (3) fish catch, (4) localized Illegal Unregulated and Unreported (IUU) fishing, and (5) floating garbage (plastics).



Figure 2. Parameters identified during local community training and implementation workshops, each to be monitored using smartphone-based tools.

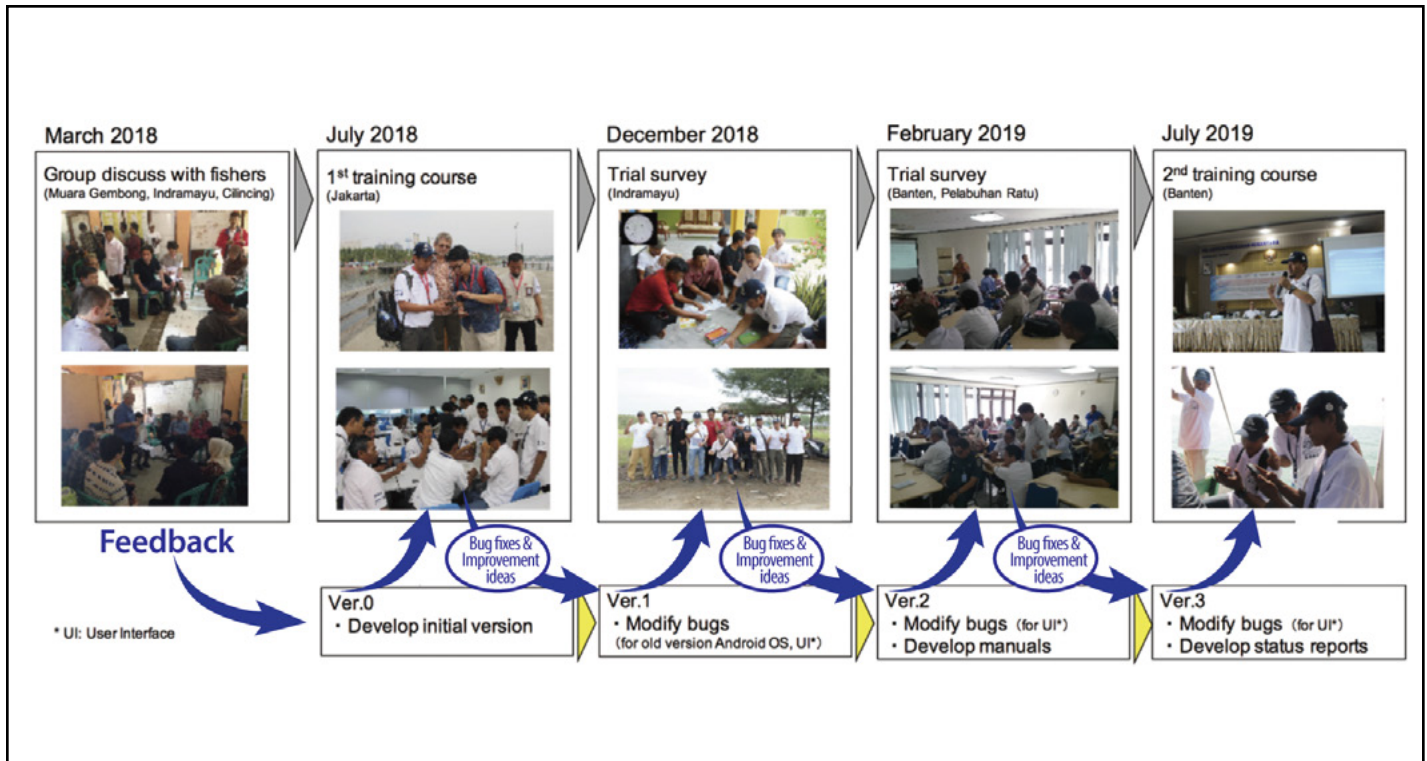


Figure 3. The transdisciplinary research process for developing the FishGIS application.

With the scientific support of PICES researchers, the project developed and implemented smartphone-based tools (applications, sampling methods, and reporting protocols) that enabled local fishers and community members to collect and electronically share fisheries and environmental data with relevant Indonesian government authorities and university researchers. Takemura et al. reported the basic structure of these tools in the winter 2019 issue of PICES Press (Vol. 27, No. 1, pp. 16–18).

The FishGIS application development was a genuinely transdisciplinary effort in which scientists, local community members, and local government officials participated in the mutual learning and technology adoption process. An example of the development process, repeated in each community, is depicted in Figure 3, where researchers created and presented an early prototype version of the application that was further modified and improved based on interactions across multiple trainings and trials with the local people. Among the several changes incorporated to the application were broadening the fish categories, enhancing their descriptions, and integrating local fish names. Examples of observation reports prepared using the FishGIS application based on data submitted by the local people are illustrated in Figure 4.

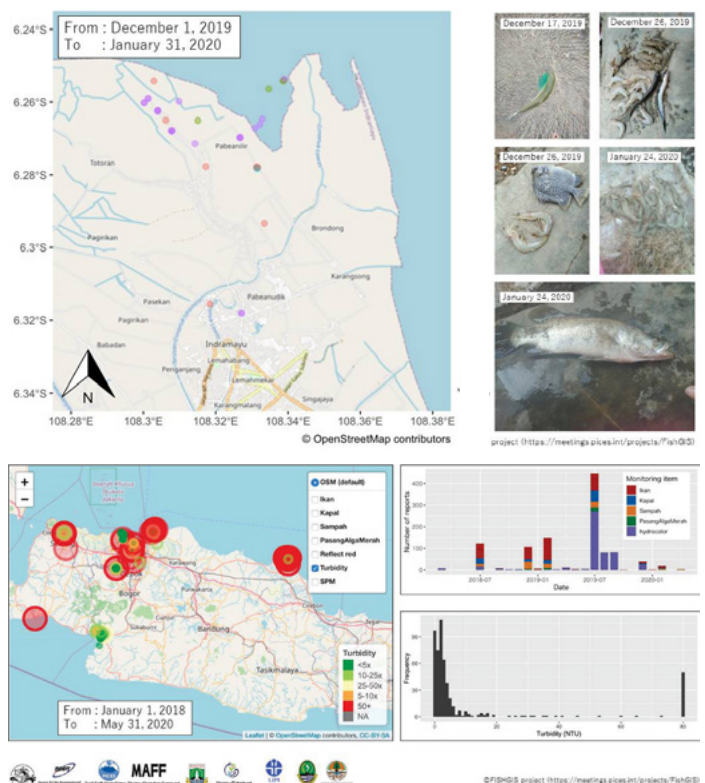


Figure 4. Examples of observation reports prepared using the FishGIS application based on the data collected by fishers and aquaculture farmers in Indramayu (upper panel) and based on turbidity level measurements in the Banten and West Java Provinces (lower panel).



Figure 5. Training workshop held July 10–11, 2019, in Karangantu (Serang Province); first row: Participants investigate the FishGIS application (left) and the foldscope (right); second row: Hands-on field practice with the HydroColor application; third row: Small-group discussions.

Implementation

This project's success depends not on simply building capacity but by crafting means to sustain the capacity use beyond the project duration. A three-pronged approach was adopted for the early workshops:

1. PICES scientists introduced ideas behind the success and failures of fisheries and the value of community members helping to collect information about their fisheries;
2. Staff of the Indonesian Agency for the Assessment and Application of Technology (BPPT) led the training of smartphone-based tools to empower their leadership role;
3. Both expert groups listened to local community members' perspectives and concerns and adapted the project to serve their needs better.

The training and implementation workshops were conducted with four participating communities (Table 1). Several dozen members from the initial two communities (Muara Gembong and Indramayu) were brought to Jakarta for the first workshop for logistical reasons and to help inform other Indonesian government agencies about the project and its longer-term goals (see PICES Press, 2019, Vol. 27, No. 1, pp. 16–18). For the two other communities (Karangantu and Pelabuhan Ratu), training was conducted on-site (rather than in Jakarta) as each of these communities was larger in size, and had appropriate venues and a more significant government presence (Figure 5).

Table 1 FishGIS training and implementation workshops and trial surveys in Indonesia.

Dates	Venue	Type of activity	Target communities
July 10–12, 2018	Jakarta	workshop	Muara Gembong, Indramayu
December 11–13, 2018	Pabean Ilir/Indramayu	trial survey	Pabean Ilir
February 4, 2019	Karangantu/Serang	workshop	Serang
February 6–7, 2019	Pelabuhan Ratu	workshop	Pelabuhan Ratu
July 10–11, 2019	Karangantu/Serang	workshop	Muara Gembong, Indramayu, Serang, Pelabuhan Ratu
December 15–17, 2019	Pabean Ilir/Indramayu	trial survey	Pabean Ilir
February 25, 2020	Karangantu/Serang	workshop	Serang
February 27, 2020	Pelabuhan Ratu	workshop	Pelabuhan Ratu

The FishGIS application and the water quality application HydroColor, both designed initially using an English language interface, were converted with the help of BPPT staff to Indonesian Bahasa versions (IKAN-GIS) for use in the local communities. With guidance from PICES experts, BPPT researchers led the training workshops for community members on how to use IKAN-GIS applications (Figure 6). The training materials covered how to install the applications onto the smartphones, the structure and operation of the applications, and provided data collection examples.

The “large-scale” training workshops were interspersed with “trial surveys” – smaller-scale independent visits by a Hokkaido University (HU) team led by Dr. Naoki Tojo to Pabean Ilir, a coastal village of about 500 people in the Indramayu District in December 2018 and 2019. These visits included in-depth on-site practical training with the project observation tools, small-group interviews with community members, and a “Fisheries Sustainability” game mini-workshop developed by the HU team (Figure 7). The trial surveys enabled closer exchanges between the locals and trainers, helped participants more clearly recognize the need to monitor coastal environment and fisheries resources and landings, explained how this monitoring could contribute to the sustainability and well-being of their community lives, and improved their understanding of the project tools. This approach also allowed the PST to better evaluate and refine the design and use of the FishGIS application. For example, from the interviews the HU team learned about a very high species diversity of the local catch composition (more than 20 species could be found in daily catches in the landing site, according to an HU student Mr. Takaaki Mori). Therefore, the categories and names of the fish in the FishGIS application were modified to improve the information return and ease of use by the local fishermen. In addition, these visits provided an opportunity to collect information on local fisheries, target species, and livelihood of local fishers and fish farmers for socio-economic research.



Figure 6. The operation manual in Indonesian Bahasa language and scenes from presentations on the use of the IKAN-GIS application by BPPT researchers at the training workshops.



Figure 7. Training activities during trial surveys in Pabean Ilir village (Indramayu District) (Top to bottom): On-site practical training, setting out by boat to collect fisheries data, small-group interviews, and playing a “Fisheries Sustainability” game.

Evaluation of the implementation activities in four communities showed both accomplishment and remaining challenges. Project implementation went very well in some communities in terms of relevancy, effectiveness, efficiency, and impact. Other communities showed less sustained success, due in part to logistical challenges surrounding workshop execution. The lessons learned here have led to ideas for alternative communication strategies for future projects in the region.

Conclusions and next steps

The foundations of the FishGIS project successes can be attributed to three primary factors:

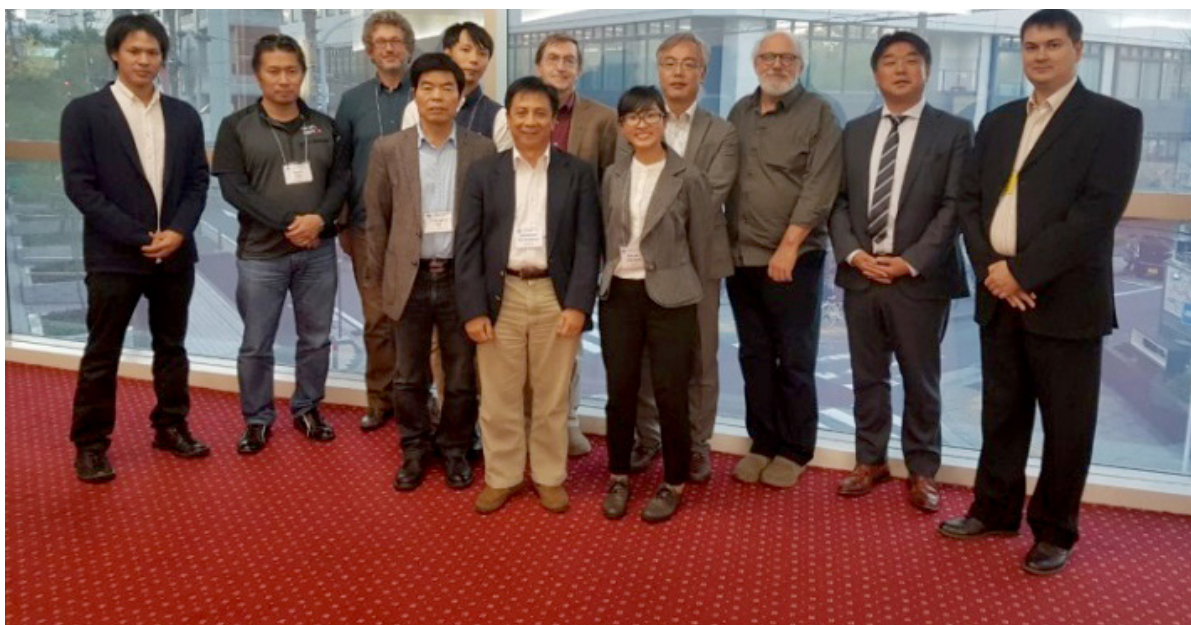
1. The wide breadth of expertise in the PST/ Indonesian cooperation spanned fisheries science, environmental science, human dimension studies, smartphone technologies, and previous extensive experience in international development and cooperation studies;
2. The productive collaborative relationship between PST members and Indonesian BPPT scientists developed during earlier PICES/MAFF projects in the region;
3. Strong official support and endorsement by the Indonesian national governments, which importantly provided a legitimacy to the project for local governments, stimulated participation by the local communities, and resulted in a commitment to establishing data storage at the Indonesia National Ocean Data Center.

While these logistical and organizational underpinnings reinforced the project, the more critical aspect was close communication and consultation with local community members. A number of training and implementation workshops and trial surveys were conducted at each case study site to discuss and define the most critical issues to be addressed and follow up with the community assessments. This approach differs from many citizen-science projects where scientists alone decide on the monitoring parameters and systems. In our case, PICES researchers, Indonesian government scientists and representatives, and local community members were “at the same table”, bringing the scientific perspective to the community, and gaining the community input and perspective on this science. This collaborative approach enabled the local communities to develop a strong sense of “ownership” of the technology, in some cases teaching about it, with pride, to other communities. The training workshops also provided the local fishers a scientific point of view on coastal fisheries, adding a new perspective to their knowledge of their waters. Local students and teachers were included in some training workshops to help foster these data collection programs’ sustainability.

Although effective answers to the two broad guiding questions of the FishGIS project could never be achieved within the 3-year term of the project, they focused attention onto developing the tools needed to address these questions, and on the training and community interactions to foster the data collections required to give insight. Moreover, considerable detailed understanding of longer-term changes in these coastal ecosystems (such as the changes in fisheries species, seasonal durations, and patterns of precipitation) was obtained through joint meetings and small-group interviews with local fishers and community members. This information was of value to both local and national government scientists. The enhanced capacity by local fishers and community members to observe and monitor basic water quality and plankton productivity, HAB incidences, fish catch trends, occurrence of IUU fishing, and plastic debris in marine waters provides an essential base for improving local decision making for more sustainable fisheries. Similarly, the local government officers now will have access to data regarding their policy effectiveness and a useful information tool to interconnect with communities more closely.

A new 3-year PICES–MAFF project on “*Building local warning networks for the detection and human dimension of Ciguatera Fish Poisoning in Indonesian communities*”, beginning in April 2020, will expand the FishGIS project to include new tools and improvements based on a community need for prophylactic understanding on benthic-borne fish toxins (<https://meetings.pices.int/projects/Ciguatera>). In this project, more efforts will be devoted to evolving data reporting features to provide better feedback to the community. We also need to pay more attention to the daily lives of local community people. In many cases, these communities exist mainly at only marginal subsistence levels, so the practicalities of time and resources are challenging. In Indonesia, like in many other developing countries, there are “extension officers” who specialize in fishing techniques and livelihood improvements, and are responsible for disseminating this information to local communities. Engaging these local extension officers will be an important strategy. In the longer term, this collective collaboration between government and local communities could foster the co-creation of new knowledge to scientifically envision the future of coastal ecosystems and livelihoods in Indonesia.

This article is prepared by the FishGIS Project Science Team, a group of scientists responsible for the detailed planning and execution of the project.



Participants of the second PST meeting held November 2, 2018, in Yokohama, Japan (left to right): Takaaki Mori (HU student, Japan), Naoki Tojo (Japan), Mark Wells (USA, PST Co-Chair), Chang-an Xu (China), Shion Takemura (Japan), Suhendar I Sachoemar (BPPT, Indonesia), Alexander Bychkov (PICES), Ayumi Kanaya (HU student, Japan), Mitsutaku Makino (Japan, PST Co-Chair), Charles Trick (Canada), Shigeharu Kogushi (GFL, Japan) and Vladimir Kulik (Russia); missing from photo: Joon-Soo Lee (Korea).



Jackie Grebmeier

PICES-2020 VW4 Workshop — How does the Pacific Arctic gateway affect the marine system in the Central Arctic Ocean?

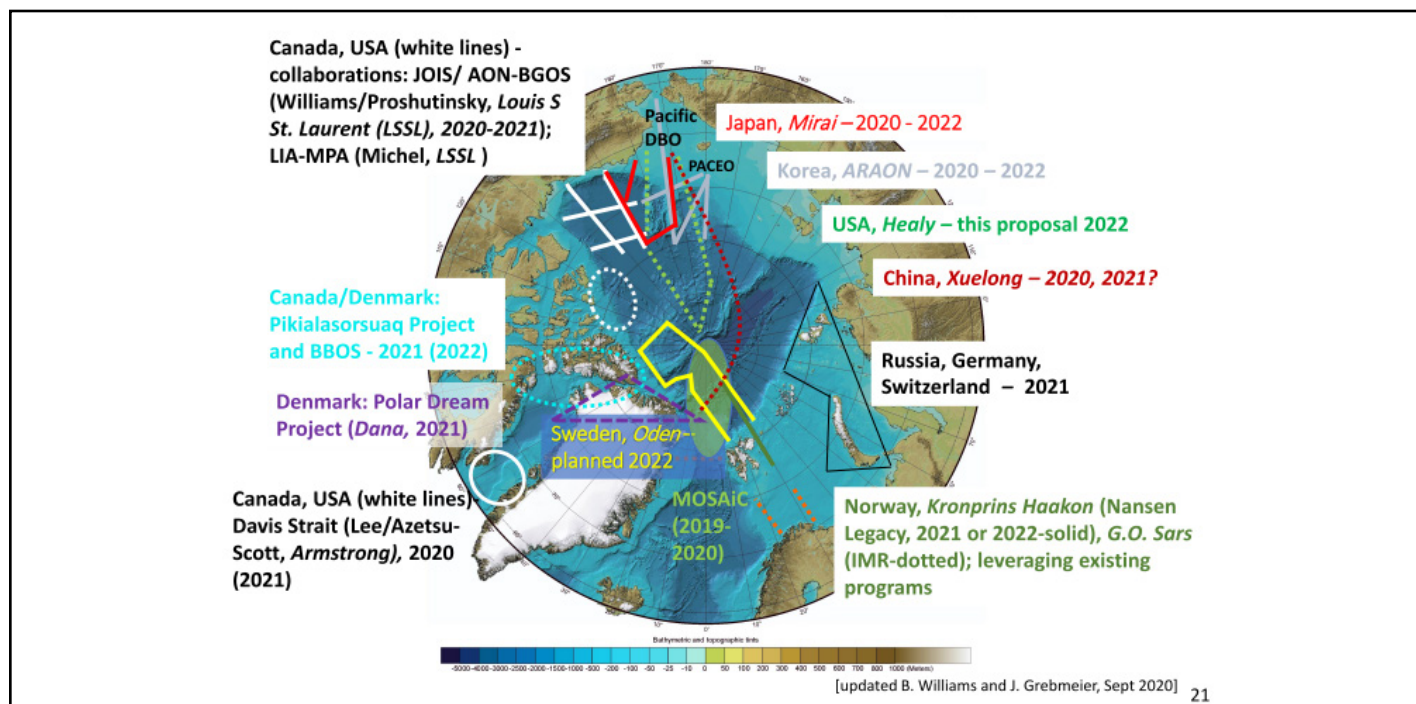
Sei-Ichi Saitoh, Hyoung-Chul Shin, Guangshui Na, Lisa Eisner and Libby Logerwell

The Central Arctic Ocean (CAO) is in rapid transition, largely driven by North Pacific environmental change, allowing it to become accessible to a range of activities. Rapid loss of sea ice cover has opened up the CAO for potential fishing opportunities. [The Agreement to Prevent Unregulated High Seas Fisheries in the Central Arctic Ocean](#) has been signed by Canada, United States, Iceland, Kingdom of Denmark, Norway, Russia, the European Union as well as China, Japan, and Korea, and is expected to enter into force soon. Scientific research in the CAO to inform and support policy decisions, however, remains scarce in contrast to an abundance of research in the neighboring North Pacific Ocean. With substantial science and policy challenges occurring in the Arctic, an integrated ecosystem assessment of the CAO is a priority task.

PICES joined forces with ICES and PAME (Protection of the Arctic Marine Environment) for such an assessment by joining the Working Group on Integrated Ecosystem Assessment for the Central Arctic Ocean (WGICA)/PICES WG 39 in 2016, with its mission period ending in 2021. The goals of the Pacific Arctic Gateway (a key gateway influencing the CAO) activity in the WGICA are to describe the status and trends of ecosystem components in the region and the connection of these parameters to the CAO. The Pacific Arctic Gateway has experienced rapid environmental change in recent years due to reduced sea ice extent and seawater warming that can impact shelf-basin exchange of water mass components and biological taxa into the offshore Arctic basin.

Therefore, the main objective for this workshop was to describe and discuss ecosystem processes in the Pacific Arctic Gateway and how physical and biological components extend into the CAO, with spatial focus on the outer shelf/slope regions to the basin. About 30 people attended this 3-hour [virtual Science Board-sponsored workshop \(VW4\)](#) on October 13 (Pacific Standard Time, in Sidney, Canada), at PICES-2020. One invited, 6 oral and 2 poster presentations were made. PICES members from three countries and an ICES member from Norway contributed the presentations. The workshop started with a brief introduction by Prof. Sei-Ichi Saitoh, outlining the background of CAO issues and the workshop objective.

Dr. Jackie Grebmeier gave an invited talk titled "[The Pacific Arctic Gateway: connecting the marine ecosystems of shelf/slope regions to the Central Arctic Ocean](#)" using recorded video. She noted that key environmental drivers that influence ecosystem dynamics and response of the CAO and shelf-basin interactions include: decreases in sea ice extent and duration, seasonally warming seawater temperatures, changes in prey concentrations, and northward movement of some species, including commercial fish. She explained that the planned international Synoptic Arctic Survey (SAS) in the Pacific Arctic Gateway region and Canadian Basin seeks to quantify the present state of the physical, biological, and biogeochemical components during the 2020–2022 period coincident with other pan-Arctic SAS programs.



2020-2022 SAS Cruise plans presented by Dr. Jackie Grebmeier



Dr. Hein Rune Skjoldal gave a talk titled “The influence of Pacific water on the central Arctic Ocean ecosystem: some productivity considerations”. He pointed out a paradox that the low productive Beaufort Sea is the summer feeding ground for 20,000 bowhead whales and 40,000+ beluga whales. The

copepod *Calanus hyperboreus* is thought to be the dominant zooplankton species in the CAO and is assumed to be a main prey for bowheads. Dr. Skjoldal was thanked for his patience in participating in the workshop, despite it being held at the inconvenient time of 3AM - 6AM his local time.

Due to internet connectivity problems, Dr. Xiaofan Luo could not present her paper on “Mechanisms of persistent high primary production during the growing season in the Chukchi Sea”. Instead, PICES showed her slide presentation, but without commentary.

Dr. Takafumi Hirata’s talk, titled “Sensitivity study on Planetary Boundary forcing to the Arctic marine ecosystems”, showed a sensitivity study on the quantification of environmental forcing by using different indicators for the Planetary Boundary processes as well as using different datasets for the three indicators: environmental forcing on the Arctic marine ecosystem, sensitivity of the Arctic marine ecosystem to the forcing and the resilience of the ecosystem itself.

Dr. Atsushi Yamaguchi analyzed life cycles of two sympatric mesopelagic carnivorous copepods (*Paraeuchaeta glacialis* and *Heterorhabdus norvegicus*) based on a year-long time-series of vertical stratified net plankton samples collected at an ice-station drifting through the Canada Basin to the Mendeleev Plain (SHEBA project). He pointed out that food availability is considered to be an important factor in determining the seasonality in life cycles of the mesopelagic carnivorous copepods.

Dr. Kohei Matsuno used general dissimilarity modeling (GDM) based on field data (including biological and hydrographical) and satellite data (e.g., sea-ice concentration, surface chlorophyll a) during autumn from 2008 to 2017, and predicted the effect of sea-ice extent, temperature and chlorophyll a on the zooplankton community. He suggested a combination of ship observations and modeling with satellite observations could resolve the dilemma of spatial-temporal limitation of ship-observation, and could be used to evaluate the impact of climate change on the zooplankton community in the Pacific sector of the Arctic Ocean.

Dr. Irene Alabia examined the impacts of climate change projections in the 21st century (2026–2100) on marine biodiversity in the Eastern Bering and Chukchi seas within the Pacific Arctic, a climate-sensitive boreal-to-Arctic transition zone. She showed that future poleward shifts of boreal species in response to warming and sea ice changes are projected to alter the taxonomic and functional biogeography of present-day Arctic communities as larger, longer-lived and predatory taxa expand their leading distribution margins.

In general discussion, Prof. Saitoh introduced a plan for WG 39 to continue the momentum from this workshop with a workshop on “Integrated Ecosystem Assessment (IEA) to understand the present and future of the Central Arctic Ocean (CAO) and Northern Bering and Chukchi Seas (NBS-CS)”, jointly with WG 44 (PICES/ICES WG on Integrated Ecosystem Assessment for the Northern Bering Sea - Chukchi Sea), at the next PICES Annual Meeting in 2021.



Dr. Sei-Ichi Saitoh is Research Professor at the Arctic Research Center, Hokkaido University. He has over 30 years of experience working as a satellite and fisheries oceanographer, GIS specialist, and consultant on fisheries issues in the North Pacific Ocean and its adjacent seas. He has also studied the impact of climate change and global warming on marine ecosystems in sub-Arctic and Arctic seas. Within PICES he is a member of the Technical Committee on Monitoring and is co-chair of WG 39. He was also one of sub project directors of the national flagship project, the Arctic Challenge for Sustainability (ArCS) supported by MEXT, Japan 2015-2019. He is a former member of both MONITOR T/C and Co-chair of WG39.



Dr. Hyoung Chul Shin, a biological oceanographer by training, has participated in and coordinated numerous expeditions to the Antarctic and the Arctic. Besides Antarctic krill biology, his activities and interests include the management of marine living resources in polar waters. He has served on the Korean delegation for the negotiation of the Central Arctic Ocean Fisheries Agreement. He is part of PICES WG 39 and WGICA Central Ocean Ecosystem assessment efforts.



Dr. Guangshui Na is a scientist at the Key Laboratory of Coastal Ecology and Environment of State Oceanic Administration, National Marine Environmental Monitoring Center, Dalian, PR China. His current focus is on detecting microplastics in different types of environmental media. In PICES he is chair of the MEQ Committee and is a member of Science Board, FUTURE SSC, WG 35 and WG 39.



Dr. Lisa Eisner 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 vice-chair of the PICES Technical Committee on Monitoring and is a co-PI on eastern Bering Sea and Chukchi Sea research programs.



Dr. Libby Logerwell is a Research Fishery Biologist at the Alaska Fisheries Science Center of NOAA-Fisheries in Seattle, Washington. Her research focuses on oceanographic processes that influence the distribution and abundance of seabirds, ichthyoplankton, juvenile and adult fish and epibenthic megafauna. She is a PI on the North Pacific Research Board Arctic Integrated Ecosystem Ecosystem Research Project. She is a member of the PICES Fishery Science Committee and co-chair of PICES/ICES WG 44 on Integrated Ecosystem Assessment of the Northern Bering-Chukchi Sea.



PICES-2020 VW6 Workshop — Research priorities for understanding the population dynamics of small pelagic fish in the North Pacific

Ryan Rykaczewski and Akinori Takasuka

Populations of small pelagic fish (SPF) are key components of the marine food web and support important commercial and subsistence fisheries in communities around the global ocean. [PICES WG 43 on Small Pelagic Fish](#) is a joint endeavor with ICES to apply a comparative approach to examine ecological, management, and socioeconomic questions concerning these planktivorous fishes. Populations of SPF have exhibited sensitivity to climate variability and change, and the response of their ecosystems to anthropogenic forcing (both climate and fishing) can have consequences for marine predators, aquaculture, marine natural products industries, and human communities that rely on these fishes as an important source of animal protein and income.

A major goal of PICES WG 43 is to organize an international symposium on the science, management, and socioeconomics of SPF. The WG 43 co-chairs viewed a workshop at the 2020 PICES Annual Meeting as an opportunity to engage with the broader PICES community (particularly with early career scientists) while highlighting plans and stimulating enthusiasm for the [international symposium](#) that is scheduled for February 2022.

The workshop received broad interest from PICES member countries that included both WG 43 members and guests. A total of seven talks—six of which were presented by early career scientists—and three posters were presented during the workshop. The talks focused on a variety of small pelagics from around the North Pacific basin (and included presentations on nektonic invertebrates as well as on bony fishes), and addressed a spectrum of life stages (e.g., spawning, larval transport and distribution, recruitment, and adult landings). Brief periods of questions followed each talk, and a lengthier discussion followed the last of the presentations. In this discussion, it was noted that regardless of the location or taxon of focus, there are some persistent issues that emerge in studies of SPF. Apparent sensitivity to interannual variability in the physical conditions of the ocean (e.g., temperature and

the direction and intensity of advective currents) was evident in the ichthyoplankton distributions, spawning locations and timing, or in landings as highlighted during the session's talks. These shared characteristics, though not unusual in marine fishes, are probably emphasized in populations of SPF given their swimming abilities and rather short life spans. Another issue noted is the persistent challenge of forming conclusions regarding interannual-to-decadal variability given observational data that are short in duration. There is a widespread need to be able to resolve environmental/fisheries relationships in a manner robust enough so that environmental information can be incorporated into stock assessments and harvest guidelines.

The oral presentations in the workshop were arranged as a tour that sampled examples of research being conducted around the Pacific Basin, starting in the Southeast Pacific and moving in a clockwise direction until concluding in the tropical central North Pacific.

Wei Yu from Shanghai Ocean University presented a talk entitled "[Trans-Pacific 'synchrony' in multidecadal change of habitat patterns for *Ommastrephes bartramii* and *Dosidicus gigas*](#)" highlighting different empirical relationships between environmental properties and squid catches-per-unit-effort in Chinese fisheries in the Northwest and Southeast Pacific. Wei and his co-authors hypothesized that synchronous changes in squid fishery productivity is associated with a basin-scale model of ocean variability, such as the Pacific Decadal Oscillation.

Tatiana Naumova from the Kamchatka branch of the Russian Federal Research Institute of Fisheries and Oceanography presented her research talk "[Some data on biology and distribution of larval capelin *Mallotus villosus catervarius* on the west Kamchatka shelf](#)" that described an effort to utilize a long-term ichthyoplankton survey along the shelf of western Kamchatka to assess the variability of larval capelin distributions in relation to hydrographic



anomalies. Naumova's results indicate relationships between circulation (coastal currents and mesoscale eddies) and the distribution of larvae and related these conditions to the region's sea-ice cover in later winter and spring.

In his talk "Diel vertical migrant species in structure of epipelagic nekton of Pacific waters off the Kuril Islands in autumn of 2019", Pavel Emelin from the Russian Federal Research Institute of Fisheries and Oceanography described the taxonomic composition of trawl catches (both bony fishes and cephalopods) that were collected during a recent cruise on which the primary goal was to scout for Japanese sardine and chub mackerel.

Beatriz Dias's recorded talk "[Influence of environmental and population factors on herring spawn timing in Prince William Sound](#)" described the historical variability in populations of Pacific herring in the region. With her co-authors, she used generalized linear and additive models to investigate relationships between conditions (both environmental and demographic) and the timing of herring spawning. Higher population biomass, increased adult age, cooler April ocean temperatures, reduced wintertime upwelling, and negative phase of the Pacific/North American pattern was associated with later spawning time.

Peter Kuriyama from NOAA's Southwest Fisheries Science Center presented on "Evidence of time-varying processes in Pacific sardine stock assessments," describing how including time-varying vital-rate parameters in the stock assessment model for Pacific sardine in the California Current can improve model fits and permit testing of

hypothesized relationships between environmental conditions and stock productivity.

Elizabeth Saraf from the University of Rhode Island worked with co-authors at NOAA's Southwest Fisheries Science Center, and presented "[Particle tracking reveals Pelagic Red Crabs as indicators of anomalous conditions in the California Current](#)" describing efforts to apply a particle-tracking algorithm in a regional circulation model to investigate the potential sources of pelagic red crabs that anomalously appear along the coast of central California.

Finally, Johanna Wren's talk entitled "[Towards a plankton-based predictor of tuna recruitment](#)" (co-authored with Phoebe Woodworth-Jefcoats) from NOAA's Pacific Islands Fisheries Science Center highlighted a new hypothesis linking recruitment of bigeye tuna in the central North Pacific to anomalies in phytoplankton size (as estimated from an algorithm utilizing remotely sensed data).

A last-minute cancellation of a talk allowed the co-convenors to highlight the topics being discussed within the joint Working Group and announce the dates and location of the scheduled international symposium that is being planned. The co-convenors and the other members of WG 43 feel that this workshop and subsequent discussions were fruitful and helped to stimulate interest in the Working Group's activities. We are grateful for the opportunity to have led a workshop despite the restrictions of travel and social engagement that we currently face.

List of presentations

Trans-Pacific “synchrony” in multidecadal change of habitat patterns for *Ommastrephes bartramii* and *Dosidicus gigas*. Wei Yu, Jian Wen, Xinjun Chen, Yi Gong and Bilin Liu.

Some data on biology and distribution of larval capelin (*Mallotus villosus catervarius*) on the west Kamchatka shelf. Tatiana Naumova.

Diel vertical migrant species in structure of epipelagic nekton of Pacific waters off the Kuril Islands in autumn of 2019. Pavel Emelin. [LOGIN Access only](#).

Influence of environmental and population factors on herring spawn timing in Prince William Sound. Beatriz S. Dias, David W. McGowan, and Trevor A. Branch.

Evidence of time-varying processes in Pacific sardine stock assessments. Peter Kuriyama, Paul Crone, Kevin Hill, Juan Zwolinski. ~ *permission to post denied*

Particle tracking reveals Pelagic Red Crabs as indicators of anomalous conditions in the California Current. Elizabeth Saraf, Stephanie Brodie, Megan Cimino, Isaac Schroeder, Michael Jacox, Steven Bograd, and Elliott Hazen.

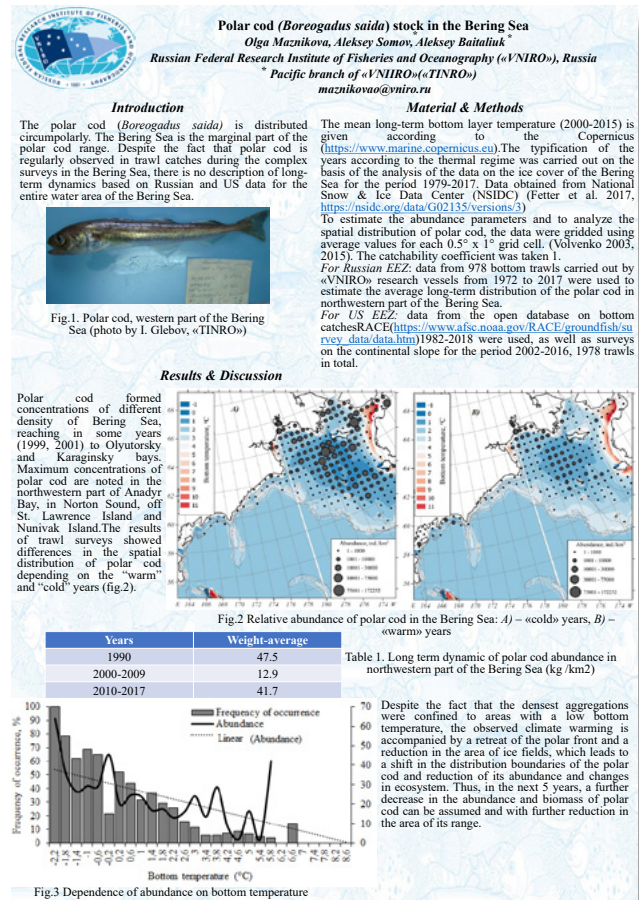
Towards a plankton-based predictor of tuna recruitment. Phoebe A. Woodworth-Jefcoats and Johanna L.K. Wren.

Poster presentations

Accounting for price responses in economic evaluation of climate impacts for a fishery. Juhyun Yi, Chang K. Seung, Juhyun Yi, and Dohoon Kim. [LOGIN Access only](#).

Polar cod (*Boreogadus saida*) stock in the Bering Sea. Olga Maznikova, Aleksey Somov, and Aleksey Baitaliuk. (Shown at right).

Variability and change of the oceanographic conditions in the feeding migrations and reproduction areas of sardine, mackerels and saury in the Northwest Pacific. Elena Ustinova, Viktor Filatov and Yuri Sorokin.



Dr. Ryan Rykaczewski is a Marine Scientist with the Ecosystem Sciences Division at NOAA's Pacific Islands Fisheries Science Center in Honolulu, Hawaii, USA. His research focuses on the sensitivity of marine biogeochemical cycles, ecosystem structure, and fisheries production to changes in ocean climate and physics. Ryan has been active in PICES and ICES for several years and strives to find ways to incorporate knowledge of regional to basin-scale climate processes into the management of living marine resources. In PICES he is co-chair of WG 40 (Climate and Ecosystem Predictability) and WG 43, and is a member of the FUTURE SSC and AP-CREAMS.



Dr. Akinori Takasuka is a Professor in the Department of Aquatic Bioscience, the University of Tokyo, Japan. His interests are in the fields of Fisheries Biology and Oceanography. His current major research themes include biological mechanisms behind climate impacts on population dynamics of small pelagic fish, growth and survival dynamics during the early life stages of fish, and density-dependent and density-independent processes in the life history of fish. In PICES he co-chairs WG 43 and is a member of WG 40 on Climate and Ecosystem Predictability.

PICES-2020 VW9 Workshop — Building a PICES Early Career Ocean Professional (ECOP) Network
Raphael K. Roman, Erin Satterthwaite, Alex Davis, Aoi Sugimoto, Hiroaki Sugino, Pengbin Wang, Taylor Goelz and Yanhui Zhu



Figure 1. A Zoom snapshot of the remaining participants at the end of the virtual workshop (VW9).

Since its 1997 Annual Meeting, PICES has become more active in nurturing young scientific talents and in recognizing the value of integrating their diverse perspectives, fresh ideas and visionary thinking into addressing important issues in the North Pacific Ocean and beyond. Early career ocean professionals (ECOPs) continue to receive support to participate in PICES-sponsored workshops and symposia, with the excellence of their oral and poster presentations regularly highlighted at PICES Annual Meetings. In the context of the UN Decade of Ocean Science for Sustainable Development (2021-2030), it has been suggested that ECOPs should play a key role in disseminating PICES science and in ensuring its international leadership at the science-policy-society interface. To that end, efforts are needed to cultivate ECOPs' skills and relationships, while explicitly integrating and defining their role and activities within PICES.

It was with great enthusiasm that our planning committee of 8 ECOPs initiated this important process by hosting a virtual workshop (VW9) on Zoom (Fig.1) on October 15(6pm Pacific time) and October 16 (9am Beijing and 10am Tokyo time), 2020. Following a preliminary survey that was widely distributed in summer 2020, this first virtual gathering was aimed at consulting the PICES community in order to exchange ideas and generate outcomes to help lay the foundations of a future PICES ECOP network. The meeting was attended by an amazing 58 participants, including ECOPs (70%) and PICES mentors (25%), some of them courageously braving vast time zone differences (kudos to all East

Coasters). Attendees mainly called from the United States, Japan, Canada, China and South Korea (34%, 29%, 18%, 11% and 5% respectively), bringing their diverse perspectives to the table and showing great energy and support, which were crucial to the success of the workshop.

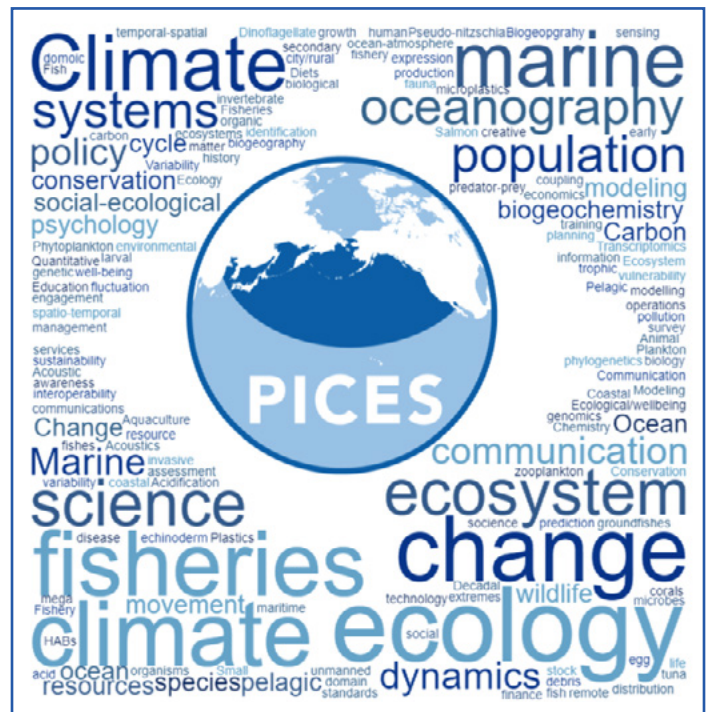


Figure 2. Word cloud illustrating the range of professional interests of our pre-workshop survey respondents.

During the introductory phase of the workshop, we shared the results of our pre-workshop survey, which demonstrated the breadth of PICES ECOPs' professional interests and academic expertise, including fisheries, climate change, ecology and ecosystems, science communication, public policy and conservation, among many others (Fig. 2). Coming mainly from academic and government organizations, the majority of ECOPs are relatively new to PICES (have been attending PICES meetings for 1 or 2 years), while others have been part of it for a longer time (4 to 7 years). Importantly, 83% were not part of an existing early career professional network, which further builds the case for the establishment of a PICES ECOP community to connect us all.

This need for greater collaboration and networking opportunities was reinforced when we asked the workshop participants why they were interested in getting involved in the ECOP community. The chat box was brimming with a diversity of statements, ranging from the wish to connect and collaborate across disciplines and geographies to cultivating leadership in PICES and learning ways to contribute to its Expert Groups. Interest in co-developing knowledge and networking with fellow ECOPs and senior scientists was a recurrent theme, while mentors emphasized the fact that ECOPs are the future and that new innovative ocean solutions are in the hands of the next generation. We transitioned to our panelist discussion with the conviction that ECOPs need to be better engaged in PICES and their voices leveraged accordingly.

PICES Journeys: Panel discussion

Centered around the theme of "Training and Mentorship", we invited three distinguished panelists to share their own journeys and perspectives on the future of PICES and the role ECOPs can play: Cisco Werner (former PICES Governing Council member), Sonia Batten (PICES Executive Secretary) and Vera Trainer (PICES Science Board Chair). The primary goals of this panel session were to:

- Learn from PICES mentors' experiences, involvement in PICES and vision for the future of the Organization and its ECOPs;
- Give a bird's-eye view of PICES structure and its history for new members;
- Discuss and brainstorm how training and mentorship can become an integral part of engagement of ECOPs within PICES.

Under the motto: "PICES: it's business and it's personal", Dr. Cisco Werner started by offering a concise overview of the history and philosophy of PICES as a regional incubator for many fruitful collaborations and working groups on science across the Pacific Ocean. One important take-away from him is the sustained commitment, dedication

and support that the PICES ECOP network will require in the near-future, mentioning the need to integrate ECOPs within the FUTURE Science Program. He also highlighted the necessity for diversity and inclusivity in our group to move forward in its formal recognition process.

Dr. Sonia Batten followed with her personal PICES journey, which started as an early career scientist in 1998, a time during which mentorship was already a vital part of the Organization, but which was not as well defined as it is today. She reminded us that PICES is part of a bigger, interconnected picture, wherein ECOPs can be highly beneficial in facilitating interactions with a variety of outside stakeholders (e.g., ENGOs, CSOs, national government bodies, etc.), enhancing science communication capacity and integrating novel ideas and skill sets into the community.

Dr. Vera Trainer closed the presentations with her personal journey as a PICES member, which began in 1999, and which led her to having many opportunities for international collaborations, mentoring, culturally-rich interactions and friendships, all of which were key pathways to success. While reiterating the critical role that ECOPs should play in the FUTURE Science Program, she also advocated for a more explicit representation and engagement of ECOPs in expanding PICES communications, mentioning the need to revamp the PICES website while raising greater environmental consciousness for future conferences (such as CO₂ emission-reduction trackers).

The ECOP workshop presentations and subsequent discussion demonstrated the commitment of all participants to collaborate across generations, sectors, disciplines, and geographies to nurture an interdisciplinary, diverse and inclusive PICES community. The shared goal of the participants was to generate and communicate scientific knowledge to contribute to marine sustainable development and ocean health. Experienced mentors want ECOPs to be formally integrated within PICES, and they can help us make it happen and encourage us to take bold and proactive actions in the process. Closing the panel session with optimism and hope, we took a well-deserved virtual break to rehydrate ourselves, stretch and even showcase some fabulous dancing skills.

The next and final part of our workshop involved presentations from the 8 workshop organizers, centered around three main priority areas: (1) Collaborative science, (2) Policy engagement and science communication, and (3) Diversity and coordination. We structured the conversation that way based on the feedback we received from the pre-workshop survey.

Collaborative science

Pengbin Wang and Yanhui Zhu emphasized the need for collaborative science to be both multidisciplinary and interdisciplinary. Specifically, they called for greater cooperation between PICES members and across disciplines, especially between natural and social scientists (e.g., economists, political scientists, indigenous studies scholars, etc.). They employed a creative food analogy whereby the field of marine science can be likened to different cuisines, with natural and social sciences represented as ingredients and condiments, respectively. While both are indispensable, it is only when mixed and combined together that different recipes can enable the production of fruitful and outstanding results. In that context, PICES could be seen as the stove upon which many various dishes will be delicately simmered.

Two key opinion polls were conducted on the theme of collaborative science. The first question gathered 100% of the vote in favour of combining social science with natural science when promoting marine sustainable development. The second multiple choice question asked which activities the attendees deemed to have potential in carrying out regional and global-level collaboration for interdisciplinary research purposes. While cooperative projects gathered a majority of the vote (88%), 38% and 13% expressed value in study groups and senior professional lectures, respectively. These results demonstrate the need for more collaborative science within PICES and between PICES and outside stakeholders, which constitutes one of the objectives pursued by the FUTURE Science Program. Other interesting considerations that were raised during the discussions concern the creation of cross-regional study projects and exchange programs that would allow ECOPs to build a network with scientists from different disciplines across the Pacific Ocean.

Policy engagement and science communication

In the context of the UN Ocean Decade, we explored how ECOPs can help expand science communication and policy engagement within PICES. Documenting the growing interest in marine science communication, Aoi Sugimoto and Hiroaki Sugino first explored ways to develop the communication capacity of PICES scientists and how to do so in collaboration with communication specialists. Connecting their presentation to the newly established PICES [Science Communications Study Group \(SG-SciCom\)](#), they wondered what kind of activities should both groups (SciCom and ECOPs) engage in and what participants think is most important to enhance communication capacity among ECOPs. Drilling deeper, they touched upon the design of science communication training within PICES, specifically what kind of skills do we need and want to learn and who would be a suitable trainer.

Envisioning collaborative research projects with experts in communication (e.g., designers, artists, etc.), they also inquired into which areas of ocean science would be best investigated with such experts or specialists, and how can we properly assess the scientific and social impacts of science communication more broadly.

The sub-theme of policy engagement was then introduced and discussed by Raphael Roman and Taylor Goelz, which was aimed at sparking conversations around ways to involve ECOPs in the science-policy interface, with a focus on the upcoming UN Ocean Decade. While a key question addressed to the audience sought input on what would ECOP engagement in the UN Ocean Decade look like and how we can contribute, other more specific questions of interest included:

- What should opportunities for career development look like? (funds, mentorship, networks, etc.)
- How can we advocate for a greater voice in policy planning processes and where do we want to use it? Can we guarantee seats for ECOPs in committees, panels and other decision-making bodies?

The ensuing conversations revealed that PICES is an ideal platform to connect different stakeholders and to cultivate a shared understanding of the complex ocean issues that are on top of the agenda for the next decade. Some important gaps and limitations will need to be addressed, however, starting with the need to create an explicit stakeholder base for PICES and to assist ECOPs in communicating and engaging beyond academic and scientific circles. While the PICES membership system may limit communications with a broader lay audience, PICES is working to address this issue. Senior attendees did not hide the challenges of engaging with different non-scientific audiences, and they highlighted the need to adopt a more understandable lay-language when communicating science. ECOPs can play a strong role on that front, disseminating important research outputs from PICES to a broader audience in a more accessible and palatable way. This would encourage a symbiotic relationship with the new SG-SciCom. Based on this and on positive feedback received from the 2019 science communication workshop in Victoria, BC, may demonstrate that annual science communication workshops will be highly beneficial to ECOPs and mentors alike. Examples of successful cross-sectoral workshops hosted by PICES members illustrated the value of two-way learning between the scientific community and frontline stakeholders, but we need to ensure full integration of outside communities into the process. Finally, we need to move beyond merely “ticking boxes” for ECOP representation at conferences, panels and other international gatherings, by creating task teams to enhance coordination and communication among all ECOPs in the field.

Lastly, Alex Davis and Erin Satterthwaite presented on



Establish an inclusive ECOP community

While attracting future members, be it ECOPs, mentors or supporters, this community should be aimed at providing opportunities to connect, network and collaborate with other PICES members, regardless of their discipline, career stage & geographic location. This can provide a valuable way for knowledge-sharing within and across the PICES community.



Train the next generation of ocean leaders

As an intergovernmental organization, PICES is a unique platform to train and cultivate the essential skills and relationships needed by ECOPs to navigate the science-policy-society interface. A focus on international, interdisciplinary, and cross-sectoral scientific collaborations and communication should be encouraged.



Convert science and knowledge into practice

Our PICES community is a regional incubator for fresh, diverse and creative ideas. In the context of the UN Decade, collaborating and developing our science communication activities with outside stakeholders will open new and innovative research opportunities geared towards the solving of our complex contemporary ocean issues.



Sustain diverse engagement within PICES structure

Future ECOPs should be more formally integrated into PICES, becoming a vital part of the organization. We will follow PICES science agenda and focal areas across the North Pacific Ocean, lead with conviction and hope to see our fledgling study group evolve into an advisory panel to ensure diverse and inclusive representation.

Diversity and coordination

the importance of diversity, equity and inclusion for engagement within and outside of PICES. Increasing ECOP involvement is about sustaining diverse engagement, and by boosting participation from low-attending countries and different disciplines into both PICES and the ECOP group, we can ensure long-term diversity within the PICES structure. It is also crucial to guarantee the inclusion of a variety of voices within and outside the Organization. This mirrors earlier discussions and touches upon the potential need to write a diversity statement and a code of conduct for our ECOP group. Another important point about ECOP inclusion is the kind of processes and structure expected to support our integration within PICES, and thus ensure that we will keep coming back. This workshop was driven by 3 key questions:

1. What are the key priorities for ECOP engagement within PICES? And how can we best align with existing PICES groups and partners?
2. What other organizations serve as good models for ECOP engagement?
3. How do we identify key areas for assessment of diversity, equity and inclusion?

The discussion with the workshop participants showed the importance of enhancing diversity within PICES expert groups, by ensuring greater representation at different career stages, including ECOPs. On that note, including at least one ECOP voice within the PICES structure could increase the chances of a long-term presence within it and give them a unified voice in advisory decisions. Another idea would be to allow one ECOP to sit on the Science Board or serve on a variety of advisory panels or committees. Encouraging greater participation of ECOPs in existing expert groups will also increase opportunities to learn by doing, especially regarding international collaboration processes and leadership. Last but not least, connectivity within PICES and with other ECOP groups beyond the Organization will be crucial. For example, it can be beneficial to host regular meetings between ECOPs and FUTURE-SSC members to exchange ideas and share knowledge, while it has been suggested that great synergies can happen from connecting the PICES ECOP group to other ECOP networks such as IMECaN.

Actionable items

We received strong support from the workshop participants for continuing to explore opportunities for sustained ECOP engagement within and outside of PICES.

Next steps

With our new Study Group formally established during PICES-2020, we are now working to continue expanding, strengthening and raising awareness of our ECOP community in the decade to come. The recommendations and guidance received during this virtual workshop will help us design future surveys, ECOP consultations and workshops, while more input from PICES ECOPs, mentors and supporters will be sought in the drafting of the Terms of Reference for a future working group. To help facilitate this work, a communication platform will be developed for our nascent ECOP community and an interactive inventory of all members will be created as a first tangible product to accelerate knowledge sharing and the discovery of research needs. In the long run, we hope that our growing network will stimulate new interdisciplinary, cross-sectoral and global-level collaborations, while playing a leading role within the PICES structure that supported our desire for change in the first place.

Anyone interested to join our ECOP community and be part of the discussion is invited to fill the following form: tiny.cc/PICESECOP. Everyone is welcome, whether you are a self-identified ECOP, PICES mentor or supporter!

What exactly is a PICES ECOP?

- A **self-identified** individual
- In the process of **completing** or who has **completed professional training** recently (where years since training is more important than age)
- In areas relevant to **ocean knowledge**
- From a **diverse range of sectors** (ocean policy, business, science, civil society, communication)
- **Distinct from youth** (for example, school children and undergraduates)



Mr. Raphael Roman is a research associate at Iwate University and visiting fellow at the National Institute for Environmental Studies (NIES) in Japan. His current research takes a systemic approach to marine resources conservation and multispecies fisheries management across Japan. He also investigates the social-ecological impacts of the 2011 Great East Japan Earthquake and tsunami, with a particular emphasis on disaster risk management and coastal community resilience and recovery. With his interests ranging from new economic thinking and social-environmental well-being to sustainable ocean governance and biodiversity conservation, Raphael is passionate about interdisciplinary research and driven by the need to engage at the science-policy interface, where ECOPs have a key role to play. He holds a Master of Public Policy and Global Affairs (MPPGA) from the University of British Columbia in Vancouver, Canada and a B.Sc. in Economics from the University of Montreal.



Dr. Erin Satterthwaite is the California Cooperative Oceanic Fisheries Investigations (CalCOFI) Coordinator with California Sea Grant at Scripps Institution of Oceanography. She conducts research relevant to sustainable marine resources in the context of a changing climate and engages with key stakeholders within California, nationally, and internationally within the North Pacific. She is a marine ecologist who works at the interface of use-inspired marine research, policy engagement, and science communication to advance ocean knowledge for sustainability. She is interested in ocean sustainability issues related to marine biodiversity, fisheries and mariculture, social-ecological systems, citizen science, and ecosystem oceanography. She is currently supporting initiatives to include underrepresented voices – such as early career professionals – into global policy processes, to coordinate biological ocean observations in support of the Global Ocean Observing System, and is utilizing environmental DNA to better understand biodiversity patterns in the California Current.

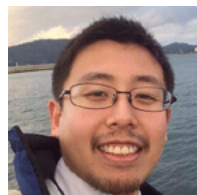


Dr. Alex Davis is a marine spatial ecologist and an advocate for equity and diversity in conservation sciences. She is a Liber Ero postdoctoral fellow, working at the University of Alberta with Dr. Stephanie Green and Dr. Thomas Theriault (DFO). Her work focuses on developing an interactive conservation tool to inform interventions for marine invasive species. She works with multiple partners and management agencies to develop spatial priorities and quantify economic costs for managing Indo-Pacific lionfish in US Caribbean and Tropical Western Atlantic territories and European Green Crab in the Salish Sea.

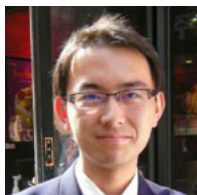


Dr. Aoi Sugimoto is a social scientist at Japan Fisheries Research & Education Agency. Her academic expertise mainly focuses on qualitative, in-depth investigation on socio-cultural and psychological phenomena in “human communities”. She has been working with various local (mostly small islands and coastal) communities in the Asia-Pacific including Okinawa, the Philippines, Indonesia, etc. Recently, her interest is expanding to the dynamic interaction among local communities,

scientific communities and communication specialists such as designers and artists. She is going to launch a series of science communication initiatives within the context of the UN Ocean Decade, which will also be part of new PICES expert group activities. She completed her PhD in 2018 at The University of Tokyo with The Dean's award for academic excellence, and won the Best Presentation Award at PICES 2018 (Human Dimension Committee) and 2019 (Science Board).



Dr. Hiroaki Sugino is an Assistant Professor at the University of Tokyo, Japan. His academic specialty is human-environmental studies based on environmental and ecological psychology. Whenever he goes and stands in fields, such as agricultural and fishery villages, he focuses on the transaction between two different systems (e.g. nature and human society, Information and Communication Technologies and human behavior) and trajectory dynamics happening there. His current research interests cover the value of sea and coastal areas in terms of the source of psychological place attachment to the ecological effect of balanced harvesting conducted by small-scale fisheries, and IoT fisheries based on big data analysis. He would like to construct a holistic system bridging nature and human society using IoT technology, and feels a strong need for trans-disciplinary research which ECOPs can be one of the leading groups in the world.



Dr. Pengbin Wang obtained his PhD from Hanyang University, South Korea, and is an Associate Professor in the Key Laboratory of Marine Ecosystem Dynamics at the Second Institute of Oceanography of the Ministry of Natural Resources of the People's Republic of China (MNR). He concurrently serves as Director of International Cooperation Department at the Fourth Institute of Oceanography. In PICES, he is Co-Chair of the Section on Ecology of Harmful Algal Blooms (S-HAB), and is an SSC member of WESTPAC-HAB. His research focus ranges from taxonomy, molecular systematics and evolution of microalgae to algal physiology and marine micro-ecology. He has also completed much applied work on the usage of microalgae as a marine resource. His scientific contributions include 19 papers with 16 SCI papers, 2 national/international patents, and more than 70 presentations in national/international conferences. He is principal investigator of 7 projects, including National Nature Science Foundation of China (NSFC), China-APEC Funding and Thailand-China Joint Projects. He is listed as main partner or sub-manager of over 15 nationally-important projects from China, South Korea and Thailand. In 2020, he was the first-ever recipient of PICES Zhu-Peterson Early Career Scientist Award.



Ms. Taylor Goelz MS/MPP is currently a John A. Knauss Marine Policy Fellow working at NOAA Research on domestic coordination, collaboration, and preparation for the upcoming UN Decade of Ocean Science for Sustainable Development. She graduated with a dual degree, a master's degree in Marine Science and a master's of Public Policy, through William & Mary and the Virginia Institute of Marine Science (VIMS). Goelz is a marine social scientist and policy wonk who is broadly interested in finding collaborative, innovative solutions to natural resource management issues. Her background has spanned the gamut of science-policy issues, from oyster restoration to coastal resilience to participatory decision-making processes. She is also currently leading the communications efforts for the Early Career Ocean Professional group and helping ensure that Gen Z and beyond have the opportunity to be involved in the Ocean Decade.



Ms. Yanhui Zhu is a first-year Ph.D. student at the Laboratory of Marine Ecosystem Change Analysis at Hokkaido University, Japan. Her research focuses on fishery resource management in Japan, mainly associated with both social science and marine science. To achieve a sustainable coastal fishery, her study tries to illuminate the relationship between fish distribution, abundance, and the marine environments; meanwhile, she converts those scientific results into practical suggestions that contribute to the local fisheries. Following the sustainable fisheries and market goals of the WWF, she is one of the members of the Smart Fishery Project in Japan. With the help of fundamental study, this group is aiming at promoting technological advances and providing accurate and efficient resource management methods that are willing to be shared with society. She won the Best Presentation Award at AFAS 2017, PICES-2018, and the excellent graduation oral defenses in 2020.

Please join the ECOP Conversation!

We are looking forward to further developing the vibrant PICES ECOP and mentor community. We hope you will join us! If you would like to join the conversation regarding early career engagement in PICES, please sign up at: <http://tiny.cc/picesecop>.

If you are unable to access the link please email: [<esatterthwaite@ucsd.edu>](mailto:esatterthwaite@ucsd.edu)

The International Year of the Salmon makes Progress towards a Pan-Pacific Expedition in 2022

Mark Saunders, Stephanie Taylor and Camille Jasinski



A team of 12 scientists from Canada, the Russian Federation and the United States at the launch of the 2020 Gulf of Alaska Expedition in Victoria, BC, March 11, 2020.

Introduction

Despite the unprecedented challenges presented by the COVID-19 pandemic, the International Year of the Salmon (IYS) initiative continues to make progress towards its mission to set the conditions for the resilience of salmon and people in a changing world. As we work to better connect institutions and people, and to generate the knowledge we need to manage salmon in a context of highly uncertain socio-ecological conditions, we are focused on three priorities:

1. Implementing a Pan-Pacific Expedition to test a partnership-driven approach to monitoring and understanding the mechanisms affecting salmon and related species in the high seas;
2. Mobilizing salmon and associated ecosystem data to expedite rapid synthesis and analyses from local to international scales; and
3. Developing analytical methods and decision support-tools to synthesize and communicate the cumulative impacts of socio-ecological changes which are affecting salmon from feeding areas on the high seas to freshwater spawning grounds.

2019 and 2020 International Gulf of Alaska Winter Expeditions

For the last 100 years, researchers have been trying to find the missing pieces which could help explain the mechanisms behind trends in salmon abundance and production throughout the Northern Hemisphere. In 2019, through a concerted international effort on the part of the North Pacific Anadromous Fish Commission (NPAFC) and chief organizers Dr. Richard Beamish (DFO emeritus scientist at the Pacific Biological Station in Nanaimo) and Dr. Brian Riddell (science advisor for the Pacific Salmon Foundation), the first salmon winter ecology survey in decades was completed in the Gulf of Alaska aboard the Russian R/V *Professor Kaganovskiy*. This expedition featured 21 scientists from Canada, Japan, the Republic of Korea, the Russian Federation, and the United States working together to study salmon in winter on the high seas. The 2019 Expedition was a first step in addressing knowledge gaps in salmon winter ecology survey work in the central Gulf of Alaska region. This year, on March 11, 2020, just one week before most of the world went into lockdown due to the novel COVID-19 pandemic, a team of 12 scientists from Canada, Russia and the United States embarked on a second month-long salmon winter ecology survey into the Gulf of Alaska.

The scientific team and crew set out to build on the research that was conducted on the 2019 International Gulf of Alaska Expedition. This year, the survey was conducted aboard the *Pacific Legacy No. 1*, a Canadian commercial fishing vessel which was transformed into a research vessel for the purpose of the expedition by Captains Brian Mose and John Roach. The research area was approximately 648,000 km² and was covered between March 11 and April 7, 2020. Altogether, a total of 566 salmon (234 chum salmon, 118 coho salmon, 51 sockeye salmon, 136 pink, 26 Chinook salmon, and 1 steelhead) were caught during the trawl survey. The 2019 and 2020 Gulf of Alaska Expeditions were the first major studies of the winter ecology of Pacific salmon in the NE Pacific Ocean in decades, and what is learned will inform plans for a pan-Pacific expedition that is being planned for 2022. Altogether, these three expeditions will form a baseline of observation and experience that will be used to develop a long-term, international approach to monitoring and understanding the changes taking place in the North Pacific Ocean (NPO) and their impacts on salmon and people.

The IYS has played an ongoing role in bringing together scientists from around the Northern Hemisphere to share their results from these expeditions and communicate them to interested audiences. Due to the pandemic, traditional press and media events were not possible. However, the IYS held virtual press conferences as well as a scientific briefing and information session for funders and friends of the Expedition in June, when preliminary results were discussed by Dr. Beamish and Dr. Riddell.



Scientists on the 2020 Gulf of Alaska Expedition collecting their trawl net catches.

Both the 2019 and 2020 Expeditions showed differences in the distribution among the five salmon species. Some species also appear to have associations with certain environmental conditions such as temperature and prey abundance. In 2020, the distribution of trawl net catches was patchier than the previous year. This, in combination with video observations of groups of salmon entering the trawl and some very large differences in hauls that were repeated several weeks apart, suggest that salmon may school more than previously believed. This has implications for survey design and future research.

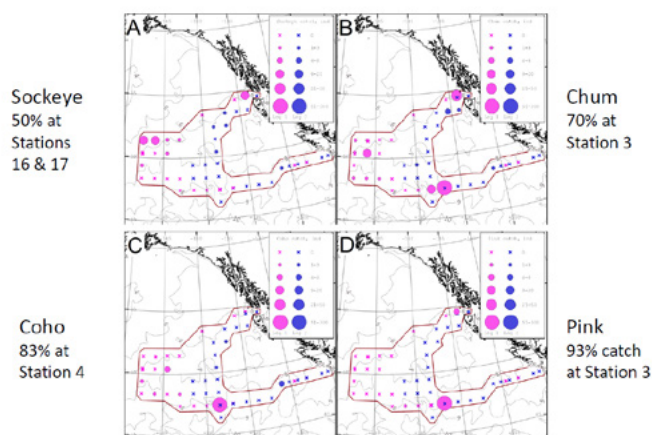
Comparison of Salmon Catches between years ...

Salmon catches during the 2019 versus 2020 studies were similar but different in important ways.



Year	2019	2020
Trawl sets:	58	52
Salmon catches:		
Chum	222	234
Pink	30	136
Sockeye	68	51
Coho	94	118
Chinook	3	26
Steelhead	0	1
Total	417	566
Estimated total abundance in Millions	55.00	51.30

increase in odd years in this area. However, they were the least abundant in the catches, apart from Chinook. In 2020,



once again, the scientific team and crew did not find many pink salmon, which should have been three times more abundant than chum salmon in the survey area, despite the overall catches being larger than in 2020 (Fig. 1). In both years, the more abundant species in the catches were coho salmon, which scientists expected to stay closer to coastal waters. We look forward to 2022, when we plan to provide broad spatial coverage to encompass the full range of each species.

The application of new genomic technologies was front and centre during these expeditions. The results from studies on board utilizing eDNA to determine species presence, near real-time genetic sequencing of salmon populations at sea, and assessments of pathogen load and physiological condition of salmon will be available shortly. Laboratory processing has been delayed by COVID-19.

In October 2020, during the PICES Annual Meeting, a topic session entitled "Implementing a collaborative, integrated ecosystem high seas survey program to determine climate/ocean mechanisms affecting the productivity and distribution of salmon and associated pelagic fishes across the North Pacific Ocean" was held, which included talks from key scientists associated with both the 2019 and 2020 Gulf of Alaska Expeditions. We encourage everyone to view the recorded talks to learn more about the results we have to date.

The 2019 and 2020 International Gulf of Alaska (GOA) Expeditions have already advanced our understanding of the winter ecology of Pacific salmon in the NPO and scientists are anxiously waiting to analyze the remaining data from the 2020 Expedition as labs are reopening from the pandemic lockdown. Overall, Dr. Beamish and Dr. Riddell believe that forecasting salmon returns can be improved using data from these surveys and suggest that after two years of single vessel surveys, sampling millions of square kilometres of ocean, it's apparent that a large integrated survey with multiple vessels is required to cover vast regions of the North Pacific Ocean simultaneously in order to learn about the lives of salmon across the North Pacific.

2022 Pan-Pacific Winter High Seas Expedition

Changing climate and associated anomalous events in the NPO are progressively exposing Pacific salmon to conditions outside the normal climate cycles. Pacific salmon are a uniquely important cultural, commercial, and biological resource for countries of the North Pacific rim, but there remain significant gaps in our understanding of the mechanisms that regulate salmon distribution, productivity, and survival in coastal and high seas environments. In a major effort to begin to fill in these gaps, as many as four vessels will go to sea in late winter 2022 to conduct the first ever pan-Pacific, epi-pelagic ecosystem survey sampling the biological, chemical and physical oceanography and biota, including salmon and related fishes. While originally scheduled to take place in the winter of 2021, the unprecedented circumstances of the COVID-19 pandemic has led to rescheduling the Pan-Pacific Winter High Seas Expedition to winter 2022.

The major objective of the Expedition is to demonstrate the utility of an international pan-Pacific winter ecosystem survey to understand how increasingly extreme climate variability in the NPO and the associated changes in the physical environment influence the abundance, distribution, migration, growth, fitness and survival of Pacific salmon and surrounding species.

The Expedition in 2022 has a number of sub-objectives including:

- Documenting the spatial and temporal variation in physical and biological oceanographic conditions;
- Documenting the distribution, condition, and standing stocks of zooplankton, and nekton that serve as the prey base for Pacific salmon and associated marine fishes;
- Demonstrating the ability to effectively collaborate across the five NPAFC parties and our partners to conduct integrated ecosystem research that will support the sustainable management of salmon in a rapidly changing North Pacific Ocean.

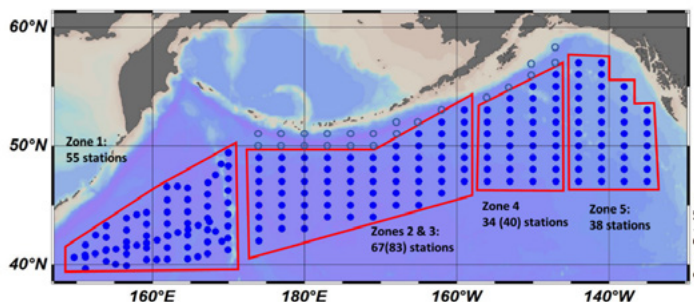


Figure 3. Sampling zones, demarcated by red boxes. Stations, demarcated by solid blue circles are spaced 60 nm north-south along longitudinal transects, up to 120 nm spacing between transects. Empty blue circles demark stations within the USA Exclusive Economic Zone which may only be possible with USA scientists aboard. Fisheries and Oceans Canada will be responsible for completing 38 stations in Zone 5.



Canadian vessel the CCGS *Sir John Franklin*. Photo: Fisheries and Oceans Canada.

The NPAFC member countries (Canada, Japan, the Republic of Korea, the Russian Federation and the United States) are working collaboratively with academic and NGO partners to complete plans for the Expedition. At the present time, we have indications from Canada, the Russian Federation and the United States that they will each make one research vessel available to cover approximately one month of ship time required to survey

one of the five survey zones, subject to the scheduling approval procedures in each country. The Canadian vessel will be Canada's newly commissioned 63m fisheries research vessel the CCGS *Sir John Franklin*. The Russian Federation will make a second research vessel available to cover the remaining two of the five survey zones under a charter arrangement. Approximately CAD\$1.5M will be required to cover each of the two zones. At the present time we have CAD\$300K committed by Fisheries and Oceans Canada and the Province of British Columbia through the BC Salmon Restoration and Innovation Fund (BCSRIF) and a recent commitment of USD\$350K from the North Pacific Research Board. We continue to seek funding from multiple sources and welcome interest from partners in the PICES community who may contribute or know of relevant funding programs. Additionally, we are in the process of developing a UN Decade of Ocean Science for Sustainable Development (UNDOS) proposal that will include the 2022 Expedition as the beginning of a multi-year program to establish an ocean intelligence system linking NPO events to socio-ecological impacts. If endorsed, the proposal will open doors to funding from countries and foundations seeking to support UNDOS proposals.

We often receive questions about how our management systems will benefit from this deeper understanding of the impact of an increasingly changing climate and changing ocean conditions. Particularly with regard to salmon, there is some hesitation towards investment in ocean research due to the assumption that resources are better allocated to freshwater activities where we can actively manage change, versus an ocean system that is assumed to be beyond our control. Our response to this is that management systems need to adopt a holistic approach, where management decisions are informed by knowledge of mechanisms affecting salmon during all life history stages, from high seas to coastal to freshwater. Since we know that increasingly poor and variable marine survival has been driving the decline in many salmon populations in the North Pacific and North Atlantic oceans since the mid 1990s, it makes sense that we deepen our understanding of these mechanisms to better inform our management decisions.



A team of early career scientists on the 2020 Gulf of Alaska Expedition. L-R: Russians Albina Kazneparova and Alexei Somov, and Canadians Rebecca LaForge, Natalie Mahara and Christoph Deeg.

Knowledge gained from understanding the mechanisms affecting salmon and associated fish in the high seas will support the following by:

- Improving the ability to forecast the state of salmon and marine fishes that in the absence of climate/ocean knowledge is increasingly unreliable.
- Informing recovery plans for species at risk and climate change vulnerability assessments — the efficacy of management actions in freshwater, such as habitat restoration, can consider the impact of changing ocean conditions.
- Informing Illegal, Unreported and Unregulated (IUU) Fishing enforcement actions — accurate and timely intelligence of the distribution of fish to effectively target enforcement surveillance aircraft and ships at the burgeoning multi-billion-dollar IUU fishing operations that threaten salmon and associated fish across the high seas of the NPO.
- Informing hatchery management — with 40% of the salmon in the NPO of hatchery origin, understanding interactions with coastal and high seas ecosystems is essential to assess the efficacy of long-term investments and in-season strategies for releases, as well as the impact of these fish on other species.
- Informing assessments and forecasts of marine fishes with leading indicators connecting the high seas to the basin/shelf processes affecting productivity of juvenile salmon and the recruitment/growth of marine fish on the shelf/slope.
- Providing baseline data for the emerging United Nations instruments on marine Biodiversity in areas Beyond National Jurisdiction (BBNJ) to inform management of ocean resource extraction.
- Raising the confidence of industry and communities that decision-makers can act proactively with knowledge of mechanisms at work rather than reacting after the fact.

One of the most important priorities for the Expedition and the IYS in general is the advancement of early career scientists. The generation of scientists that conducted high seas research in the past is largely retired and a new generation of scientists needs to build international connections and, with mentoring from outgoing scientists, take on the challenge of this high seas work. Through funding from BCSRIF, the IYS will be supporting nine early career scientists from a variety of different fields, ranging from biological to oceanographic sciences, to join the pan-Pacific Expedition team.

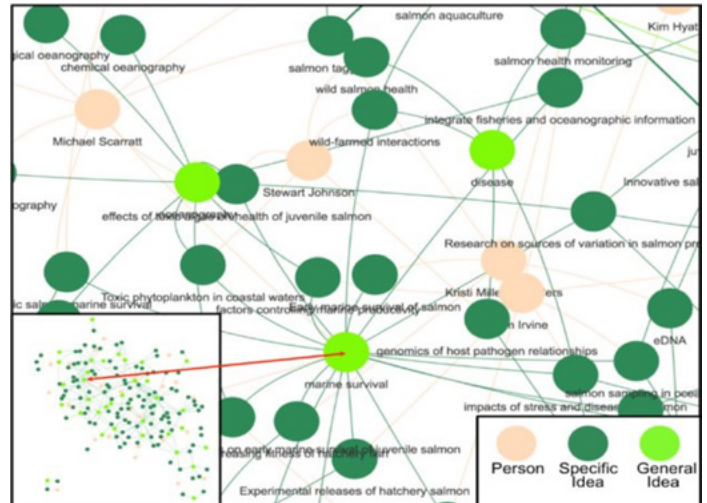


Collecting samples on the 2020 Gulf of Alaska Expedition. Pictured here: Natalie Mahara (Canada), Jacob Lerner (Canada).

Data Mobilization

Arguably, one of the largest barriers to research on salmon ecology is rapid access to standardized data. Data Mobilization is a concerted effort on the part of the IYS and various other organizations that have a keen interest in the protection and sustainability of salmon to build a framework of data, models, and knowledge networks that are standardized, accessible, and easy to navigate for dynamic groups of researchers, conservationists, and resource managers. Graph database technology is potentially the ultimate tool to synthesize data generated from the High Seas Expeditions with related socio-ecological data from coastal and freshwater systems. Underpinning the application of this new technology is developing the data standards including metadata and vocabularies for essential ocean and biological variables that will allow data to be federated in a manner that is consistent with the [FAIR data principles](#).

Specifically, FAIR data are findable, accessible, interoperable and reusable. We are working with a number of IYS partners on the broader approach to data mobilization and more specifically on a standardized approach to managing high seas data from the three Expeditions utilizing the Global Ocean Observing System protocols with the Hakai Institute in British Columbia, Canada and an NPAFC Study Group with representatives from all five member countries.



Visualization of a salmon-related graph database

Outreach

As 2020 wraps up, the IYS is working to intensify its final two years of research and outreach. Due to the increasingly virtual nature of our work, we are looking towards expanding our communications capacity. We are building our networks in order to reach a wider audience through our work, particularly as we approach the launch of the 2022 Pan-Pacific Winter High Seas Expedition, which brings with it opportunities to take advantage of various social media tools and communication technologies, and to potentially partner with some organizations in the nature documentary film-making industry. A wrap-up symposium is being planned for the fall of 2022 to engage partners across the Northern Hemisphere that have contributed to the success of the IYS.

Over the next two years we look forward to working with PICES and partners to use the 2022 High Seas Expedition and the UN Decade of Ocean Science for Sustainable Development as opportunities to re-imagine our approach to providing an ocean science-management interface that meets the challenges of this rapidly changing world.



Mr. Mark Saunders currently works for the North Pacific Anadromous Fish Commission as the Director for the North Pacific Region of the International Year of the Salmon initiative. He retired several years ago from the Canadian Department of Fisheries and Oceans where he headed up a Salmon, Aquaculture and Freshwater Ecology Division at the Pacific Biological Station in Nanaimo, B.C. with staff working on salmon stock assessment, freshwater habitat, molecular genetics, fish health, and marine ecology. The early part of Mark's career focused on stock assessment of marine fish as well as research related to hydroacoustic surveys and fisheries oceanography of the California Current system.



Ms. Stephanie Taylor is the International Year of the Salmon (IYS) High Seas Expedition Coordinator for the North Pacific Anadromous Fish Commission (NPAFC). She is the NPAFC lead on the 2022 IYS Pan Pacific Winter Expedition and has been with the NPAFC since July 2018. She began working as the North Pacific Coordinator for the International Year of the Salmon (IYS) initiative after completing an internship as the NPAFC Secretariat in December 2018, and has been working on the 2022 Expedition since August 2019. She graduated from McMaster University in 2015 with a BSc in Integrated Science and Earth and Environmental Science. She has also received a Masters of Resource and Environmental Management from Dalhousie University in Halifax, Nova Scotia.



Ms. Camille Jasinski is the Public Relations and Communications Coordinator for the International Year of the Salmon (IYS)—North Pacific Region. She is currently completing her master's degree in communications at Simon Fraser University, after which she hopes to pursue her PhD. Camille's graduate research interests include classical communication theory, ideology, philosophy, surveillance culture, environmental communication, decolonization theory, and Indigenous rights. Camille currently sits as the co-chair to the IYS Theme Council Group 4—Outreach and Communication.



The Bering Sea: Current status and recent trends

Lisa Eisner

Climate and oceanography

The Bering Sea was warm during the spring and summer of 2020 relative to historical norms, but not to the extent of most of the past 5 years. The magnitude of the anomalous warmth in sea surface temperatures (SST) during 2020 from an area-average perspective was roughly one-half that during 2019. A map of the SST anomaly distribution for the months of April through September 2020 (Figure 1) shows that it was especially warm over a broad band centered over the shelf break of the eastern Bering Sea, where the 6-month average temperatures were on the order of 1.5°C greater than their 1981-2010 averages. Positive temperature anomalies of lesser magnitude occurred in the western Bering Sea and in the vicinity of Bering Strait. Notably, the anomalies in the northern Bering Sea during 2020 were substantially weaker than those observed in that region during the same period of 2018 and 2019. The temperatures at depth appear to have been warmer than normal, but not to an extreme. In particular, the cold pool (bottom temperature < 2°C) on the eastern Bering Sea shelf was reduced in its area compared with historical norms, but to nowhere near the extent of that during 2018 and 2019 (Phyllis Stabeno, personal communication). The larger cold pool in 2020 can be attributed mostly to colder weather during the winter of 2019-20, especially in the vicinity of the west coast of mainland Alaska, and greater sea-ice extent, than during the previous two years.

The mean sea level pressure (SLP) anomaly pattern over the Bering Sea during April through September 2020 is shown in Figure 2. This period included a tongue of slightly higher than normal SLP over the eastern Bering Sea shelf extending from much greater positive anomalies over Siberia, and negative SLP anomalies farther south, with a minimum over the western Aleutian Islands. The result of this pressure distribution was mostly weak mean wind anomalies for the period of interest, with the exception of a band of easterly anomalies of 1.5 to 2 m s⁻¹ over the southwestern and south-central Bering Sea (not shown). The summer of 2020 featured relatively light winds on the southeastern Bering Sea shelf. More specifically, the mean wind mixing (u^*3) at Mooring 2 at 57°N, 164°W for the interval of June 15 through August 31 was the third smallest in the last 30 years, with only 2002 and 2014 having less wind energy for turbulent mixing of the upper part of the water column. The weak winds of 2020 are in sharp contrast with 2018, which tied with 1993 for the greatest magnitude of mean u^*3 . Wind mixing during summer can allow deep nutrients to be injected into surface waters (which are typically nutrient-depleted) and subsequently fuel phytoplankton growth.

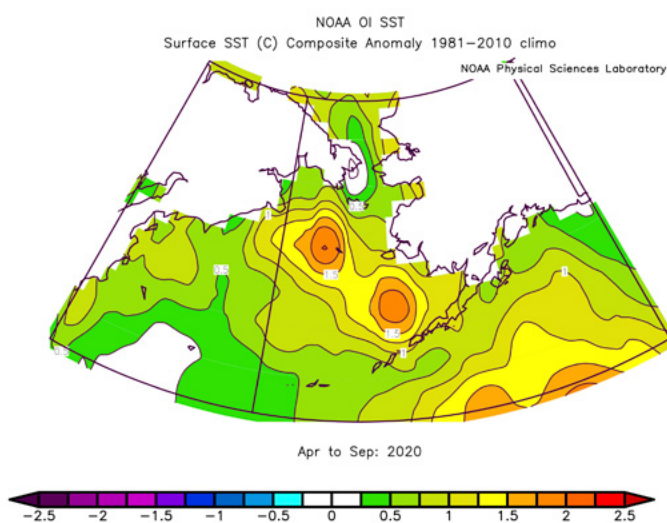


Figure 1. Mean sea surface temperature (SST) anomalies (°C) from the NCEP/NCAR Reanalysis for April-September 2020. Figure courtesy of Nick Bond, University of Washington (UW)/Cooperative Institute for Climate, Ocean, and Ecosystem Studies (CICOES).

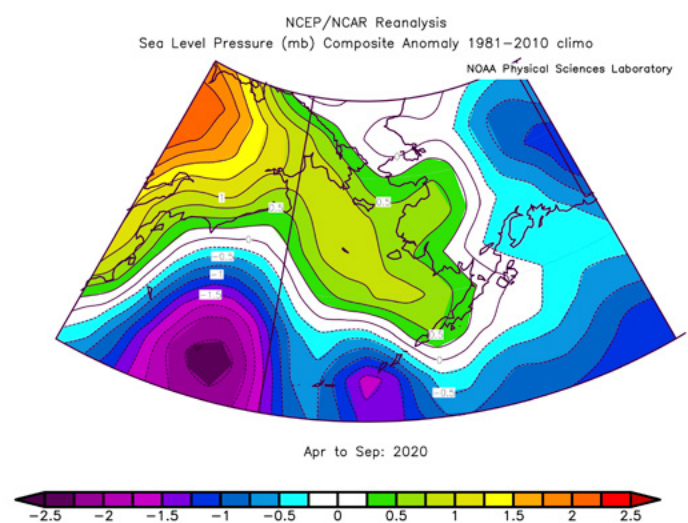


Figure 2. Mean sea level pressure (SLP) anomalies (mb) from the NCEP/NCAR Reanalysis for April-September 2020. Figure courtesy of Nick Bond, UW/CICOES.

Satellite-derived sea surface temperature (SST) time series

Satellite-derived SST data for the northern and southeastern Bering Sea (source: NOAA Coral Reef Watch Program) were accessed via the NOAA CoastWatch West Coast Node ERDDAP server (Figure 3). Trend analysis removed seasonality and noise from the daily SST time series data (Edullantes, 2019) to better illustrate the long-term trends. Trends are compared to the mean (± 1 SD) from a 30-yr baseline (1986–2015) and demonstrate that both the northern and southeastern Bering Sea are experiencing a persistent warm stanza, greater in both magnitude and duration than that of the early 2000s.

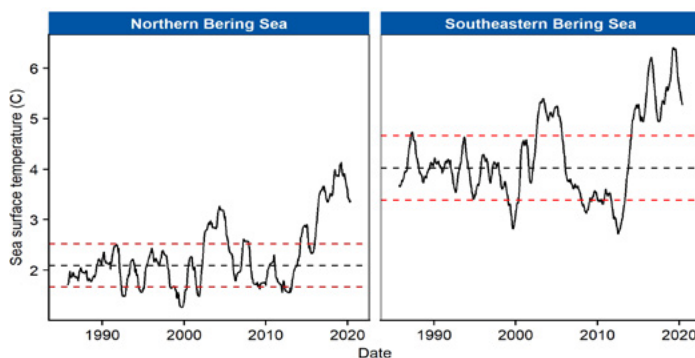


Figure 3. Satellite-derived daily SST data for the northern (60–65.75°N) and southeastern (Alaska Peninsula to 60°N) Bering Sea shelf (10m–200m). Horizontal black dashed line is the mean from 1986–2015 (i.e., the oldest 30-yr baseline period in the time series). Red dashed lines are ± 1 SD for that same time period. Figure courtesy of Jordan Watson, NOAA Alaska Fisheries Science Center (AFSC).

Coccolithophore blooms in the southeastern Bering Sea

Blooms of coccolithophores, unicellular calcium carbonate-producing phytoplankton taxa, are easily observed by satellite ocean color sensors due to their high reflectivity. Blooms are most commonly observed when cloud cover is typically lower during September than other months in the eastern Bering Sea, allowing for better quantification (Iida et al., 2012). An interannual index of the average area covered by coccolithophores in September was calculated from the MODIS-Aqua satellite (2002–2019) and the VIIRS-SNPP (2012–2020) satellite (NASA Goddard Space Flight Center, 2019). These indices are highly correlated; therefore for brevity, only the VIIRS-SNPP data are presented here (Figure 4).

For recent years, the bloom index was the lowest on record in 2017, below average in 2018 and 2019, but high in 2020 (middle shelf). Coccolithophore blooms can have important ecological implications. Variability in the dominant phytoplankton (diatoms vs. coccolithophores)

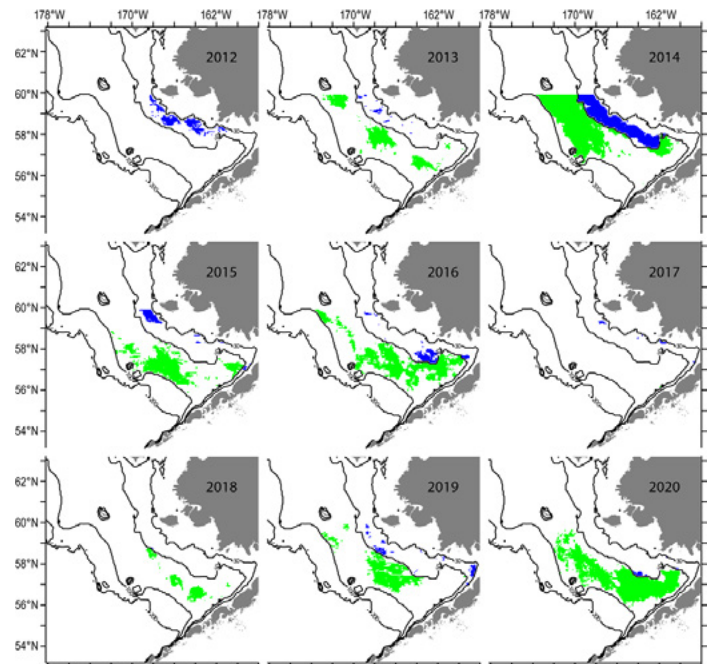


Figure 4. Location and extent of coccolithophore blooms in September of each year from VIIRS-SNPP data. Color indicates coccolithophore bloom conditions on the inner shelf (blue) and middle shelf (green). Figure courtesy of Carol Ladd, NOAA Pacific Marine Environmental Lab (PMEL).

is likely to influence trophic connections with the smaller coccolithophores resulting in less efficient transfer of energy up the food web. Coccolithophores also may be a less desirable food source for microzooplankton in this region (Olson and Strom, 2002), and the striking milky aquamarine color of the water during a coccolithophore bloom can reduce foraging success for visual predators.

Response of Pink salmon to climate change in the northern Bering Sea

Life-history and life-cycle models of Pink salmon (*Oncorhynchus gorbuscha*) were developed to provide insight into production dynamics in the northern Bering Sea (Farley et al. 2020). Arctic ecosystems, including freshwater and marine ecosystems in the northern Bering Sea, are warming at a rapid rate. Due to their short, two-year life cycle, Pink salmon are well known to respond rapidly to ecosystem change and can provide unique insight into ecosystem impacts of this warming. Life-cycle models suggest a lack of density-dependence for adult Pink salmon spawners in the Yukon River and potential for some density-dependence for adult Pink salmon spawners in the Norton Sound region. Life-history models identify a positive and significant relationship between the abundance index for juvenile Pink salmon (captured in surface trawls during September) and average Nome air temperature during their freshwater residency (August to June; Figure 5).

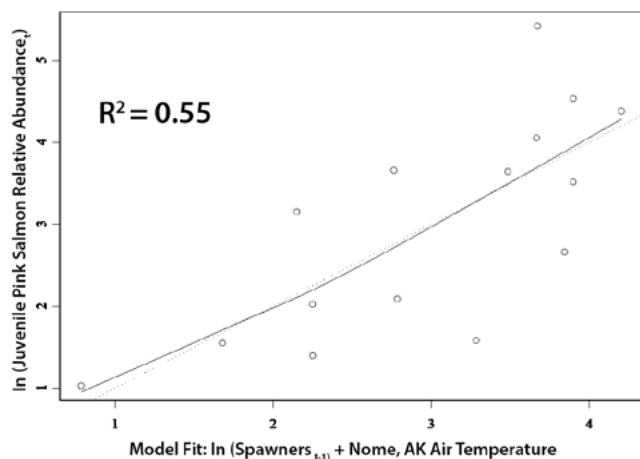


Figure 5. Relationship (line) between the natural log of juvenile Pink salmon relative abundance and the natural log of adult Pink salmon spawner index with Nome air temperature (open circles; 2003 to 2018). Figure from Farley et al., 2020.

This relationship supports the notion that warming air temperatures in this region (as a proxy for river and stream temperatures) are contributing to improved freshwater survival or increased capacity of freshwater habitats to support Pink salmon production.

Life-history models also indicate that the number of adult Pink salmon returning to Norton Sound and the Yukon River are significantly related to the juvenile abundance in the northern Bering Sea (Figure 6). For example, high juvenile Pink salmon abundance in 2019 was linked to high returns in 2020. The water temperatures were exceptionally warm in the northern Bering Sea region in 2019, supporting the positive relationship between temperature and juvenile Pink salmon abundance. These results indicate that much of the variability in survival for northern Bering Sea Pink salmon occurs during early life-history stages and that juvenile abundance is an informative leading indicator of Pink salmon runs to this region.

Estimated walleye pollock biomass in 2020

NOAA's Alaska Fisheries Science Center (AFSC) summer groundfish bottom trawl and acoustic trawl surveys in the eastern Bering Sea were canceled due to COVID-19. However, uncrewed surface vehicles (USV, sailing drones) equipped with acoustic sensors analogous to those used on the research vessels, collected data in July and August to estimate pollock biomass on the eastern Bering Sea shelf¹. Pollock biomass was estimated at 3.6 million t (Figure 7) with highest densities on the outer shelf in the northwest portion of the survey area (Figure 8) (lanelli et al., 2020). US data on pollock distribution are confirmed by the successful Russian fishery at the shelf edge and in the Navarin Current stream. See next page under "Bering and Chukchi seas: 2020 summer and fall surveys" for details of Russian surveys.

¹<https://www.saildrone.com/news/arctic-sea-ice-climate-change-impact-fisheries-management>

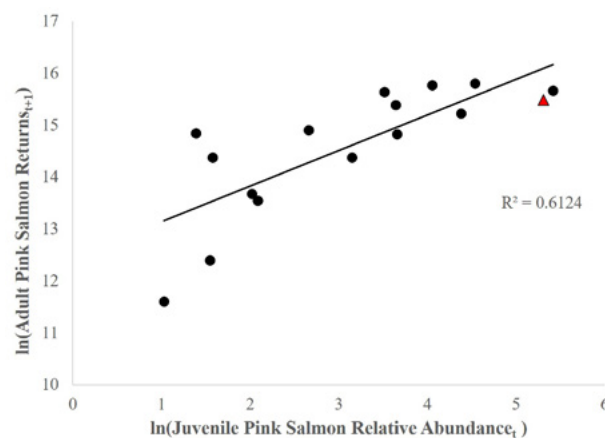


Figure 6. Relationship between the natural log of adult Pink salmon return index to the Yukon River and Norton Sound region (2004 to 2020) and the natural log of the relative abundance of juvenile Pink salmon from the surface trawl surveys (2003 to 2019). Red triangle indicates the relationship between the 2019 juvenile index and the 2020 adult returns. Figure courtesy of Ed Farley, NOAA, AFSC.

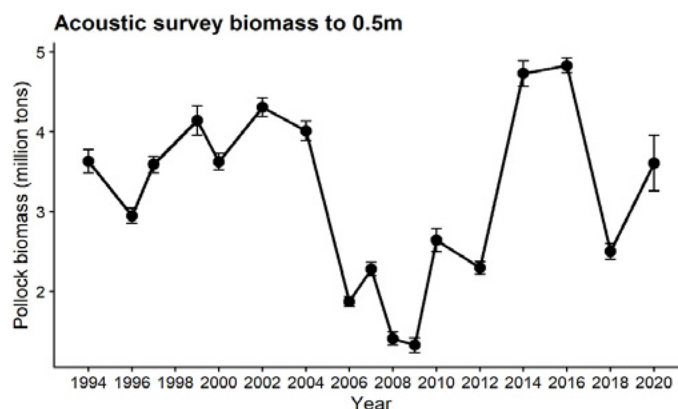


Figure 7. Acoustic-trawl survey pollock biomass time series in the eastern Bering Sea. Error bars correspond to the relative estimation error (i.e. CV) estimated with a 1-D geostatistical technique. The 2020 survey was conducted with unmanned surface vehicles (USVs), and has larger errors associated with the estimate that incorporate the effects of reduced sampling effort (i.e. 40-nmi spaced transects rather than 20-nmi transects), and the method used to convert backscatter to biomass conversion. Figure from lanelli et al., 2020.

Unusual Mortality Event continues in 2020

The elevated gray whale strandings from Mexico to Alaska in 2019 were declared an Unusual Mortality Event (UME); this UME has continued in 2020. In Alaskan waters (Gulf of Alaska, Bering and Chukchi seas), gray whale strandings decreased slightly from 48 to 45 from 2019 to 2020 (as of Dec. 1). Potential explanations include: nutritional stress, contaminants, biotoxins, disease and parasites, direct anthropogenic factors, and reaching carrying capacity. For additional information on UME data please see: [2019-2020 Gray Whale UME](#).

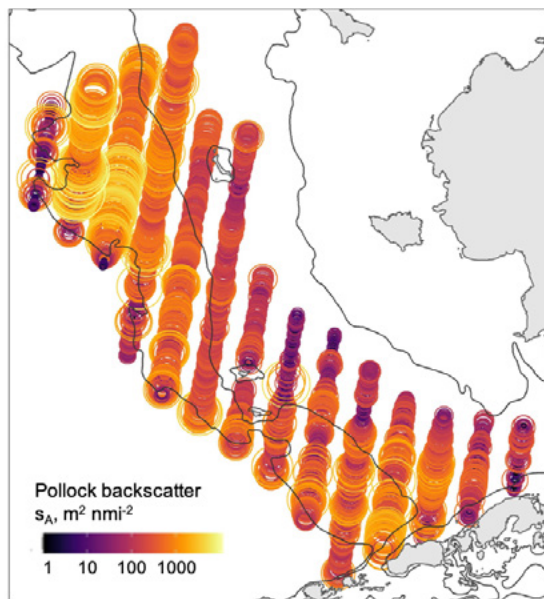


Figure 8. Map of backscatter measurements during the 2020 USV acoustic survey. The size and color of each point represents the mean acoustic backscatter attributed to pollock in a 0.5-nmi transect segment. Figure from Ianelli et al., 2020.

NOAA AFSC Ecosystem Status Reports

NOAA AFSC produces Ecosystem Status Reports (ESRs) for the eastern Bering Sea, Aleutian Islands, and Gulf of Alaska. The ESRs contain comprehensive information on aspects of the ecosystem, from oceanography through upper trophic levels, provided by numerous federal agencies, state/university partners, tribal governments, and coastal community members. The extensive efforts to compile, synthesize, and produce the ESRs are greatly appreciated in informing the ecosystem summary provided here. Notably, the sections on SST time series, coccolithophores, and gray whale UME were directly derived from these reports (Siddon, 2020). For details on these and other ESRs, please see <https://access.afsc.noaa.gov/REFM/REEM/EcoWeb/>.

Bering and Chukchi seas: 2020 summer and fall surveys

Trawl surveys accompanied by acoustic and oceanographic surveys (including chemistry and plankton) were conducted by the Russian Fishery Agency in the western Bering Sea. Surveys were done in two phases: 1) a bottom trawl surveys of the Gulf of Anadyr and the shelf at the Koryak coast by RV *Dmitry Peskov*, and in the southwestern Chukchi Sea by the RV *TINRO*, August 4 – September 17; and 2) the bottom trawl survey of the Olyutorsky and Karaginsky bays by RV *Dmitry Peskov* and midwater trawl/acoustic survey of the western Bering Sea by 2 RVs: *Professor Kaganovsky* and *TINRO*, September 18 – October 5.

NOAA PMEL and AFSC conducted an oceanographic/mooring survey in the eastern Bering and Chukchi seas on the RV *Oscar Dyson*, August 24 – September 25, 2020.

An ecosystem survey was conducted in the northern Bering and Chukchi seas at Distributed Biological Observatory (DBO) stations, on the RV *Norseman II*, October 2–20, 2020².

Acknowledgements:

Many thanks to the scientists who helped create this report: Dr. Nicholas Bond at UW/CICOES provided information on climate and oceanography; Dr. Yury Zuenko at the Pacific branch of the Russian Research Institute of Fisheries and Oceanography (TINRO) provided information on western Bering Sea surveys; NOAA AFSC scientists Drs. Jordan Watson, Ed Farley, and Elizabeth Siddon provided information on satellite SST, Pink salmon, and the Alaska ESRs, respectively, and Stan Kotwicki and Jim Ianelli provided information on the eastern Bering Sea pollock; Dr. Carol Ladd at NOAA, PMEL provided information on coccolithophores; and Dr. Kate Savage at NOAA Fisheries Alaska Regional Office provided information on the gray whale UME.

²Contact: Chief Scientist Jackie Grebmeier, jgrebmei@umces.edu.

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The western North Pacific during the 2020 warm season
Naotaka Hiraishi

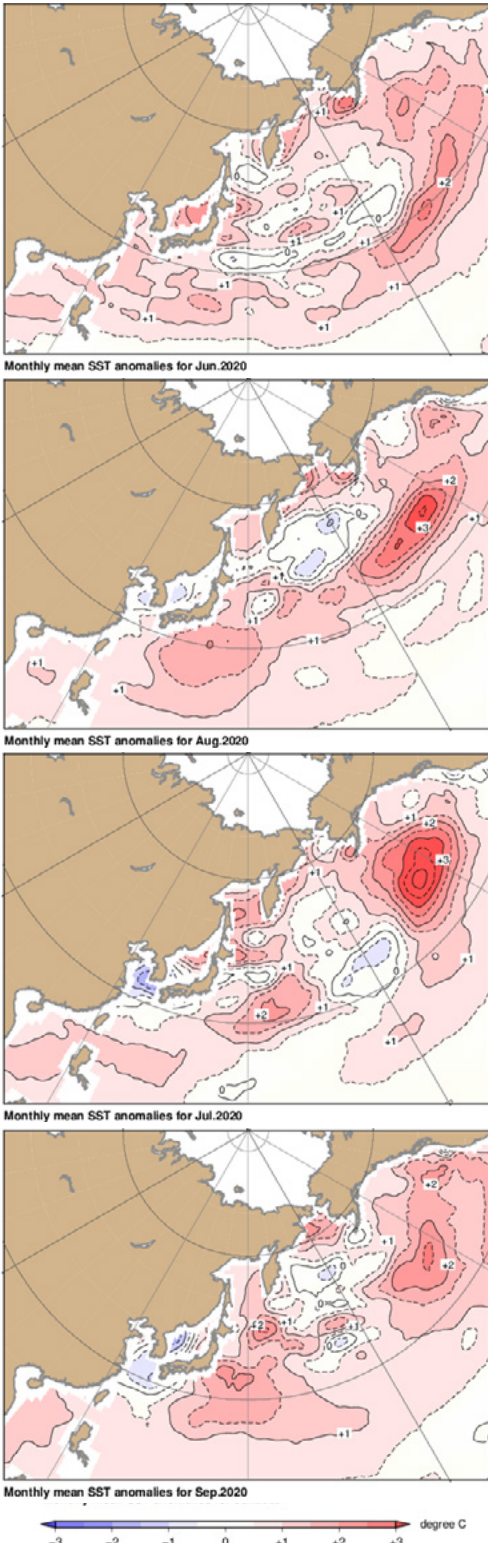


Figure 1. Monthly mean sea surface temperature (SST) anomalies from June to September 2020. Monthly mean SSTs are based on Japan Meteorological Agency's (JMA) COBE-SST (centennial in-situ observation-based estimates of variability for SST). Anomalies are deviations from the 1981-2010 climatology.

The western North Pacific was characterized by positive anomalies of sea surface temperature (SST) in almost all of this area, throughout the 2020 warm season. In particular, large positive anomalies were observed south to the southeast off Japan through the season (Figure 1).

The Kuroshio has followed a large meander (LM) path since the summer of 2017. Until May 2020, the Kuroshio has flowed southward off Shikoku Island and off Kii Peninsula and then turned northward off Tokai Region indicating the typical LM path. Although the Kuroshio path has also taken the LM path since June 2020, the course became unstable and fluctuated temporally (Figure 2, 3). Sometimes a cold eddy was generated as the result of the cut-off of the southernmost part of Kuroshio LM path.

In the early part of October 2020, a large cold eddy was cut-off and then the Kuroshio flowed in a non-LM like path (Figure 4). In November 2020, with small meanders propagating eastward off Shikoku Island to off Tokai Region, Kuroshio gradually began to flow along an LM-like path (Figure 5).

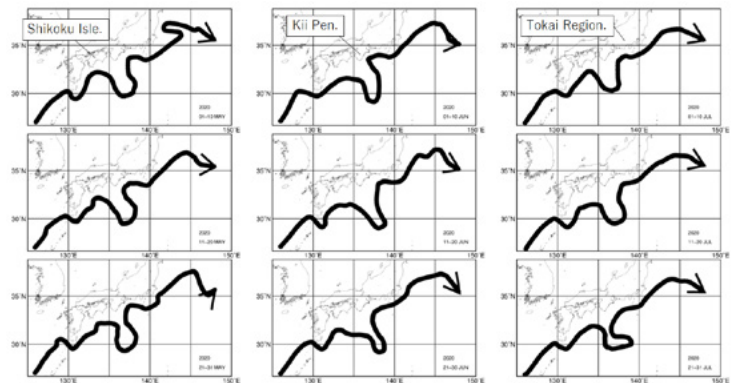


Figure 2. Kuroshio path analyzed subjectively by JMA from May 1-10 to July 21 - 31.

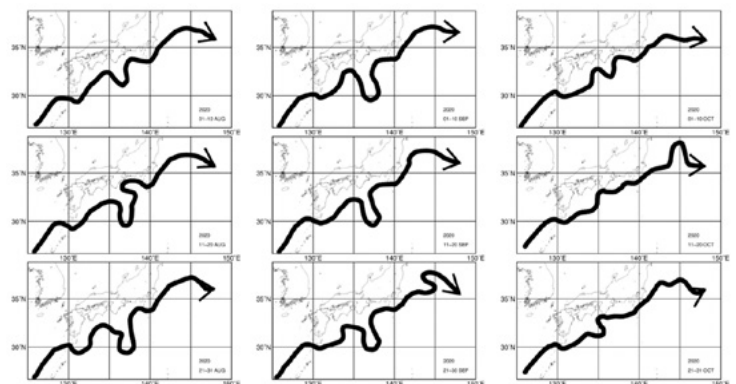


Figure 3. Kuroshio path analyzed subjectively by JMA from August 1 - 10 to October 21 - 31.

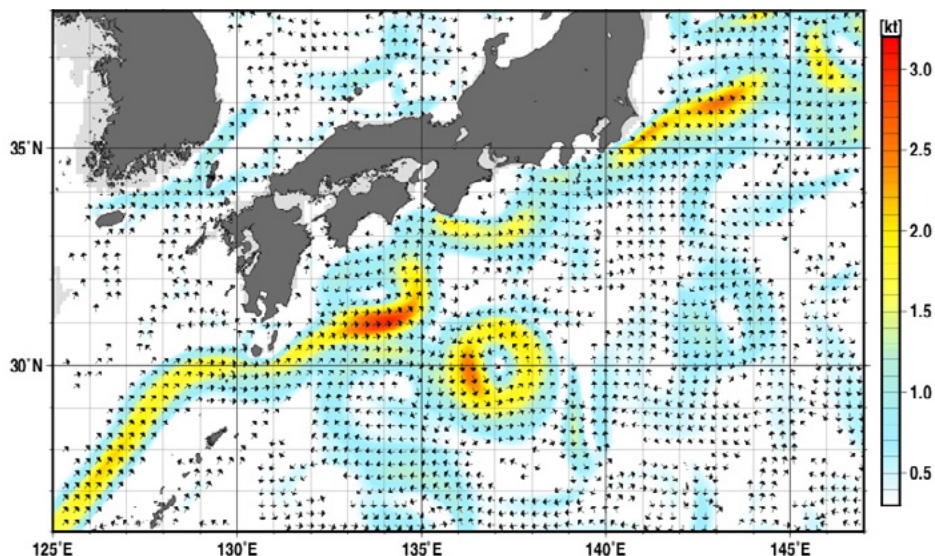


Figure 4. Ten-day mean 50-m currents in the Kuroshio region for October 11–20, 2020 obtained with JMA’s operational data assimilation system.

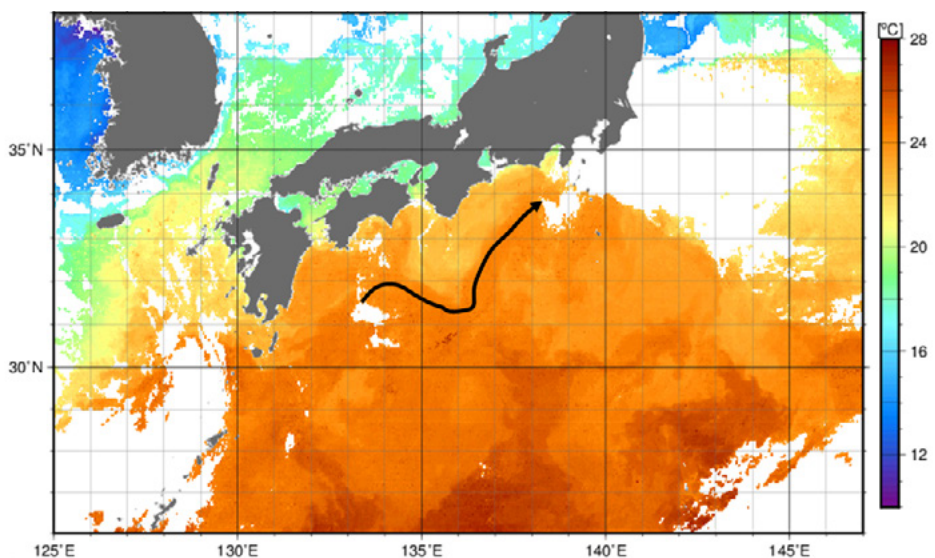


Figure 5. Sea surface temperature, November 24, 2020 (00 – 11 UTC), as observed by Himawari-8. Black line denotes estimated Kuroshio path.



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The Northeast Pacific: Update on marine heatwave status and trends

Tetjana Ross, Jennifer Jackson and Charles Hannah

Since 2014, when the research community first took notice of the sustained anomalously high sea surface temperatures that was nicknamed the “Blob” (e.g. Bond et al., 2015; Figure 1b), a lot of attention has been paid to marine heatwaves in the Northeast Pacific. While work is continuing to be published on the impacts of the 2014-16 marine heatwave (e.g. Brodeur et al., 2019; Barbeaux et al., 2020; Nielsen et al., 2020), many researchers have also taken note of a subsequent large Northeast Pacific marine heatwave in 2019 (e.g. Amaya et al., 2020; Ross et al., 2019; Figure 1a&c). This supports the idea that marine heatwaves are becoming more common (Oliver et al., 2018; Holbrook et al., 2020), but nevertheless there are significant differences between the 2019-20 and 2014-16 heatwaves that may have implications for how they might impact marine ecosystems.

While both the 2014-16 and 2019-20 marine heatwaves covered a large area of the Northeast Pacific and were of long duration, their spatial patterns differed in ways that could be important. Figures 1a (2019-20) and 1b (2014-16) show 2-year averages of sea surface temperature anomalies (SSTa), which depict a large area with sustained elevated temperatures. Note that while Figure 2

(which shows an area-averaged, but depth resolved, categorization of these temperature anomalies (derived from Argo data; see Ross et al., 2019 for methodological details)) indicates that the 2019-20 marine heatwave reached a more extreme category of heatwave (spatial pattern of peak month shown in Figure 1c), the anomalies were of shorter duration, such that the mean SSTa over 2 years was higher for 2014-16 than 2019-20. Additionally, the 2-year average SSTa shows that unlike for 2014-16, during the 2019-20 marine heatwave there has been little influence on coastal water temperatures south of Alaska. This difference may be due to the fact that heatwave conditions persist to this day or because the 2014-16 heatwave coincided with El Niño conditions.

Another major difference between the spatial patterns of the two marine heatwaves is their vertical distributions. One of the most remarkable aspects of the 2014-16 marine heat wave was the subsurface temperature anomalies in the Northeast Pacific in 2016 and 2017. As seen in Figure 2, these subsurface waters would be classified as a Category IV anomaly (Hobday et al., 2016) – even when averaged over a large section of the Northeast Pacific (35-55°N, 135-155°W). This was not observed for the

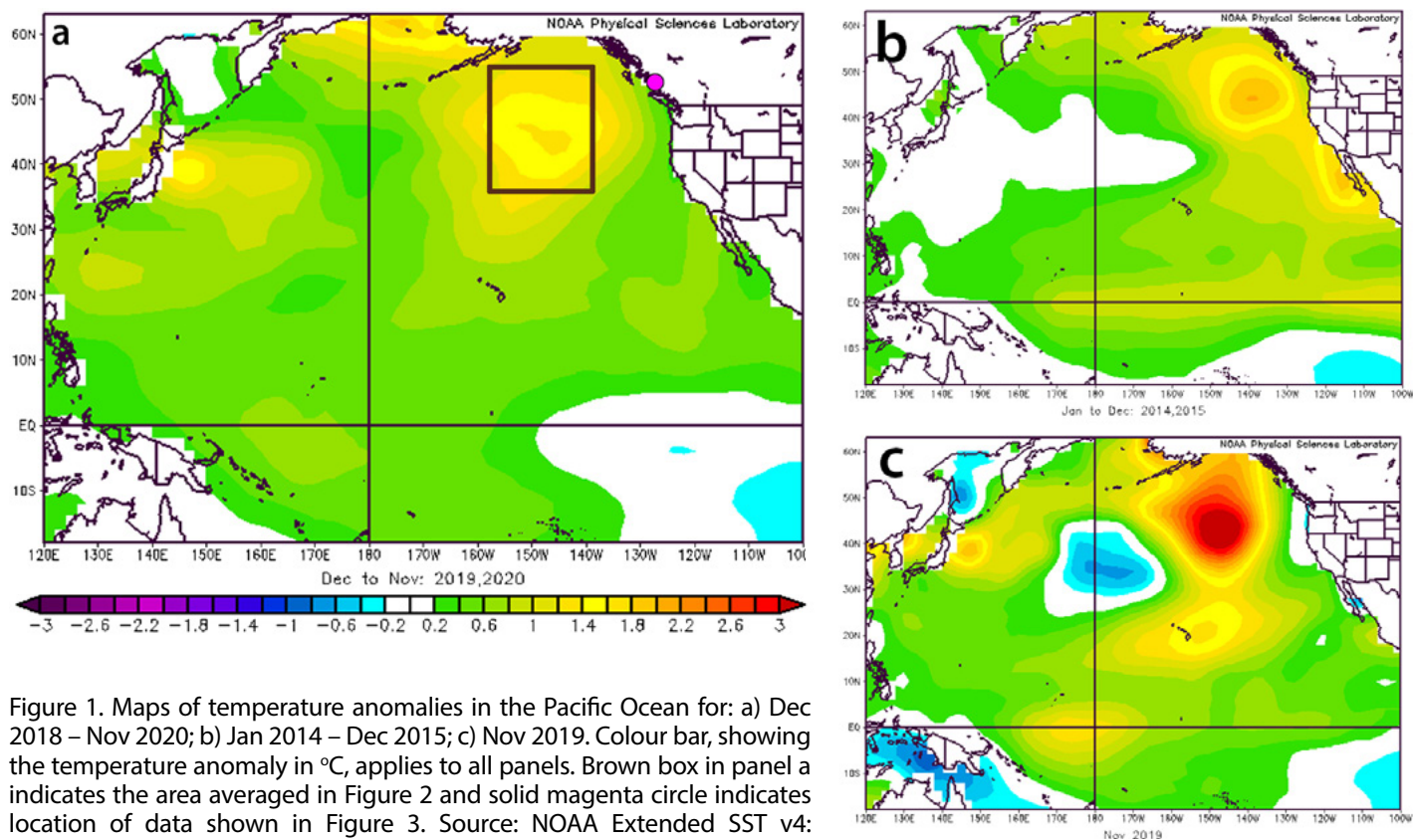


Figure 1. Maps of temperature anomalies in the Pacific Ocean for: a) Dec 2018 – Nov 2020; b) Jan 2014 – Dec 2015; c) Nov 2019. Colour bar, showing the temperature anomaly in °C, applies to all panels. Brown box in panel a indicates the area averaged in Figure 2 and solid magenta circle indicates location of data shown in Figure 3. Source: NOAA Extended SST v4: <http://www.esrl.noaa.gov/psd/cgi-bin/data/composites/printpage.pl>.

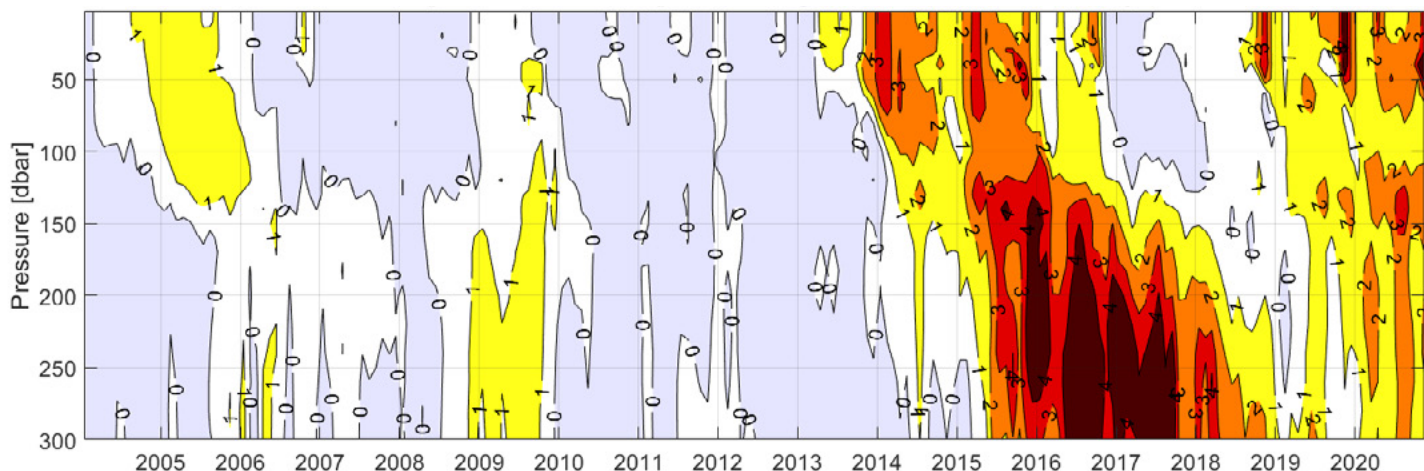


Figure 2. False colour plot of temperature anomalies as observed by Argo floats in the Northeast Pacific. The anomalies are coloured based on their categorization in the Hobday et al., (2018) scheme (the light blue colour indicates cooler than average temperatures). To create the time series, the Roemmich and Gilson (2009) gridded Argo temperature dataset was spatially-averaged over 35-55°N and 135-155°W (box shown in Fig. 1a), anomalies calculated at each monthly time step by subtracting the 2004-2013 seasonally-corrected mean and then scaled to intensity (Hobday et al., 2016) by dividing by the 2004-2013 seasonally-corrected 90th percentile increment.

2019-20 marine heatwave; there were subsurface anomalies that appear to have propagated down at the same rate as for the previous heatwave but they were much cooler. In fact, the peak intensities were reversed between the two heatwaves with Category IV only found below 100 dbar for 2014-16 and above 100 dbar for 2019-20. Note, however, that while the intensity is very high below 100 dbar in 2014-16, this is because the variability was historically smaller. The absolute anomalies between 200-300 dbar were less than 0.4°C, while the surface anomalies exceeded 1.5°C.

Supporting the idea that these differences in spatial patterns could be important ecologically is the fact that the 2019-20 marine heatwave appears to have had no impact on temperature in coastal inlets. The 2014-16 marine heatwave has been shown to extend into many coastal regions up and down the west coast of North America (e.g. Fewings and Brown, 2019) and has ecological impacts in coastal regions (e.g. Zhu et al., 2017; Brodeur et al., 2019; Shanks et al., 2020). This includes in the deep waters of coastal fjords such as Rivers Inlet (Jackson et al., 2018). There was a considerable increase in the temperature of deep waters in Rivers Inlet in 2015, associated with the 2014-16 marine heatwave extending across Queen Charlotte Sound, over a 140 m sill and into Rivers Inlet (Jackson et al., 2018; Figure 3a). During the 2019-20 heatwave, however, the deep waters in Rivers Inlet appear to have been cooling slightly (Figure 3a), which suggests that this heatwave will have a much smaller impact on this and similar deep water fjords that are essential habitat for Pacific salmon.

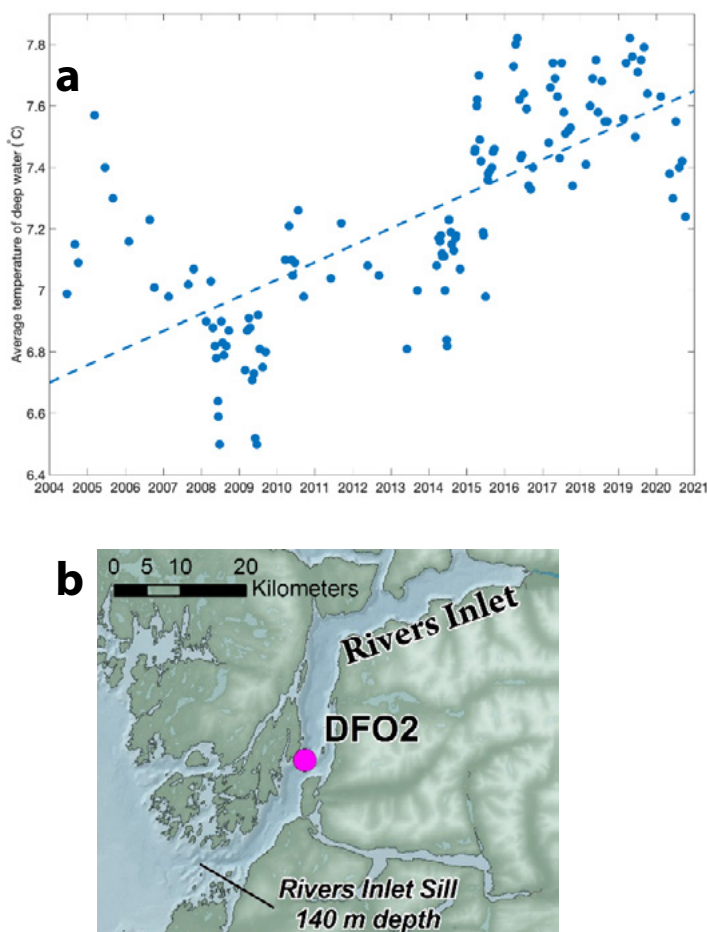


Figure 3. Temperature time series (panel a) based on CTD data collected at station DFO2 in Rivers Inlet (solid magenta circle in panel b; Fig. 1). The temperature data are average below the sill depth of 140 m in Rivers Inlet. Panel b was modified from Figure 1 in Jackson et al., (2018).

Acknowledgements

Argo data were collected and made freely available by the International Argo Program and the national programs that contribute to it. (<http://argo.jcommops.org>). The Argo Program is part of the Global Ocean Observing System. Rivers Inlet data were collected jointly by Fisheries and Oceans Canada, the University of British Columbia, and the Hakai Institute and are freely available at: www.cioospacific.ca.

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Dr. Tetjana Ross is a Research Scientist at the Institute of Ocean Sciences, Fisheries and Oceans Canada, in Sidney, BC. She is an ocean physicist who develops new ways to observe the ocean – from observing ocean mixing using sound to taking photographs of zooplankton in turbulence. Nowadays, she rarely goes to sea, sending robots out to do the work for her: both gliders and Argo floats (i.e., she currently leads the Pacific component of DFO's Argo and glider programs). In PICES she is member of the Technical Committee on Monitoring and Working Group on Mesoscale and Submesoscale Processes (WG 38).



Dr. Jennifer Jackson is a physical oceanographer who studies currents, waves, tides, how the atmosphere interacts with the ocean, and how the physical environment affects marine animals and plants. Over her career, she has studied the Arctic, Indian, and Pacific Oceans. Jennifer currently works as a research scientist at the Hakai Institute, a not-for-profit organization that is actively studying the coastal margins of British Columbia. In PICES she is a member of the Physical Oceanography and Climate Committee.



Dr. Charles Hannah is a senior Research Scientist for Fisheries and Oceans Canada based at the Institute of Ocean Sciences in Sidney, BC. His research program is focused on the oceanography of the central and north coast of British Columbia and he is currently leading a program of moored observations along the British Columbia continental shelf. Within PICES he is member of the Advisory Panel on North Pacific Coastal Ocean Observing Systems.

PICES New Chair: Professor Enrique Curchitser



Professor Enrique Curchitser stands on sea ice in front of the US RVIB *Nathaniel B. Palmer* during a 2003 expedition to the Ross Sea.

Professor Enrique Curchitser was born in Buenos Aires, Argentina. Besides his native country, he spent a significant part of his childhood in Israel, Switzerland and the United States, where he ultimately returned for his university and post-graduate education. In 1988, he graduated with honors from Rutgers University with a degree in Mechanical and Aerospace Engineering, winning an award from the American Society of Mechanical Engineering for his first work in Computational Fluid Dynamics (*"A Numerical Study of Rayleigh-Bénard Convection in 3D"*). After obtaining a Master of Science degree from the same program, he merged his passions for fluid dynamics, sailing and the ocean and pursued a doctorate degree in Oceanography under the supervision of Dr. Dale Haidvogel, also at Rutgers University. After completing his dissertation (*"On the Transient Adjustment of a Mid-Latitude Abyssal Ocean Basin with Realistic Geometry and Bathymetry"*), he started a post-doctoral position at the NASA Goddard Institute for Space Studies in New York City. A year later he was awarded a fellowship by the Earth Institute of Columbia University Center for Non-Linear Earth Systems to pursue research at the Lamont-Doherty Earth Observatory and the Department of Applied Physics and Applied Mathematics. During these years, with support from the U.S. GLOBEC program, Enrique became interested in the intersection of climate and ecosystems. He developed a series of nested regional models for the North Pacific and the California Current System that are used to this day in studies of both

physics and ecosystems in the region. He was invited by the current PICES Deputy Executive Secretary, Dr. Hal Batchelder, to present at PICES-2004 in Honolulu. In PICES, Enrique found a scientific home and he has participated in nearly every Annual Meeting since. He was appointed as a US member to the Physical Oceanography and Climate Committee (POC); served as co-chair with Chan Joo Jang, (Korea) of PICES Working Group 29 on Regional Climate Modeling; as well as serving as a member in Working Groups 20 (Evaluations of Climate Change Projections) and 27 (North Pacific Climate Variability and Change). In 2014, Enrique was appointed as the US national academic delegate to the PICES Governing Council, and became GC Vice-chair in 2017.

After a few years as a research scientist at Columbia University, Enrique returned in 2006 to Rutgers University in New Jersey, where he is a faculty member. Beyond PICES he contributed to international science through participation in CLIVAR panels (Ocean Model Development Panel, Eastern Boundary Upwelling) and the SCOR working group on upwelling systems. He is currently the Editor-in-Chief for [Progress in Oceanography](#) and an affiliate scientist at the National Center for Atmospheric Research, in Boulder, Colorado, where he often spends the summer months. Over the years, his regions of interest have expanded beyond the North Pacific and he has engaged in research in the Atlantic, Bering Sea and the Coral Triangle.



Professor Curchitser with his wife, Dr. Randy Rutberg.

His group of students and post-docs at Rutgers University, The Earth System Modeling Lab, remains heavily involved in the development and use of high-resolution, coupled physical-biological models.

In his free time, Enrique can be found taking photographs, hiking or riding his bike. He enjoys reading and music and is looking forward to spending more time playing his classical guitar.



Enrique Curchitser, Jack Barth and Art Miller at a PICES reception.



Enrique Curchitser following a climb to Brainard Lake, Colorado, on his bicycle.

PICES new Science Communication Study Group (SG-SciCom): Bringing our science to the world

Aoi Sugimoto, Erin Satterthwaite, Pengbin Wang and SG-SciCom members

PICES - Leading in marine science and communication

As the first World Ocean Assessment of the United Nations stated in 2016, “humankind was running out of time to start managing the ocean sustainably.”

“Recent scientific findings brought together in the World Ocean Assessment show that the world is running out of time to bring the overall human impacts on the ocean under sustainable management.”

~ UN World Ocean Assessment

Acknowledging this critical time, the UN Decade of Ocean Science (UNDOS) has been proposed as a framework to promote transformative change toward more sustainably managing our oceans. Transformative change will require that ocean scientists improve communication, to better engage stakeholders and the public in a process of co-design and knowledge-sharing, to move society towards a sustainable future.

PICES, as a leading North Pacific marine science organization, recognizes its unique position, studying one of the richest and at the same time the most environmentally threatened ecosystems in the world. In order to better protect North Pacific ecosystems, PICES aims to better communicate its scientific results to a broader audience. The new Study Group on Science Communications (hereinafter, SG-SciCom) was envisioned to develop the communication capacity of PICES ocean scientists, to aid PICES strategic goals. Through collaboration with communication specialists, and by developing a suite of tools to assist scientists with better communicating their scientific results, the SG-SciCom aims to further raise awareness of PICES science. The group also intends to increase and improve communication with the general public, helping ensure greater support and broader uptake of PICES science. Additional background and details are described herein.

Background of the initiative

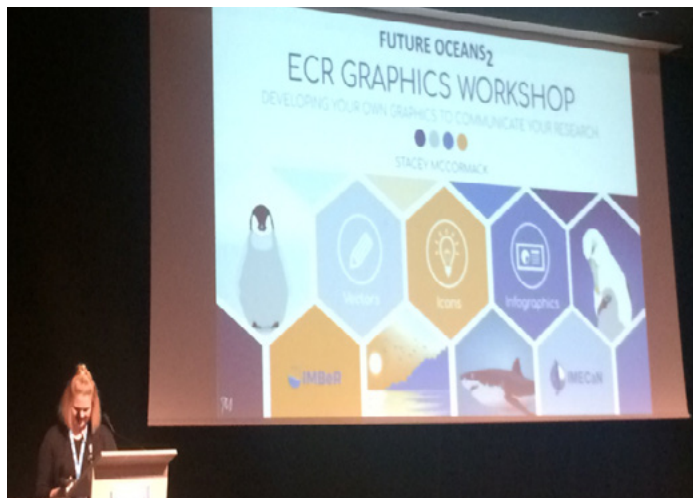
In recent years, the marine science community has become increasingly aware of the need for increased science communication. As far as the authors of this article know, **MSEAS 2016** was the first, successful PICES-ICES conference collaboration which paid strong attention to a science communication perspective. MSEAS 2016 invited an artist to create graphic recordings of the keynote speeches, participants’ presentations and workshop



Figure 1. Graphic from Thebaud et al., 2017 “Managing marine socio-ecological systems: picturing the future,” *ICES Journal of Marine Science* 74(7).

discussions throughout the conference. Artwork created during the conference was then presented as a paper contribution to the Symposium in the *ICES Journal of Marine Science* (Figure 1) to help the participants disseminate the success and excitement of the conference long after its closure.

More recently, the 2019 **IMBeR Open Science Conference (OSC)** organized a Graphics Workshop for Early Career Researchers, shown below. This workshop offered simple techniques that every marine scientist can, and arguably should, use to improve the impact of their scientific work.



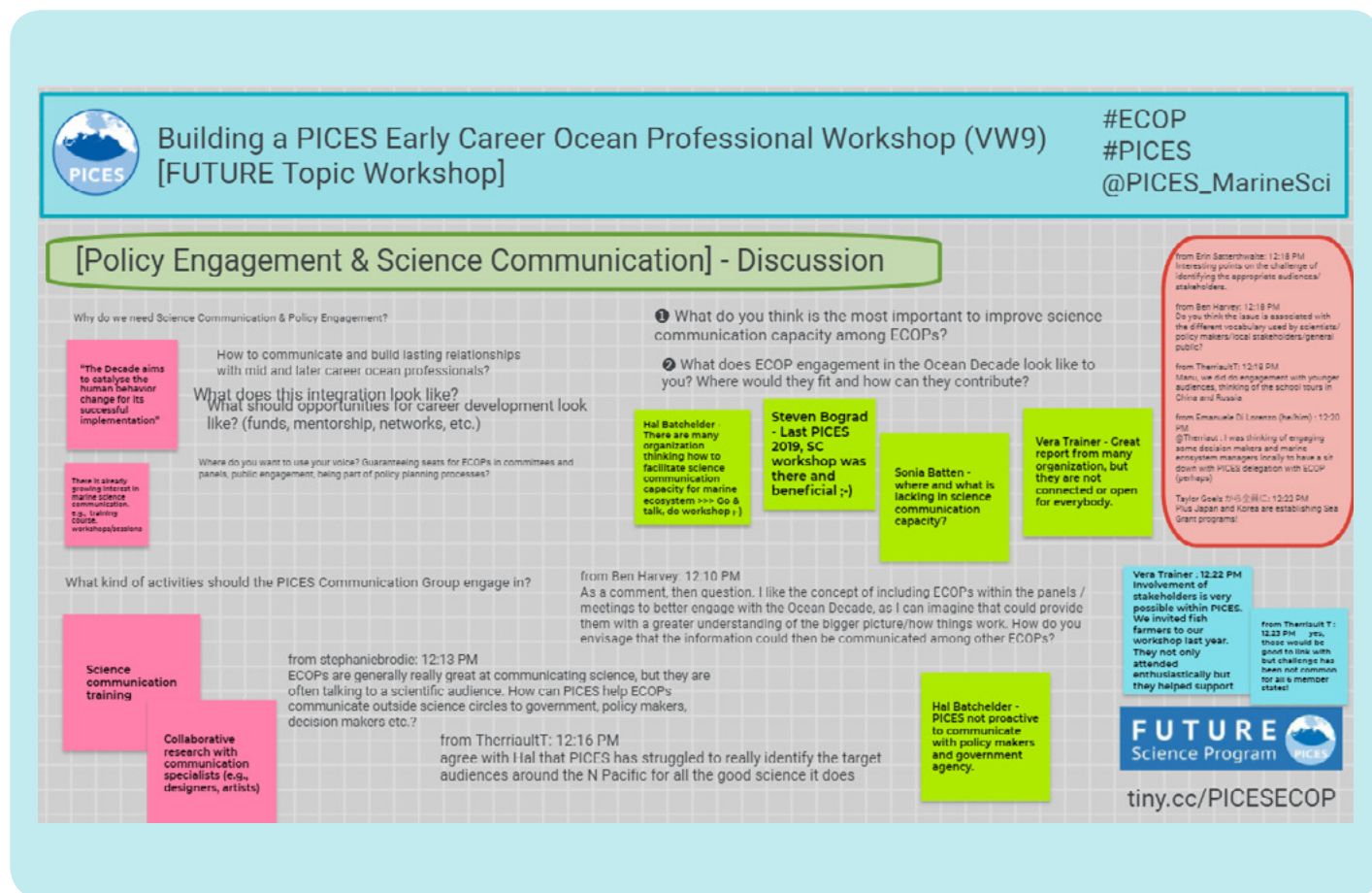


Figure 2. Image of ECOP Workshop “Jamboard” - a record of discussions on PICES science communication during the ECOP workshop. <https://jamboard.google.com/d/1xqyQMxeBrnE9-usjJQSpWjEdPv113xenXWMOjd4oS-U/viewer?f=6>

With the background of broadening of marine science communications, and with UNDOS in mind, the vision and plans for a Science Communications Expert Group were developed through the ECOP Workshop. At PICES-2020, [SG-SciCom](#) was proposed, recommended by Science Board, and approved by PICES Governing Council.

PICES Science communication and the UNDOS context

The ECOP Workshop - [Building a PICES early career professional network \(VW9\)](#) met under the co-chairmanship of Erin Satterthwaite (USA), Aoi Sugimoto (Japan), and Pengbin Wang (China), and with the support of the ECOP Workshop Leadership Team: Raphael Roman (Japan), Hiroaki Sugino (Japan), Yanhui Zhu (Japan), Alexandra Davis (Canada), and Taylor Goelz (USA), on October 15, 1800 (PDT)/ 16, 0900 (Beijing)/ 1000 (Tokyo). The meeting was attended by approximately 58 PICES participants who identified as ECOPs and PICES ECOP mentors. Prior to the workshop, an online survey was carried out for the potential participants through the PICES Secretariat office network. The survey aimed at exploring the interests and needs of PICES ECOPs, in their own words.

Four topic groups were identified for discussion at the workshop:

1. Interdisciplinary collaboration;
2. Science communication;
3. Policy engagement;
4. Diversity and inclusion.

The survey results confirmed that science communication is one of the areas that ECOPs are also interested in, in addition to the international interests and needs as described above. Based on this result, the ECOP team developed a sub-group for facilitating the discussion on science communication during the workshop. Aoi Sugimoto, Raphael Roman, Hiroaki Sugino and Taylor Goelz were assigned to this group to facilitate discussions of the priority issues and vision of PICES science communication (Figure 2). An introduction to some of the key discussions follows.

A need to identify and target key stakeholders

As one of the first issues to be addressed, it was suggested that PICES should identify key audiences and their information needs in order to effectively achieve PICES science communication goals. Mentors (experienced PICES scientists and personnel) at the workshop noted that it has been a struggle to identify and reach target audiences, which may have resulted in some PICES science not effectively reaching important stakeholders. Therefore, identification of key audiences is an important goal of any long-term PICES science communications strategy and implementation plan. ECOPs and mentors alike voiced their desire to collaborate to ensure fulfillment of these goals as part of the Terms of Reference of SG-SciCom.

A need for science communication skills training

Participants also agreed upon the importance of and need for increased opportunities to develop our science communication capacities, such as training courses and collaborative projects between scientists and communication specialists like designers and artists. Although there was a discussion about whether or not to participate in existing training courses or develop custom Science Communication courses within PICES. It was suggested that several schemes within PICES and partner agencies may be suitable venues for science communication training.

Both of the above-identified needs were incorporated into the SG-SciCom Terms of Reference.

Study Group on Science Communications Terms of Reference

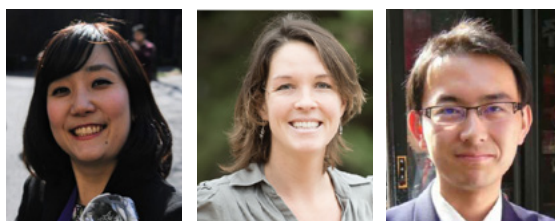
The main objectives of the SG-SciCom are to:

- Empower PICES Scientists and the broader PICES community, by helping to provide the tools and skills required to more effectively communicate the importance of PICES scientific findings, with the aim of collectively improving ocean sustainability.
- Enhance broader communication of PICES sciences, especially within the context of the UN Ocean Decade, by broadening the scope of its scientific community to include communication specialists (e.g., designers, journalists, videographers, artists, educators, etc.) and policy makers.

SG-SciCom expected deliverables:

- Establish international transdisciplinary opportunities to enhance communication capacity of PICES scientists. Opportunities will include workshops on science communication, similar to the FUTURE Workshop “Learn to Effectively Communicate Your Science”, held at PICES-2019. However, future workshops will result in finalizing products that will be highlighted on the PICES website.
- Collaborate with the PICES Secretariat to review current PICES Science Plans and priority areas, to determine a long-term PICES Communication Strategy and an Implementation Plan for PICES science priorities, within the context of the UN Decade for Ocean Science.
- Collaborate with the PICES Secretariat to develop a “public-friendly” PICES website (including any other online means). This will include a visually appealing landing page and other content, such as video, short articles, and consensus pieces on PICES science.
- Promote “green” science and highlight PICES contributions to carbon reduction on the PICES website by working with the Human Dimensions Committee, Section on Carbon and Climate and other expert groups to develop a green strategy for PICES. Develop a strategy for PICES meetings to be carbon neutral within the next decade.

We feel that PICES has made a brave and clever decision to promote science communication. Similar to the discussions on other topic areas of the ECOP workshop, the dialogue on this subject matter was very exciting, engaging diverse range of participants from early career to experienced, from eastern to western side of the North Pacific, from natural to social scientists, both female and male. This diverse coverage must be something that makes PICES an exciting and bright Organization with a great potential. We also need to realize a bright future for the ocean and humankind, for which the SG-SciCom can play a central role.



Please see author biographies for Dr. Aoi Sugimoto, Dr. Erin Satterthwaite, and Dr. Pengbin Wang (shown L-R above) on pages 32 and 33 of this issue.

Remembering Richard Marasco — The legacy of a PICES leader

Dr. Richard J. Marasco passed away peacefully in his home in Redmond, Washington on August 23, 2020 surrounded by his wife, Darlene, and his two daughters, Carly and Deina. He had bravely lived with the degenerative effects of Parkinson's disease for over 12 years.



Dr. Richard Marasco
1943-2020

Rich was a natural resources economist and spent the majority of his career at the Alaska Fisheries Science Center of the National Oceanic and Atmospheric Administration. During that time, he was a leader on many scientific fronts. He was involved in overseeing the provision of scientific advice and data collection in support of fisheries management for Alaska federal fisheries. In addition, he was instrumental in advancing and coordinating international scientific cooperation, particularly for PICES.



In 2016, Rich was the recipient of the first PICES Chair Award, in recognition of the sustained contributions he made over the years to PICES development. As the US delegate to PICES and also as Chair of the PICES Finance and Administration Committee, he led efforts in the successful hosting of PICES meetings in the US and in supporting and encouraging

sustained scientific efforts of US scientists to PICES. He supported PICES financially during years when there was inadequate funding of the Organization to accomplish basic functions. His design of a financial approach to allow PICES to expand in the absence of real increases in annual fees was instrumental in providing PICES with a solid foundation to continue its work.

Just as important was his advocacy and promotion of PICES goals within his home institution. Rich was highly supportive of early career scientists' participation and attendance at PICES meetings, which led to meaningful scientific contributions and an increase in leadership roles there. While his work on the financial front allowed PICES to proceed on more solid financial footing, he also provided the key leadership support to give PICES a strong scientific foundation. This advanced the stature of PICES in the world of international marine organizations and helped it to grow in its mission of furnishing important and meaningful scientific knowledge to its member countries.

Rich gave similar support to many other domestic and international science organizations. He had a quality of leadership such that he was asked to chair a wide variety of scientific endeavors. He was a kind of "Chairman extraordinaire" of the marine science world on the West Coast. For many years, Rich was the chair of the Scientific and Statistical Committee of the North Pacific Fishery Management Council; the North Pacific Research Board's Scientific Advisory Panel; the Scientific and Technical Committee of the Convention for the Conservation and Management of the Pollock Resources of the Central Bering Sea; and the bilateral Korea-US fisheries conference. He had an incisive approach that kept meetings organized, on-time, and made sure the goals of the meeting were accomplished.

Many scientific connections and friendships were made along the way through his leadership at these institutions. In addition to collaborations between US and other member country researchers in PICES, where scientific programs and publications resulting from those have advanced climate change and ecosystem-based management issues on the international front, there have been many close friendships with Korean colleagues that were advanced and nurtured by Rich over the years. Through his support, many young Korean scientists were able to increase their scientific capability and attained high professional stature at home and internationally.

Rich traveled widely in support of PICES and the other international organizations he was involved with. He had an efficient travel style, which involved a modest carry-on bag and good strategies for adapting to the local culture and time zone. Those who traveled with him soon learned to do the same. The local food traditions in each of the PICES countries were always savored and appreciated. One of his Korean colleagues remembers a dish, sun-du-bu, that was a favorite of Rich whenever he was in Korea. Others remember his good advice about



PICES Governing Council, PICES-2001.



Rich flanked by Dr. Warren Wooster and wife, Darlene, and Dr. Hyung Tack Huh and Dr. Tokimasa Kobayashi. PICES-2004.

wine selections. He was always adaptable and prepared and led others more by example than by direction, a key quality of leadership.

Family was the highest priority in life for Rich. With his wife, Darlene, they had the opportunity to travel the world and enjoy many adventures together. Over the years, he was the biggest supporter of his two daughters. After retiring, he reveled in spending time with his grandson. His Italian heritage was also a key part of his life. Rich was an adventurous eater and loved to cook. Many family traditions revolved around sharing and appreciating Italian food.

His loss is greatly mourned by all who knew him, but his legacy of leadership continues in all those he has mentored over the years and the international organizations he has strengthened through his efforts.



Rich and wife, Darlene, at Joshua Tree National Park, California



Rich playing the Italian game of bocce during a family Birthday party at Perrigo Park in Redmond, Washington.



Rich with Dr. Ron Felthoven and Ms. Pat Livingston. PICES-2016.



PICES Chair, Dr. Vera Alexander, presents Rich with a Certificate of Recognition for his term as F&A Chair. PICES-2004.



Rich and Dr. Warren Wooster at a PICES Annual Meeting Poster Session, PICES-2001.



Rich with daughter, Carly, and wife, Darlene, wearing their Team Marasco shirts at the Family and Friend outing for the Michael J. Fox Parkinson's Disease fundraiser, in anticipation of Carly running in the New York Marathon.



Rich with all his immediate family at Cinarama after a family viewing of "Star Wars".

Remembering Doug McKone - PICES' First Executive Secretary

Dr. Warren Douglas (Doug) McKone passed away on June 2, 2020. Dr. McKone was the first Executive Secretary of PICES, serving from 1993 until his retirement in 1998.

Doug was born in Vancouver, British Columbia, in 1935. He started his working career as a mechanic in the British Columbia forest industry but decided after 14 years that a change of career was needed.

In 1975, he graduated from the University of British Columbia in Zoology, specializing in aquatic ecology. He immediately moved all the way across Canada to St. John's, Newfoundland to take up a position with the Department of Fisheries and Oceans working on the biology of juvenile herring.

After a short period, he moved to manage the Redfish (*Sebastes* sp.) Section and became involved in providing advice to managers on the status of redfish stocks. With his mechanical expertise, he became involved in the construction of two new fisheries research vessels for use in the Atlantic Ocean.

In 1991, he relocated to the Department of Fisheries and Oceans headquarters in Ottawa as a Senior Advisor on Fisheries Ecology. In this position, he provided advice to senior managers on fisheries ecology issues, climate change impact on fisheries, stock assessment of invertebrates on both the Atlantic and Pacific coasts and groundfish and herring on the Pacific coast. Doug also provided support to the Canadian Delegation during all negotiations leading up to the formation of PICES.

He left the department in 1993, returning to his "native habitat" of British Columbia to become the first PICES Executive Secretary, and assembling the Secretariat for the new organization at the Institute of Ocean Sciences in Sidney, Canada. Doug held this role until his retirement in 1998.

Right: Doug at the PICES 1993 Annual Meeting in Seattle, USA – his first serving as PICES Executive Secretary.



Dr. Doug McKone
1935-2020

In retirement, Doug and his wife, Diana, continued to indulge their passion for travel. In all, they travelled to 107 countries and made regular winter trips to Mexico to escape the Canadian winter.

Doug is survived by Diana, four adult children and their seven grandchildren, all of whom live in British Columbia.



Doug, the first Executive Secretary of PICES, with Dr. Warren Wooster, the first Chair of PICES (1992-1996) at the PICES 1997 Annual Meeting in Busan, Korea.



Doug with Dr. Takashi Sasaki (Japanese national delegate to Governing Council) at the PICES 1995 Annual Meeting in Qingdao, China.



Doug with Dr. Hyung Tack Huh (Chair of PICES from 1998–2002), at the PICES 1997 Annual Meeting in Busan, Korea.



Doug with Dr. Makoto Kashiwai (Science Board Chair, 1995–1998) at the PICES 1998 Annual Meeting in Fairbanks, USA.

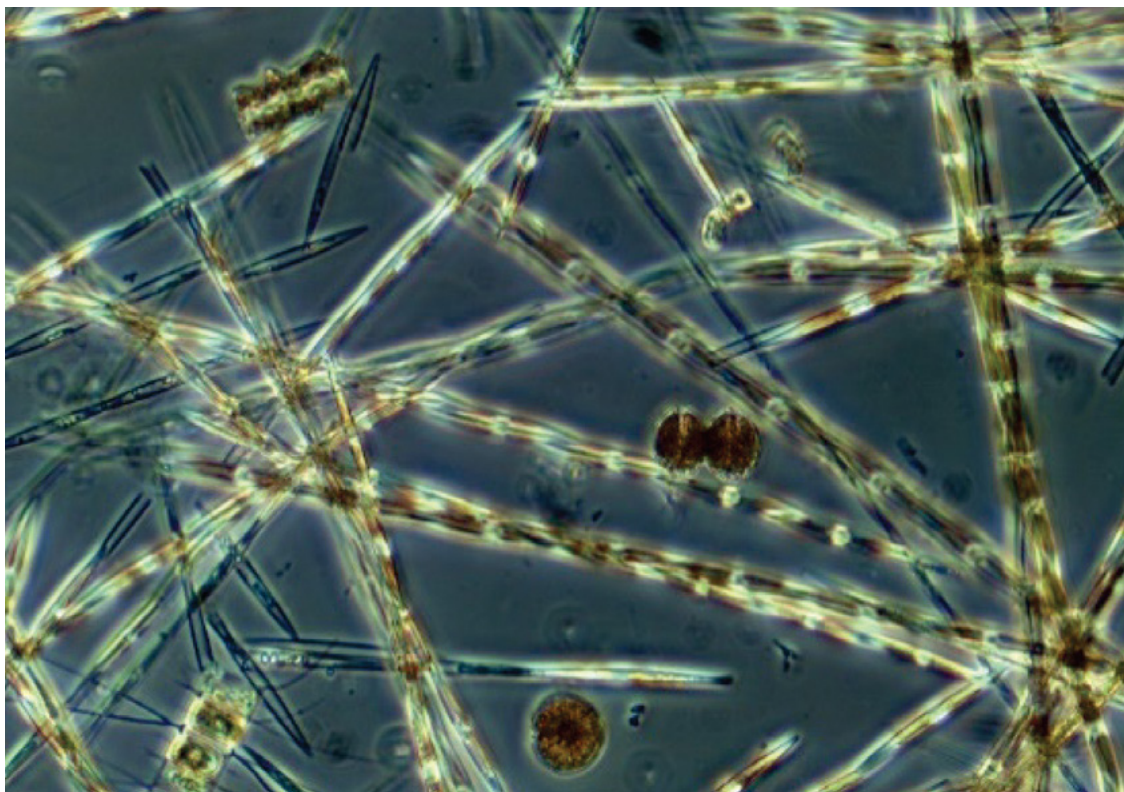


L-R: Dr. Andy Bakun, Dr. David Welch, Dr. Alec MacCall, Doug and Dr. Lloyd Dickie at the 1995 PICES Annual Meeting in Qingdao, China

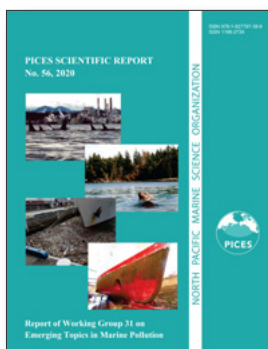


Doug was invited to attend the 2001 Tenth Anniversary Annual Meeting in Victoria, British Columbia. These two photos were taken during the Chair's Reception in Craigdarroch Castle. At left, Doug is with Dr. William Arron (former US national delegate to Governing Council) and at right, he visits with Mr. William Sullivan (former US member of the F&A Committee, who contributed greatly to the preparation of PICES Convention, Rules of Procedure and Financial Regulations).

Your PICES science images



The microscopy image for this issue is of two harmful algal genera, *Pseudo-nitzschia* and *Alexandrium* - microscopic phytoplankton that can cause economic damage to fisheries (Source: Brian Bill, NOAA). They are featured on the cover of one of PICES' most recent Scientific Reports: Trainer, V.L. (Ed.) 2020. *GlobalHAB. Evaluating, Reducing and Mitigating the Cost of Harmful Algal Blooms: A Compendium of Case Studies*. PICES Sci. Rep. No. 59, 107 pp. This Scientific Report is one of four recently published by PICES - read the full reports online.



Call for images

People of PICES: do you have an interesting PICES science image to share in PICES Press? An interesting species? Perhaps some novel field work or sampling gear?

Please email your high-resolution .jpg or .tif files, along with a short caption and image credit to: Lori.Waters@pices.int

Thank you!

PICES by the numbers
Lori Waters, editor, PICES Press



These *PICES By the Numbers* figures are derived from this issue. 2020 was a memorable year, in which PICES scientists continued their scientific endeavors, and made significant contributions despite the challenges of the Covid-19 global pandemic. This bodes well for PICES scientific collaborations moving into 2021 and the start of UNDOS. Thank you, PICES members!



768.85MT
Cumulative CO₂ emission savings, equivalent to taking 166 vehicles off the road for one year, or planting >1000 acres of US forest in one year.
(see p.2 in this issue)

PICES-2020:
29th Annual Meeting

502 Scientists from **17** Countries

80 Observers, including **37** representatives of partner organizations outside of PICES

60 virtual workshops and business meetings hosted between September and November 2020

10 years of transformative science to meet 7 needs:

1. A clean ocean where sources of pollution are identified and removed
2. A healthy and resilient ocean where marine ecosystems are mapped and protected
3. A predictable ocean where society has the capacity to understand current and future ocean conditions
4. A safe ocean where people are protected from ocean hazards
5. A sustainably harvested ocean ensuring the provision of food supply
6. A transparent ocean with open access to data, information and technologies
7. An inspiring and engaging ocean where society understands and values the ocean.

Moving into 2021, PICES is preparing for UNDOS. What is your vision, as a PICES member, for the ocean YOU want to see by the end of UNDOS?

Make your UNDOS vision a reality: share your thoughts in your EG's this Spring!

Looking ahead to 2021 - Stay tuned for details of PICES-2021, anticipated to be held in Qingdao China - we hope to see everyone there!



Open call for PICES Press submissions

PICES Press welcomes your articles. Please consider submitting articles on: research; conference or event highlights; programme news; and announcements. Please see our [Submission Guidelines](https://pices.int/publications/pices-press/). Previous issues are online at: <https://pices.int/publications/pices-press/> Deadlines are June 1st / December 1st for Summer / Winter volumes, respectively.

PICES appreciates you sharing your work. Thank you for your contributions!

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