





From April 27 – 29, prior to the ISB-2021, the [FUTURE Program Scientific Steering Committee](#) (FUTURE SSC; **F**orecasting and **U**nderstanding Trends, **U**ncertainty and **R**esponses of North Pacific Marine **E**cosystems), also met virtually, as outlined in the next article in this issue. More recently, many of you participated in the June 23 FUTURE workshop to develop PICES Expert Groups around the theme of **“Climate Extreme Events and their Impacts on Coastal Ecosystems and Communities.”** These integrated EGs, once approved, will help PICES strengthen its partnerships with the International Commission for Exploration of the Sea (ICES), the Asia Pacific Network (APN) and Climate and Ocean: Variability, Predictability and Change (CLIVAR) and will be a means to strengthen ECOP voices during the UNDOS.

The SB welcomed members of newly established Expert Groups, including those appointed by their countries to the Study Group on Early Career Ocean Professionals (SG-ECOP), Study Group on Scientific Communication (SG-SciCom), [WG-47: Ecology of Sea Mounts](#), [WG-48: Towards best practices using Imaging Systems for Monitoring Plankton](#), [WG-46: Ocean Negative Carbon Emissions](#) (WG-ONCE), and new members of Standing Committees.

Science Board recommended at ISB-2021 that a new expert group be formed: a joint Study Group of the Asia Pacific Network and PICES on Scientific Cooperation in the Pacific Ocean (SG-APN-PICES). One of its objectives is to strengthen our collaborations with countries in the south Pacific during the [UN Decade of Ocean Science for Sustainable Development](#) (UNDOS). The UNDOS (2021–2030) began in January 2021, with contributions by PICES and its partner organizations to the scientific and public activities led by the Intergovernmental Oceanographic Commission of the United Nations Educational, Scientific and Cultural Organization (IOC UNESCO). Keep reading to learn more about [PICES contributions to UNDOS](#) and how you can get involved!

PICES members will want to review these new PICES reports recently recommended by Science Board for publication, including:

- [2020 ICES/PICES/PAME Working Group 39 on Integrated Ecosystem Assessment \(IEA\) for the Central Arctic Ocean \(WGICA\)](#). ICES Scientific Reports. 2:79. 144 pp.
- [WG-43 Review Paper: Peck, M. A., et al., 2020 Small pelagic fish in the new millennium: A bottom-up view of global research effort](#). *Progress in Oceanography*, 102494.
- [A Special Issue of \*Frontiers in Marine Science\* \(on North Pacific Climate and Ecosystem Predictability on Seasonal to Decadal Timescales\)](#), containing ten papers, resulting from the 2019 Qingdao workshop and papers from the PICES-2019 Annual Meeting in Victoria. Editors: S. Minobe, A. Capotondi, F. Chai, M. Jacox, M Nonaka, and R. Rykaczewski.

PICES collaborations also recently resulted in the following publications and were recommended by Science Board for publication:

- Barth, J. A. et al., 2019: [Better Regional Ocean Observing Through Cross-National Cooperation: A Case Study from the Northeast Pacific](#), *Frontiers in Marine Science*, 6
- Lee, E. et al, 2019: [Climatological descriptions on regional circulation around the Korean Peninsula](#), *Tellus A: Dynamic Meteorology & Oceanography*, 71:1, 1 - 22
- Hallegraeff, G.M. et al 2021. [Perceived global increase in algal blooms is attributable to intensified monitoring and new impacts](#). *Communications, Earth & Environment*.1-10.



## Featured in the UN Ocean Decade Special Issue ecomagazine.com



A special issue of ECO Magazine was published in May 2021, featuring a collection of stories about different initiatives contributing to each of the UNODS seven societal outcomes: a clean ocean, a healthy and resilient ocean, a productive ocean, a predicted ocean, a safe ocean, an accessible ocean, and an inspiring an engaging ocean. PICES and ICES joint contribution introduced SMARTNET and was in an article entitled [“Championing Ocean Diversity: Introducing the SMARTNET Ocean Knowledge Network- Accessible, Diverse, and Solution-Oriented.”](#)

symposia with international partners in the Southern hemisphere and will extend cooperation in the Arctic. The international programme will embrace new working cultures, with emphasis on remote meetings, aimed at greater accessibility, reduced travel and lowered greenhouse gas emissions.

I sincerely acknowledge the tremendous efforts, dedication and contribution of the SB in steering PICES science activities. We would have preferred to meet in person, however the dedication and focus shown by the SB during our intersessional meeting is greatly appreciated. Our collective gratitude is extended to all members of the PICES Secretariat for their help in stellar organization and scheduling of meetings as well assistance in visioning the future for PICES. A special thanks and congratulations are extended to Dr. Hal Batchelder, PICES Deputy Executive Secretary, who retired on June 30, 2021. We welcome Dr. Sanae Chiba who will join PICES as the new Deputy Executive Secretary on 1 July 2021, as you may have seen in the announcement on International Women’s Day, 2021.



SMARTNET “The **S**ustainability of **M**arine Ecosystems through global knowledge **net**works (SMARTNET)” was formally endorsed as a UN Decade Program on 8 June 2021 by the Intergovernmental Oceanographic Commission. SMARTNET will leverage the expertise and infrastructure of ICES and PICES to advance scientific progress, communication and capacity development.

Through SMARTNET, we will expand our scientific progress in climate change, fisheries and ecosystem-based management, social, ecological and environmental dynamics of marine systems (SEES), coastal communities and human dimensions. Together, we will incorporate strategies to facilitate cross-cutting inclusivity themes of gender equality, early career engagement, and involvement of indigenous communities and developing nations in the planning and implementation of joint activities. SMARTNET will accelerate transformative science through joint working groups, workshops and



**Happy International Women’s Day!**  
PICES Secretariat proudly announces that Dr. Sanae Chiba will be joining us on July 1<sup>st</sup>, 2021, as PICES new Deputy Executive Secretary!  
**Congratulations, Sanae! Welcome!**





The next PICES Annual Meeting (PICES-2021, October 25-29 in the Eastern Pacific; October 26-30 in the Western Pacific) will be a virtual meeting, hosted by China.

We plan to expand upon the virtual format used for last year's Annual Meeting to enable engagement opportunities which we hope will feel more like "in person" meetings. The Opening Ceremony will be followed by the Science Board session, "*Towards a shared vision of sustainable marine ecosystems*", and a series of parallel Science Sessions. We anticipate that we will hear many excellent live presentations as well as previously-recorded presentations and e-posters that will be available for viewing ahead of discussion sessions. We will also hold a "live" virtual poster session, with individual chat rooms where PICES members will be able to engage with poster presenters and other scientists "visiting" the poster. This session will also provide an opportunity to connect with other scientists in informal chat rooms — meeting old friends and hopefully make some new ones!

PICES virtual Workshops will be held in September 2021 prior to the Annual Meeting in October. The SB hopes that these virtual events will facilitate communication and interaction, and perhaps also provide inspiration for collaboration among Expert Groups. Please visit the PICES-2021 [meeting website](#) for regular updates. This virtual meeting fits well with the SB goal of supporting "greener" meetings, by using a strategy that combines virtual and in-person meetings, and reducing the carbon footprint of live meetings to allow us to lead the ocean community by promoting exemplary carbon savings through our direct actions.

We look forward to working with ECOP, our partner organizations, and other IOC/UNESCO endorsed programs for UNDOS programs to achieve PICES scientific goals. The entire SB looks forward to working with all of you, the PICES community, on these exciting new activities and "seeing" all of you during the virtual 2021 Annual PICES Meeting this October.



Vera Trainer,  
Science Board Chair

## ISB-2021 Attendees:

### Science Board

Vera Trainer	Science Board Chair
Igor Shevchenko, rep. Russia	Science Board Vice-Chair
Steven Bograd	FUTURE SSC Co-Chair
Sukvung Kang	FUTURE SSC Co-Chair
Akash Sastry	BIO Chair
Xianshi Jin	FIS Chair
Mitsutaku Makino	HD Chair
Guangshui Na	MEQ Chair
Emanuele Di Lorenzo	POC Chair
Sung Yong Kim	MONITOR Chair
Jeanette Gann	TCODE Chair

### \*Governing Council

Enrique Curchitser	PICES Chair (TBC)
Tetsuo Fujii	PICES Vice-Chair (TBC)

### PICES Secretariat

Sonia Batten	Executive Secretary
Harold (Hal) Batchelder	Deputy Executive Secretary
Sanjae Chiba	Deputy Executive Secretary - Incoming
Lori Waters	Science Board Support

### Invited Guests

Alex Bychkov	PICES
William Karp	ICES
Jörn Schmidt	ICES
Erin Satterthwaite	ECOP
Raphael Roman	ECOP
Kaori Imai	Observer, Ministry of Foreign Affairs, Japan
Hidetaka Kiyofuji	F&A Member, Japan Fisheries Agency
Yugo Shimizu	Observer, Japan Fisheries Agency

### \*PICES Standing Committees

- BIO - Biological Oceanography Committee
- FIS - Fishery Science Committee
- HD - Human Dimensions Committee
- MEQ - Marine Environmental Quality Committee
- POC - Physical Oceanography and Climate Committee
- MONITOR - Technical Committee on Monitoring
- TCODE - Technical Committee on Data Exchange

## FUTURE SSC's 7<sup>th</sup> inter-sessional meeting highlights

Steven Bograd and Sukyung Kang



The **FUTURE Scientific Steering Committee** (herein after referred to as "FUTURE") held its 7<sup>th</sup> inter-sessional 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 virtual meeting was held April 27–30th, 2021. The 3-day affair, led by FUTURE SSC Co-Chairs Steven Bograd and Sukyung Kang, was attended by 13 SSC members, 8 guests and 5 PICES Secretariat representatives who hosted the online meeting.

### Review of 2020-21 activities

The SSC reviewed our activities since our last virtual meeting at PICES-2020. A key accomplishment was the completion of a draft FUTURE Product Matrix, which links PICES expert group products to specific objectives and questions of the FUTURE Science Program. This allows for an easily-accessed catalog of FUTURE-relevant products, a synthesis of products, and a gap analysis for any unmet objectives. Over the past few months, Saeseul Kim, PICES intern, collaborated with SSC members to prepare the draft. We expect to work with the Secretariat to post the Product Matrix on the PICES website in the near future. The SSC also plans to prepare a journal manuscript that will use the Product Matrix to highlight key achievements of the FUTURE program, identify knowledge gaps and the reasons they remain, and determine next steps for addressing FUTURE's goals. The Product Matrix will be included in the FUTURE Phase II Final Report, which SSC members are working to complete prior to PICES-2021.

The SSC continued planning for the next FUTURE Open Science Meeting (OSM), targeted for early 2023 in Hawaii. The SSC will work with the Secretariat to organize the event, which will highlight and synthesize accomplishments of the FUTURE Phase II Science Program (2014-2020), including applications of the Social-Ecological-Environmental Systems (SEES) framework. The OSM will also focus on plans for PICES activities associated with the UN Decade of Ocean Science for Sustainable Development (UNDOS). The SSC envisions an alternate meeting structure, including holding 'ideation' workshops to develop ocean solution roadmaps, as well as events targeted to increase the participation of early career ocean professionals.

### PICES engagement with the UN Decade of Ocean Science for Sustainable Development

A key component of Phase III of FUTURE is engagement with the UNDOS. Dr. Bograd briefly summarized the work of an 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 had a series of calls between January and April 2020. The products created during these meetings included: a letter to the PICES Governing Council and ICES Science Committee describing a strategy for joint UNDOS activities; a draft Strategic Plan of joint ICES-PICES UNDOS activities, (still under development); joint comments on the draft UNDOS Implementation Plan; a proposal for a Study Group (SG-UNDOS) to coordinate joint ICES and PICES UNDOS activities; and, finally, a joint ICES-PICES UNDOS program proposal, **S**ustainability of **M**ARine ecosystems **T**hrough knowledge **N**ETworks, as described later in this issue.

As part of FUTURE's mission to guide PICES engagement with UNDOS, the SSC discussed priorities for new Expert Groups. This is particularly important given that several FUTURE-related PICES Working Groups are ending this year (WG-36, 40, 41). Dr. Bograd reviewed the coordination meeting between WGs-36, 40 and 41 and FUTURE SSC held at PICES-2019. One idea that gained traction at the meeting, and at subsequent WG, FUTURE SSC and Committee meetings, was an expert group focused on '*Climate Extremes and Coastal Impacts in the Pacific*'. The FUTURE SSC considered a draft proposal for a new WG on this topic but concluded that there was a need for additional scoping and input from the broader PICES community. A virtual workshop was held in June 2021 to further scope this idea and prepare a WG proposal for consideration at PICES-2021.

### Upcoming FUTURE activities

The FUTURE SSC prepared an Action Plan for the coming year, which includes: (a) hosting a workshop on development of a climate extremes Working Group; (b) facilitating development of other new Expert Groups to advance FUTURE objectives, along with ways to provide greater synergy amongst existing Expert Groups; (c) coordinating PICES engagement in UNDOS, through collaborations with SG-UNDOS and SG-ECOP; (d) finalizing and distributing a FUTURE Phase II Product Matrix and Final Report; (e) reviewing the WG-36 final report; (f) planning for the next FUTURE Open Science Meeting to be held in 2023; and (g) preparing for PICES-2021.



### Endnote: FUTURE inter-sessional meeting participants

#### FUTURE Co-Chairs:

Steven Bograd (USA)  
Sukyung Kang (Korea)

#### FUTURE Members:

Emanuele Di Lorenzo (USA)  
Toyomitsu Horii (Japan)  
Oleg Katugin (Russia)  
Jackie King (Canada)  
Vyacheslav Lobanov (Russia)  
Mitsutaku Makino (Japan)  
Guangshui Na (China)  
Hanna Na (Korea)  
Fangli Qiao (China)  
Ryan Rykaczewski (USA)  
Thomas Therriault (Canada)

#### Guests and Observers:

Enrique Curchitser (GC Chair, USA)  
Vera Trainer (SB Chair, USA)  
William Karp (ICES)  
Jörn Schmidt (ICES)  
Karen Hunter (Canada)  
Erin Satterthwaite (SG-ECOP)  
Raphael Roman (SG-ECOP)  
Sung Yong Kim (MONITOR)

#### PICES Secretariat:

Sonia Batten  
Harold (Hal) Batchelder  
Saeseul Kim  
Alex Bychkov  
Lori Waters

## Sustainability of Marine Ecosystems Through Knowledge Networks (SMARTNET) Endorsed as a UN Decade of Ocean Science Program

PICES: Steven J. Bograd, Vera L. Trainer, Sonia Batten, Sanae Chiba, Erin V. Satterthwaite, Lori Waters  
ICES: Jörn Schmidt, Ellen Johannesen, William Karp, Anne Christine Brusendorff



In December 2017, the United Nations General Assembly proclaimed the [UN Decade of Ocean Science for Sustainable Development](#) (UNDOS; 2021-2030), designed to “*facilitate stronger international cooperation to bolster scientific research and innovative technologies to ensure science responds to the needs of society.*”

At PICES-2019 in Victoria, Canada, PICES scientists began working with our partners from ICES to determine the best ways for our organizations to engage in and provide leadership to UNDOS. These collaborations culminated in a proposal for a joint ICES-PICES Study Group/Scientific Initiative on the UN Decade of Ocean Science (*SG-UNDOS*), which was approved by both organizations in November 2020. *SG-UNDOS* members from PICES have been appointed, and together with ICES members comprise the ICES-PICES Ocean Decade (*IPOD*) Steering Committee. *IPOD* held an initial planning meeting in April 2021 and will continue to provide guidance and coordination on UNDOS activities for ICES and PICES.

The *SG-UNDOS* / *IPOD* Terms of Reference are:

1. Define and describe the joint scientific activities of ICES, PICES and partner organizations that will contribute to UN Ocean Decade societal outcomes.
2. Draft a strategy that prioritizes engagement with early career ocean professionals, indigenous communities, developing nations, and recognizes the importance of promoting diversity and gender equity in our activities.
3. Identify and engage partner organizations to ensure their full participation in this process.
4. Develop UN Ocean Decade Activity proposals for endorsement by IOC, with new and existing partners, allowing for participation of additional partners throughout the Decade.
5. Develop recommendations for new and existing ICES and PICES Expert Groups to implement and maintain the Programme activities, and also encourage and support expert group participation in all aspects of the UN Ocean Decade.



With UNDOS launching this year, the first calls for Decade actions were due in January 2021. Although IPOD was not yet fully functional at this time, ICES and PICES scientists collaborated on submission of the SMARTNET UNDOS program proposal. The aim of SMARTNET was to support and leverage ICES, PICES, and member countries' priorities and initiatives related to the UNDOS, by emphasizing areas of mutual research interest and policy needs, including climate change, fisheries and ecosystem-based management, social, ecological and environmental dynamics of marine systems, coastal communities and human dimensions, and communication and capacity development (Figure 1). SMARTNET will also incorporate strategies to facilitate UN Ocean Decade cross-cutting inclusivity themes relating to gender equality, early career ocean professional engagement, and significant involvement of indigenous communities and developing nations in the planning and implementation of joint activities (see the ECO Magazine article in this issue).

On World Oceans Day, June 8<sup>th</sup>, the Intergovernmental Oceanographic Commission [announced the first set of Decade-endorsed activities](#). We are pleased to announce that SMARTNET has been endorsed by the IOC as an official Decade Program. Endorsement of our program ensures that ICES and PICES will play a leading role in the development of UNDOS from its inception. An initial task for SMARTNET will be to identify and facilitate engagement of partner organizations to enhance communication and outreach to diverse stakeholders and to identify priority activities. We will engage with organizations that have capacity to bring traditional/indigenous knowledge into our activities, as well as those that are active in regions outside our formal membership. We anticipate that IPOD will work closely with SG-ECOP, SG-SCICOM, S-CCME, and the FUTURE SSC. We encourage the entire PICES community to engage with IPOD and play a role in contributing to the success of the UN Decade of Ocean Science.



SMARTNET featured in ECO magazine

PICES: Steven J. Bograd, Vera L. Trainer, Sonia Batten, Sanae Chiba, Erin V. Satterthwaite, Lori Waters
ICES: Jörn Schmidt, Ellen Johannesen, William Karp, Anne Christine Brusendorf



As part of PICES objectives to increase our science communication audiences and reach, PICES made a submission to the Environment, Coastal, and Offshore Ocean Science Exploration and Innovation (ECO) Magazine special feature issue on UNDOS, created in partnership with IOC-UNESCO.

We collaborated with our ICES partners to create a visually-rich, informative communications piece aimed at a broad audience, in an effort to "spread the net" in our quest for additional collaborative partnerships and participants for our UNDOS initiatives.

We're proud of this work, linked below, and we hope you'll take a few minutes to read it. Your comments and suggestions, as always, are welcome.

"Championing Ocean Diversity: Introducing the SMARTNET Ocean Knowledge Network - Accessible, Diverse, and Solution-Oriented."



Championing Ocean Diversity
Introducing the SMARTNET Ocean Knowledge Network - Accessible, Diverse, and Solution-Oriented

By Vera L. Trainer, Sonia Batten, Steven J. Bograd, Sanae Chiba, Erin V. Satterthwaite, Lori Waters (PICES), Jörn Schmidt, Ellen Johannesen, William Karp, Anne Christine Brusendorf (ICES)

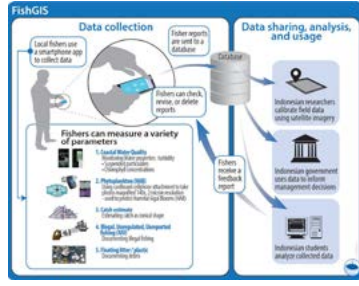
As the Northern Hemisphere begins its multi-national collaborations to further our understanding of the ocean's natural systems, the International Council for the Exploration of the Sea (ICES) and the North Pacific Marine Science Organization (PICES) have joined together for decades on shared interests. The global ocean science community has a rare and unique opportunity to bring resources together and share knowledge more widely through the UN Ocean Decade to expand our collaborations beyond our member countries to countries in both the Northern and Southern Hemispheres.

Our well-established mechanisms for scientific cooperation will be used to further the development and delivery of the science we need for the ocean we want, specifically to understand the dynamics of coupled marine social, ecological and environmental systems under global change. A UN Ocean Decade program led by ICES and PICES, the Sustainability of Marine Ecosystems through global knowledge networks (SMARTNET) will support and encourage the establishment of joint working groups, workshops and seminars with partners in the Southern Hemisphere and in the Arctic.

gates in some places. Visibility will clear over the weekend, with good chances for herring and mackerel.
Mark Petya provided similar expertise in his feature article. Pinar Prediction Matters, stating that both farmers and fishers depend on the weather of nature, sometimes a feast and at other times, famine in tropical countries, small island developing states and Arctic communities, the ocean provides employment, food and a preservation of coastal community culture. With fish forecasts, these communities might be able to adapt to the changing and variable nature of our planet. One of the goals of ECO2021 is to improve forecast models for fish stocks, which will facilitate their management in a changing climate.

Toward an Accessible Ocean
We see the great potential of citizen science as a means to enhance ocean accessibility and capacity development. An example of this is the PICES collaboration with scientists in Indonesia. Building capacity for coastal monitoring with local small-scale fishers in PICES' ICES-UN Ocean strategies to facilitate fisheries-related to regional career ocean professional training and indigenous community stewardship and implementation.

Toward an Integrated Ocean
To understand marine systems, a holistic view is necessary. ICES and PICES have several groups working on Integrated Ecosystem Assessments of regional seas. Integrated Ecosystem Assessment encompasses different disciplinary



By holding PICES meetings virtually in 2020, we have discovered that as many as 1000 people are equivalent to taking 166 passenger vehicles off the road for 1 year. Prior to 2020, ICES conducted a number of meetings online and are documenting this and also assessing which meetings to continue in hybrid online, in person or using a hybrid approach.

approach to understand environmental impacts from the Bering Sea and we plan to bring fisheries, discovery and resource using respect, especially on marine biodiversity is among the most important. In the survival of fish and non-fish species, we provide basic coverage.

SMARTNET is the framework of science needed to shape "the ocean we want" during the UN Ocean Decade and beyond. We look forward to building new relationships with partners around the world, including ICES and underrepresented communities to build a diverse and inclusive alliance. The time is now to apply the building blocks of our science-based, developing solutions to mitigate the impacts of climate change in order to govern our ocean and the coastal communities that depend upon its bounty.



## Early Career Ocean Professionals: Evolving Contributions to PICES and the UN Ocean Decade

*PICES Early Career Ocean Professionals Study Group (SG-ECOP)*

### ECOP Initiatives in PICES & internationally

- Developing an **engagement plan** for **PICES ECOPs**
- **Intergenerational exchange** within **PICES FUTURE & Science Board**
- Fostering **international partnerships** through the **ICES/PICES conference**
- Conversations on **ocean solutions** at the **Ocean Visions Summit 2021**
- Participation & engagement in the **UN Ocean Decade V.ECOP days**

Intergenerational diversity is central to sustainability since it relies on meeting the needs of the present generation without compromising the ability of future generations to meet their own needs. As such, early career ocean professional (ECOP) engagement is a central focus of PICES, particularly within the context of the UN Decade of Ocean Science for Sustainable Development (2021-2030). Emerging ocean leaders bring fresh ideas, sustained engagement and scientific cooperation, and diverse perspectives to the next chapter of scientific discovery.

We have been working on various initiatives within PICES, in partnership with other international organizations, and within the context of the Ocean Decade to ensure that ECOPs continue to be key players and leaders in ocean science for sustainability.

Our initiatives include:

- **Developing a PICES ECOP engagement plan.** The PICES Early Career Ocean Professional Study Group (SG-ECOP) was formed as a follow-up to the FUTURE topic workshop, “*Building a PICES early career professional network*”, at PICES-2020. SG-ECOP has been meeting regularly since its inception, to create an engagement plan for early career ocean professionals in PICES, by focusing on:
  1. conducting background research to better understand gaps, opportunities, and priorities for engagement within PICES
  2. developing an engagement plan based on the background research for ECOPs within PICES
  3. depending on the outcomes of the research and engagement plan, develop Terms of Reference for a PICES expert group such as an Advisory Panel to implement the study group’s recommendations on ECOP engagement and retention from engagement plan.

### Increasing PICES ECOP Representation &

### intergenerational exchange through meeting attendance.

The members of the ECOP study group participated in the FUTURE and Inter-sessional Science Board (ISB) meetings in April and May 2021, respectively, and will contribute to the planning for a working group proposal focused on climate extremes and coastal impacts.

Spread over three days, the virtual ISB allowed the two ECOP invited guests the opportunity to present the mid-year achievements and ongoing progress of the ECOP Study Group, which is parented by the FUTURE program. The meeting was also the perfect occasion to assess gaps and opportunities in better engaging and including ECOPs across expert groups, committees and PICES-sponsored activities and events such as conferences, workshops and summer schools. There was great momentum and energy coming out of the meeting, with most scientific committees mentioning and encouraging greater funding, leadership and facilitation opportunities for ECOPs, as well as increased participation and representation from country-specific ECOPs in some expert groups. One overriding sentiment that transpired from the meeting is that ECOPs are openly welcomed to engage, coordinate and bring their fresh perspectives to any PICES groups, projects and activities. PICES ECOPs have an open window to shape the course of the organization over the foreseeable future, liaising between expert groups, representative countries and external stakeholders, steering the PICES ship across and beyond the North Pacific. The next steps are up to us.

In addition to being a focus of many PICES initiatives, Early Career Ocean Professional engagement is a core focus of the Ocean Decade and associated activities. Specifically, PICES ECOPs have been taking leadership roles in international Ocean Decade events and with international partners, such as ICES. These include the 4th ICES/PICES Early Career Scientist Conference, the Ocean Visions Summit 2021, and the Virtual ECOP days. PICES



ECOPs are also key participants in the newly formed joint ICES/PICES Study Group on the UN Decade of Ocean Science (SG-UNDOS), and contributed to the joint PICES/ICES UNDOS SMARTNET program proposal [detailed in this issue](#).

**Fostering international partnerships through the ICES/PICES conference.** Since early 2021, three PICES ECOPs have been part of the Scientific Steering Committee (SSC) of the 4<sup>th</sup> ICES/PICES Early Career Scientist Conference, to be hosted by Fisheries and Oceans Canada, and slated to be held 9–12 May 2022 in St. John’s, Newfoundland, Canada. Composed of 9 ECOPs (PICES/ICES/DFO) spread over several time zones in East Asia, North America and Europe, the SSC has been meeting on a monthly basis and has recently finalized the theme of the conference program. Inspired by the goals and societal outcomes of the UN Decade of Ocean Science for Sustainable Development, the conference theme is “Ocean sciences for the future we want” and the program revolves around 3 main themes and 10 different sessions, spanning all natural and social science disciplines indispensable to the understanding, protection and stewardship of our global ocean. Key topics range from ecosystem functions, ocean processes, developments in taxonomy, human-ocean interactions and the Blue Economy to science communication, indigenous knowledge systems, emerging technologies and open-source science. After hosting a booth at the Virtual ECOP day on June 1<sup>st</sup>, the review of submitted abstracts will be the next important task of the SSC in the fall.

**Ocean Visions Summit 2021 Conversations on ocean solutions.** Some of the PICES ECOPs co-convened a series of special events at the Global Online Ocean Visions Summit called “Conversations on Ocean Solutions with ECOP”. These were short, interactive events that brought together over 60 professionals interested in sustainability, resilience, and ocean solutions. The discussions were

focused on ocean solutions around the themes of justice, equity, diversity and inclusion, community knowledge integration, international and interdisciplinary collaborations, harnessing the digital revolution, healthy oceans & healthy people, innovation for regeneration, innovation for policy and governance, nature-based solutions and sea level rise.

**Participation & engagement in the UN Ocean Decade with the V.ECOP days.** PICES ECOPs presented on the unique value of participating in PICES as an ECOP and highlighted that PICES provides a great opportunity for ECOPs to get involved in the Ocean Decade since it provides a clear organization to engage with through conference & travel awards, as well as training and involvement in expert groups all related to interdisciplinary, international science collaboration and linking ocean knowledge to action in the North Pacific. Interestingly, a poll during the event identified collaboration and coordination as a key challenge to overcome in the Asia Pacific region. We noted that PICES fills the role of international collaboration well. In addition, some PICES ECOPs were involved in an international presentation on the Diversity, Equity, and Inclusivity initiative that is developing with the global ECOP Programme to ensure that underrepresented groups are included in all aspects of the Ocean Decade.

We look forward to continuing to foster intergenerational and international connections in the North Pacific and beyond.

#### To join our community please:

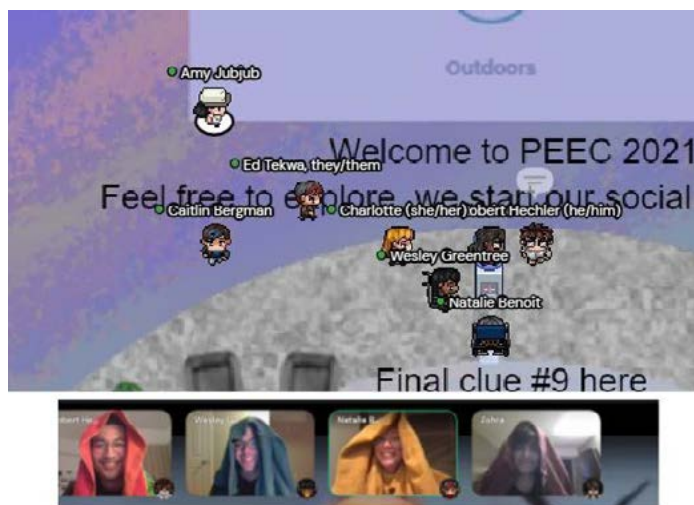
- Visit [tiny.cc/PICES](https://tiny.cc/PICES)
- join the conversation on slack [#NorthPacific](https://tiny.cc/GlobalECOP)
- social media @PICES\_MarineSci (#ECOP).

## Pacific Ecology Evolution Conference (PEEC)

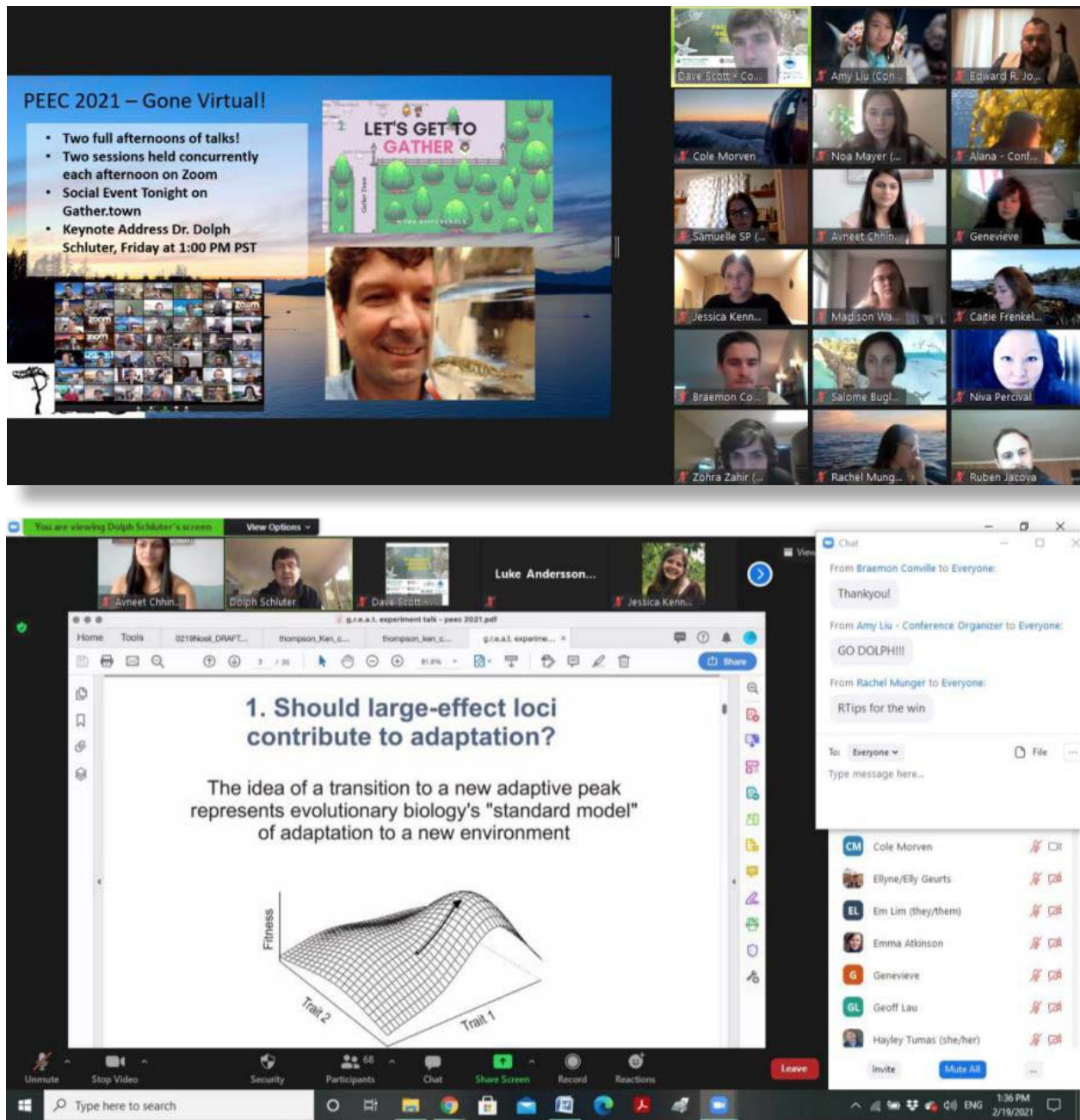


The Pacific Ecology Evolution (PEEC) conference held on February 18th and 19th 2021 marks the 42nd year of this student-led conference. Like so many aspects of life during the pandemic, this year's conference looked quite a bit different from the 41 others that preceded it. While we weren't able to hold this year's conference at Bamfield Marine Science Centre (BMSC) like usual, 250 participating graduate and post-graduate students, early career scientists and self-proclaimed long-term students of life reimagined the identity of this virtual event. We set off on strong footing with a beautiful welcome given by Edward R. Johnson from the Huu-ay-aht First Nation whose traditional territory encompasses BMSC. From there we headed into 4 sessions of talks that fell under the broad categories of Landscape and Plant Ecology and Fish and Fisheries Ecology and Marine Ecology. Together these sessions comprised 21 twelve-minute talks and 11 three-minute blitzes. The curiosity and excitement that filled these afternoon sessions spilled over into our evening social event. Participants were also encouraged to participate in our photo contest, where we were blown away by the amazing nature landscape, wildlife, and field research photos. All photo contest submissions can be viewed here: <https://padlet.com/peeconference/wxax2id47wh74qbx>.

In the evening, we hosted a social event on [gather.town](https://gather.town) which featured a virtual scavenger hunt!



Participants roamed around a virtual conference space searching for clues and completing various tasks such as dressing up as sea creatures featuring items only from their closet. It was a heated race, but team Sassy Salmons pulled ahead, with Team Biomass or Nothing, Team Science Rocks, and Team Zebrafish close behind. Even after the main event, groups stayed behind and socialized.



The energy from the previous night set the tone for Day 2 of the conference with an intriguing keynote speech given by Dr. Dolph Schluter on the identification of a major gene in introduced Stickleback populations. From there we headed into our afternoon session of rapid-fire talks so diverse that we were unable to find a single title to introduce them. Presentation topics ranged from newly discovered mesophotic kelp forests in the Galapagos Islands to the ecology and evolution of a newly discovered endemic sea snake in Costa Rica.

PEEC also hosted an interactive training workshop on how to be an ally (in partnership with the Gainesville

Ally Skills Network and sponsored by the Canadian institute of Ecology and Evolution). Being an ally involves using one's privilege to support marginalized and/or underrepresented groups. Workshop participants walked away with new insights and skills which will help them foster inclusive, equitable environments in academic spaces and beyond. Overall, we could not have been happier with the outcome of PEEC 2021! Each year PEEC occurs again for two reasons: a small group of students who volunteer their time to organize all aspects of the conference and the continued generosity of our sponsors, without whom none of this would have been possible.

## The (Virtual) International Symposium on Plastics in the Arctic and Sub-Arctic Regions

*Matthew Savoca and Seung-Kyu Kim*



At the start of the UN Decade of Ocean Science for Sustainable Development, marine researchers are excited to contribute time, energy, and most importantly, international coordination, to the myriad challenges that face the ocean. In the preceding decade (2011-2020), ocean pollution – specifically ocean plastic pollution – has come to the fore as an emergent issue of global concern. In 2017, PICES scientists formed a study group to begin discussions how we can best coordinate monitoring of plastic pollution in the PICES region. One year later, our study group became a working group ([WG-42](#)), which has catalyzed our conversation about the plastic pollution trends and research within and outside the PICES region.

In March 2021, we attended the virtual [Symposium on Plastic Pollution in the Arctic and sub-Arctic Region](#). The symposium was originally scheduled to take place in Reykjavík, Iceland in April 2020. However, due to the coronavirus pandemic, it was postponed and held fully virtually. The symposium was hosted by the government of Iceland (the Ministry for Foreign Affairs, the Ministry for the Environment and Natural Resources, and the Ministry of Industries and Innovation). It was further sponsored by the International Council for the Exploration of the Sea

(ICES), PICES, the United Nations Environment Programme (UNEP), the OSPAR Commission, the Intergovernmental Oceanographic Commission of UNESCO (IOC), the Marine and Freshwater Research Institute of Iceland, the Harvard Kennedy School and the International Arctic Science Committee. Iceland holds the Chairmanship of the Arctic Council from May 2019 to May 2021 and has led discussions on the understanding and mitigation of plastics in the Arctic Marine Environment. This symposium helped advance that goal.

The symposium was especially relevant to [PICES WG-42](#) in our efforts to assess the extent and impact of plastic pollution in the PICES region, and to suggest biotic and abiotic components of the ecosystem for continued monitoring. It is, therefore, prudent to engage with other regional groups with similar goals. This is particularly true for the Arctic, a region which borders the northern fringe of the PICES domain. As a result, we share common species (e.g., northern fulmar, a well-established bioindicator of plastic debris in the ICES region), and common abiotic reservoirs of plastic pollution (e.g., the Bering/Chukchi/East Siberian/Beaufort Sea).

Nearly 100 scientists, diplomats, and NGO leaders spoke or made presentations during the five-day online symposium. Each day the symposium first hosted keynote talks followed by a live panel discussion with that day's presenters. The presentations included 55 primary science talks from researchers working in the Arctic ecosystem. Recordings of all panel discussions, as well as the presentation talks and poster sessions, are available on the [Arctic Council's website](#)<sup>1</sup>. These scientific presentations and discussions centered around several main themes including:

- Sources and transport of plastics in the Arctic and sub-Arctic including shipping, tourism, fishing, and terrestrial sources
- Setting a baseline for Arctic plastic pollution
- Arctic challenges in waste management strategies
- Methodology for isolating and quantifying on macro-, micro- and nanoplastics: instrumental technology and guidelines for harmonization of monitoring
- Arctic monitoring of macro-, micro-, and nanoplastics
- Impact of plastic pollution in the Arctic: Ecotoxicology, toxicology, and socioeconomics
- Solving the plastic challenge: Best mitigation practices from around the world (ocean-based and land-based efforts including clean-up, biodegradable alternatives, social communication)
- Developing a regional action plan for the Arctic. Taking coordinated actions between sectors and developing joint initiatives for different industries.

One way in which plastic pollution in the Arctic region differs from the PICES region – and many other large marine regions – is that a majority of the plastic in the region may not originate from land bordering the basin itself. Dr. Melanie Bergman of the Alfred Wegener Institute spearheaded the discussion of the origin of plastic pollution in the Arctic with a keynote lecture on the first day of the Symposium. In the Arctic, marine debris has grown sevenfold since the turn of the 21st century, and it appears the situation will get worse before it improves. Less than 40% of debris in the Arctic comes from local sources and ~10% of debris originates from distant locations including Asia and the continental United States. The majority of plastic in the Arctic is from Europe and North America and enters the region from the Atlantic Ocean. As a result, the global community is responsible for marine litter found in the Arctic. Both sea ice and seafloor sediment are the primary sinks of debris in the region; detailed analyses of both compartments has revealed microplastic and

microfiber concentrations in the millions per cubic meter. When compared to the west coast of North America this is approximately two orders of magnitude higher than seafloor sediment and six orders of magnitude higher than in surface seawater. The mechanisms behind these extremely high concentrations of small plastics in the Arctic are believed to be the results of large-scale ocean currents and atmospheric deposition. By comparison, macro debris is more likely to originate from local sources.

A parallel between several presentations at this symposium and [PICES WG-42](#) was the discussion of how best to track plastic pollution via indicators. In addition to monitoring abiotic components – including seawater, sediment, and the cryosphere – bioindicators to measure plastic debris in the food web were also discussed. Several researchers referenced studies on seabirds as bioindicators of plastic in Arctic marine food webs. Dr. Jennifer Provencher gave a presentation on Arctic Monitoring and Assessment Programme's (AMAP) use of the northern fulmar (*Fulmarus glacialis*) as a biomonitor of plastic. This species is also used as an indicator in the ICES region and is under discussion by [PICES WG-42](#) as to whether it should be used as a bioindicator in our region as well. Encouragingly, new research from the Arctic and North Atlantic suggests that plastic ingestion by fulmars is decreasing over time. If these trends continue, fulmars may be below OSPAR-EcoQO guidelines of <10% of individuals having >0.1 g plastic particles in the stomach by mid-century. Julie Baak also presented on plastic ingestion by Arctic seabirds and found that, even with these declining trends, fulmars still ingested the most plastic of any of the four species her team studied. Scott Fleming reported on a high degree of plastic ingestion by breeding shorebirds in the region as well. The cocktail of chemicals that plastic debris harbors has also been monitored in Arctic seabirds. Several researchers including Dr. Provencher and Veronica Padula reported on their ecotoxicological findings. Veronica is a Ph.D. student at the University of Alaska and her findings that 10 seabird species nesting in the Aleutian Islands had detectable concentrations of phthalate plasticizers in their tissues should raise alarm for PICES scientists as all these species use the PICES region as well as the Arctic.

While seabirds can be used as a bioindicator for large-sized microplastics (LMPs), zooplankton can be used as a bioindicator for small-sized microplastics (SMPs <100 µm) in Arctic marine food webs. Dr. Fabiana Corami suggested amphipods that ingested various polymeric SMP particles could be used as a biomonitoring indicator of SMP pollution. Dr. Zara Botterell also found SMPs in all species analyzed, with much higher SMP abundance in amphipods than copepods. However, two presenters including Dr. Rist and Rocío R. Torres did not find any significant adverse effects in copepods caused by SMP exposure. The Institute of Oceanology Polish Academy

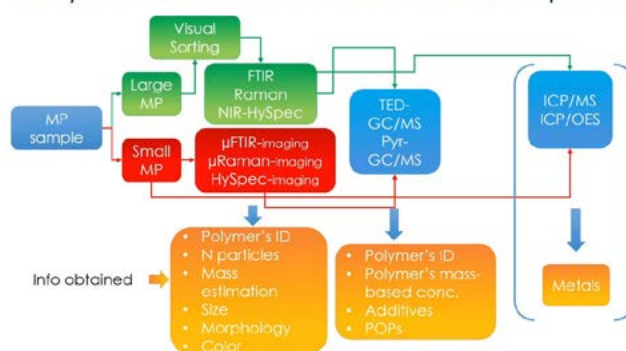
<sup>1</sup> <https://arctic-council.org/en/explore/topics/ocean/plastics/>

of Sciences team has a research scheme to elucidate the transfer of microplastics from seawater via plankton to seabirds. These studies show there are implications for the selection of bioindicators, a main issue for PICES WG-42.

Transport of microplastics across the Arctic basins and compartments is also an important theme of interest, considering the increasing number of findings on the importance of air and sea ice as moving vectors of microplastics. This is of importance due to their strong association with climate change. Dr. Chris Wilson of the National Oceanography Centre, UK predicted that cross-basin and cross-shelf slope fluxes would be affected by the change of ocean circulation (variability of surface drift and dense water cascading) driven by sea ice decline and enhanced atmospheric forcing. He presented “Pacific-to-Atlantic travel time reduction by ~30% in second half of the century, increased flow through Canadian Archipelago, and the disappearance of the Siberian route for Pacific water” as a future change to transport pathways. Dr. Seung-Kyu Kim, a professor of Incheon National University, South Korea, stressed the importance of the entry and accumulation of microplastics in the western Arctic Ocean (WAO; Bering/Chukchi/East Siberian/Beaufort Sea) from two years of monitoring that was conducted using a Korean Ice Breaker vessel (Araon) in a collaboration with Korea Polar Research Institute (KOPRI). Recently, his research team published a paper regarding the importance of seasonal sea ice in WAO to the Arctic and global microplastic budgets. This can be a strong driving force for collaboration between ICES and PICES on future changes.

Interesting discussions at this symposium also concerned action plans to mitigate plastic pollution and the consensus on harmonizing monitoring and measurement methods. While experts expressed support for a global agreement or treaty to address growing amounts of plastic in the oceans, some, cautioned against letting progress on a treaty distract from other efforts to prevent plastic pollution, since the treaty would take many years to come into force despite its benefits. There was emphasis on the necessity of other actions now—for example, moving forward to develop plastics made from organic materials and holding an annual coastal clean-up day in all eight Arctic countries. Arctic clean-up activities have advantages of immediately removing plastic debris, preventing their break-down into small pieces that are consumed by marine life, as well as drawing local and international attention to plastic pollution. However, due to different geographical features, the Alaska regional coordinator for the NOAA Marine Debris Program suggested that researchers in the Arctic cannot simply adopt methods developed in other regions for beach clean-up. Even worse, the different methods of analyzing microplastics make it impossible to compare each other.

Analytical methods have diversified and improved



Jes Vollertsen, a professor of Environmental Engineering at Denmark’s Aalborg University, gave a sense of how diverse methods are applied to microplastic analysis (above). Despite expectations for method standardization, it is not easy to obtain the ‘silver bullet’ since the method depends on the aims of researchers. Nevertheless, efforts to standardize methods that make it possible to compare measurement data, through cross-validation of methods need to continue.



*Dr. Matthew Savoca is a National Science Foundation Postdoctoral Research Fellow at the Hopkins Marine Station of Stanford University. He studies the foraging behavior and ecology of marine top predators, from seabirds to marine mammals. He also works on applied conservation problems including marine plastic pollution and legacy pollutants. Within PICES, Matt serves on Working Group 42 and the Study Group on Early Career Ocean Professionals. He lives in Monterey, California with his wife Rachel and dog Marley.*



*Dr. Seung-Kyu Kim is a professor at the Incheon National University. He studies the monitoring, fate and transport of legacy and emerging pollutants including persistent organic pollutants and microplastics. Over the past few years his research has focused on the distribution of microplastics and plastic-additives in multiple compartments (air, freshwater, seawater, soil, sediment, seafood and wildlife) covering inland, coastal region, open ocean and polar region (Arctic and Antarctic). His final goal is to elucidate the mass flow of plastics among compartments and among basins/oceans. He participates as a member of PICES WG-42.*



## Hal Batchelder's legacy — in PICES words

*Introduction by Sonia Batten, with selected comments and well-wishes from the PICES Scientific Community*

Hal became Deputy Executive Secretary of PICES in March 2014, but his time with PICES stretches back much further. In fact, Hal attended the second PICES annual meeting in 1993 and was a regular fixture at annual meetings from 1998. Hal was Scientific Director of the USA GLOBEC Steering Committee office at the time that PICES was being established, and in 1993 PICES and International GLOBEC began discussing a joint science program on Climate Change and Carrying Capacity. These discussions resulted in the first PICES Science Program, CCCC or 4Cs for short, and ran from 1995 to 2009. Hal's experience with US GLOBEC made him ideally suited to take a lead role and he was a Co-Chair of this program from 2001 to 2009. During his leadership the NEMURO ecosystem model was developed, which has become the standard ecosystem model for the North Pacific. Overall, the CCCC program was viewed by PICES, and the individual member countries as being a resounding success.

In 2006, Hal was a co-convenor (with Dr. Suam Kim) of an international PICES-GLOBEC symposium on "Climate Variability and Ecosystem Impacts on the North Pacific: A Basin-scale Synthesis" (the final CCCC symposium), which resulted in a special issue of Progress in Oceanography that he co-edited.

Hal has made many other scientific contributions to PICES over the years; as a member of other expert groups (WG on the first North Pacific Ecosystem Status Report, WG on Fisheries and Ecosystem Responses to Recent Regime Shifts and SG on Future Integrative Scientific Programs) and was a US National Delegate to Governing Council in 2012/2013. When these experiences gained him the position of Deputy to Alex Bychkov at the PICES Secretariat Hal and his wife Stephanie, as well as their numerous cats, moved from Oregon to Sidney, British Columbia in spring 2014. The comments from colleagues which follow demonstrate the large contribution Hal has made to PICES over the years, and how his attention to detail, and passion for the science PICES does, are appreciated.

I wish that our time working together in the Secretariat this last year could have been under different circumstances - the pandemic has definitely been limiting - but I am still grateful for the opportunity to work with Hal in PICES.

I will miss his knowledge and his insights into the things PICES has done, and I wish him a happy retirement and move back to Oregon. I hope we will see him at a future PICES event!

~ Sonia Batten, PICES Executive Secretary, June 2021



Hal's career and contributions to marine science are marked by several high points including:

- A passion (dare I say obsession?) with all things zooplankton.
- A strong conviction about the importance and the benefits of collaborative marine ecosystem science. Much of his career has been spent fostering and facilitating this in the US GLOBEC Program and in PICES.
- A commitment to encouraging and supporting international collaboration in marine ecosystem science. This was manifest in his roles in the PICES Climate Change and Carrying Capacity Programme as well as his service as US academic delegate to the PICES Governing Council even before he came to the PICES Secretariat.
- A deep and abiding concern for the support and development of early career scientists - graduate students, postdoctoral fellows and researchers who getting established in the field. This is demonstrated by his work with students while at OSU and was a specific focus of his work at PICES, supporting early career scientists to travel to PICES Annual Meetings and Symposia, taking a leadership role in joint ICES/PICES Early Career Scientist Conferences and his role on the SCOR Capacity Development Committee.

Within the PICES Secretariat, Hal is famous for his deep commitment to personal and science-based carbon capture and storage, in the form of many, many (did I mention many?) filing cabinets, shelves and boxes of scientific books, papers and records of collaborative marine science.

Congratulations on a career full of contributions to collaborative marine science and welcome to the "dark side" (retirement). It turns out that it is not dark at all. I wish you and Steph all the best in this next phase of your career!

~ Robin Brown, Retired PICES Executive Secretary



Aloha Dr. Hal Batchelder, Congratulations for your retirement! Thank you for your many year services at PICES! I remembered your friendly smiles you showed us in all the PICES meetings and also the fun time on the bus ride from Los Cabos to La Paz with a group of PICES Secretariat staff. Best wishes to your retirement!

~ Dr. Minling Pan, Economist, NOAA, Pacific Islands Fisheries Science Center

Hal-san, I hear you are retiring. I have been Waiting for you because now we again have the same occupation. You will write "retired" on the Arrival Card. I will be waiting for you on my surf board in Hawaii after COVID-19 also retires. Please also let me know when you visit Japan, I will take you to special Japanese restaurant and surfing place.

- Michio J. Kishi, Professor Emeritus, Hokkaido University

Hal, It was a pleasure to work with you in Science Board. All those long meetings! But you kept things interesting, your depth of knowledge of the ins and outs of PICES was impressive. I hope you have a chance to apply your passion and intelligence to some new and exciting projects in your new endeavors. All the best, Libby.

~ Elizabeth Logerwell, Research Fisheries Biologist, NMFS/AFSC, NOAA Fisheries

I first learned his name from his 1985 paper to Deep-Sea Research I on the life history of subarctic copepod *Metridia pacifica*. As a graduate student studying zooplankton biology and ecology, the paper was a benchmark in how to proceed with the study of biological oceanography. In 2002, Hal published another paper on *M. pacifica*, in which he reproduced the distribution by means of individual-based model coupled with two-dimensional physical model and NPZ model. It was a beautiful combination of ecology and physics, and also observation and model. I was quite excited the paper and recognized him as a leading scientist of US-GLOBEC program.

When I served as Science Board (SB) Chair, the most tough duty was reporting SB decisions and requests to GC, usually starting from afternoon of the final day of PICES annual meeting, i.e., Sunday. After finishing SB meeting on Saturday, usually late evening, Hal and Rosalie worked so hard to prepare the SB report to GC. In the next morning just before GC meeting, it was seriously tense time to check the report without any missing issues and errors. But, at the same time, I felt a kind of happy feeling working with best colleagues to realize PICES scientific activity. Without Hal's devoted support, I could not fulfil my duties as SB Chair.

It is quite unfortunate I am unable to send my sincere acknowledgement to Hal face-to-face before he leave PICES, due to COVID-19 pandemic. Here, I say thank you Hal so much for your publications to lead me as a biological oceanographer and your long enthusiastic support to PICES. Best wishes Hal!

~ Hiroaki Saito, Atmosphere and Ocean Research Institute, University of Tokyo, Japan

Congratulations on your retirement, Hal. Time flies! Since we worked together for CCCC Program in early 2000s, we have shared many memories because both of us have attended the PICES annual meeting without absent. I still remember that we discussed seriously at the hotel lobby at jeju how we operate the CCCC Symposium to be held in Hawaii in 2006, and we made it very successful. Whenever we talked, your experience in US GLOBEC also was very helpful in developing my professional career, and your comments to my former students stimulated elaborating their scientific hypothesis.

I do not think your retirement from the PICES is a real retirement from scientific community. After you return to the OSU, you might come to the PICES events frequently as I did. So, I have a small wish to you when I will meet you next time. I would like to go seafood restaurant for having fish and wine/beer together. (You are the only marine biologist around me who doesn't eat fish/alcohol.) We all are proud of being friend of yours, and appreciate your collaboration and advice within PICES activity. Best wishes.

~ Suam Kim, Professor of Fisheries Oceanography, Pukyong National University

Harold (Hal) Batchelder and I started work together after he took a zooplankton ecology class with me at Oregon State University. After completing an MS degree under Jeff Gonor, Hal was looking for work. I was looking for biologically-trained people to sample zooplankton on the Canadian weather ships that had long occupied Station "P" to the west in the Gulf of Alaska. Hal conducted deep net tows on three of the 49-day patrols, Victoria to Victoria, as his introduction to Western Canada. The samples provided materials for Hal's Oregon State dissertation on the population dynamics of *Metridia pacifica*, a classic of mid-ocean ecology.

After post-doctoral work at the University of Rhode Island, Hal worked with Tom Powell at U.C. Davis, later moving to U.C. Berkeley. Tom was doing much of the Steering Committee work of the NOAA/NSF GLOBEC projects of the 1990s. Hal became the data and communications manager for that committee, developing the advanced modern skills he has applied at PICES. He then coordinated GLOBEC's Pacific projects, at OSU Corvallis. We became reacquainted then and shared several scientific projects.

For his next adventure, Hal took his position as Deputy Executive Director at PICES. I will let his coworkers tell of his role at Sidney. I know it has meant a staggering amount of travel: Russia, Korea, Japan, China, Mexico, even Europe for ICES/PICES interaction. It has been fun to follow him at all the meetings via reports in The PICES Press. No matter what the subject, the personnel, the location, Hal was always somewhere in the essential group photo. His role in sustaining the scientific exchanges central to the existence of PICES has surely been key to their success. His hand in the recurring North Pacific status reports has been obvious to me. Thanks Hal for that valuable work. I wish Hal a long and enjoyable retirement. It will be good to have him and Stephanie back in Oregon. Perhaps he will get back into woodworking.

~ Charlie Miller, Prof. Emeritus Oceanography, Oregon State University

Dear Hal,

Congratulations on your retirement! You will be greatly missed at PICES, but I hope you will continue to be involved in PICES meetings and events. It has been a pleasure to work with you! I always appreciate your enthusiasm for and dedication to science, your availability to provide advice when needed, your kindness, your sense of humor, and your love of candy, watches, cats, and kayaking. Please stay in touch.

~ Jennifer Boldt, Research Scientist, Fisheries and Oceans Canada

Dear Hal,

Thanks for all the energy you have put into PICES over the years. You certainly helped me as Science Board Chair. All the best in your retirement - it's certainly well-deserved. I hope to see you at a PICES meeting in the future - definitely wearing our matching Hawaiian shirts!

All the best to you,  
Tom

~ Thomas Therriault, Research Scientist, Fisheries and Oceans Canada

Wow! How time flies! I can't believe that your term has already come to an end. You've given so much to the Organization, especially considering your longstanding involvement prior to becoming Deputy. You always made a valuable contribution and were never afraid to speak your mind. The Secretariat's work is often underappreciated but absolutely vital to PICES' success. Thank you for all your efforts! I want to wish you all the best and I hope that you genuinely enjoy your retirement.

~ Laura Richards, PICES Chair (2012-2016)

Hal has served PICES in many capacities over the years, from providing key scientific inspiration for PICES' first scientific program, Climate Change and Carrying Capacity (4 C's), to serving earnestly and enthusiastically as Deputy Executive Secretary. Over the years, Hal has become something of a 'walking PICES encyclopedia' on the history of the organization, as comfortably absorbed in the minutiae of the Rules of Procedure as he is in planning Scientific Programs. He was always seeking ways to engage PICES members and promote the organization. Whenever I would see an incoming call from (250)-363-6826, I knew I was in for a lengthy, but always relevant and interesting, discussion about current happenings in PICES and things that need to get done.

But mostly I enjoyed spending quality time with Hal at PICES meetings all around the Pacific Rim (see photo). Hal was one of my main 'meal buddies' at these meetings, as we share a distaste for alcoholic beverages and a very picky palate (No fish! No mushrooms!). I'll never forget sharing that cheese pizza with Hal and Tom Therriault one evening in Yeosu, Korea, after a long week of very seafood-focused meals. I wish Hal well in his retirement and sincerely hope to see him at future (FUTURE?) PICES meetings - in his Tori Richards Hawaiian shirt, of course - so we can go get a pizza and a Pepsi!

~ Steven Bograd, Co-Chair of PICES FUTURE Science Program SSC; Program Lead, Climate and Ecosystem Group, NOAA



*Hal, your position in the PICES Secretariat has been very similar to mine in ICES, hence our paths converged at various points. Many thanks for fruitful collaboration, expert group alignment, event organization and all the intellectual bungee jumps within the diverse marine science of the northern hemisphere. Both you and I did have especially revelled within the brilliant community of our early career professionals. Many thanks for sharing the experience and the positive energy, it will be tough to keep the hamster on the early career scientist wheel from now on. Farewell but stay in touch – looking forward to hearing about your next life phase, I already envy you all the free time! 😊*

*~ Wojciech Wawrzynski, Head of ICES Science Support*

*I have known Hal for almost the entire stretch of my time with PICES. I first met him when he was leading the latter phase of the CCCC program. Since then, Hal has remained a friend with great humor and brilliant ideas. Now, he is going to retire from the PICES Secretariat but I am sure he will never retire from PICES. PICES needs his ideas and inputs in its journey ahead.*

*~ Sinjae Yoo, Korea Institute of Ocean Science and Technology*

*Congratulations on your retirement, Hal! You have left a permanent mark on PICES as a valuable contribution. Thank you for your hard work and dedication to the community.*

*Thank you for helping me when I joined the FUTURE SSC as a member. Whenever we had meetings, you contributed a lot to make those meetings more productive, memorable, and humorous. I will remember you as a gentleman who would join the meetings wearing an eye-catching Hawaiian shirt along with Steven and Tom. I wish you a happy second life with your family.*

*~ Sukyung Kang, Co-Chair of PICES FUTURE Science Program SSC; National Institute of Fisheries Science, Republic of Korea*

*Congratulations on your retirement! It's been wonderful interacting with you over these many years, both as fellow scientists interested in coastal upwelling ecosystems and as PICES colleagues. Your work at Oregon State University on modeling zooplankton in response to coastal upwelling really challenged us to think, especially how to make better observations at sea. We all appreciated your collegiality, mentoring of students, and good cheer. I also found out that you are not too bad of a basketball player, albeit with pretty sharp elbows, when we both were finally old enough to be invited to play in the over-40 game. Go Beavs!*

*Besides our many scientific collaborations and discussions, I value you as a fellow member of the PICES Swim Team! From the very beginning of my involvement in PICES in the early 2000s, you, George Boehlert, and others welcomed me to the early morning swims at each of the PICES venues. Needless to say, I was a bit skeptical of swimming in the dark of early morning in Vladivostok, but we all tried to never miss the swim during the PICES Annual Meeting. Those were great times and great camaraderie. We have the photos to prove it!*

*I want to express my thanks to you in your role at PICES with helping us carry out some very successful summer schools on ocean observing. Your help with the 2013 summer school "Ocean Observing Systems & Ecosystem Monitoring" that I led in Newport, Oregon, was invaluable. My sincere thanks. After you transitioned to the PICES Secretariat, you helped the Advisory Panel on North Pacific Coastal Ocean Observing Systems (AP-NPCOOS) hold additional ocean observing summer schools.*

*Congratulations and thanks for your friendship, collaboration and support over these years. I look forward to seeing you soon, hopefully in Oregon!*

*With all my best,*

*~ Jack Barth, Oregon State University*



Dear Hal,

*Congratulations on your retirement! You are a leading marine scientist who has helped to shape the questions asked and the research being conducted on issues of global importance. You have had a fabulous career, and have definitely made a positive difference. You are always scientifically curious, insightful, and capable of multi-tasking.*

*I remember when we first met. It was in Woods Hole, at a GLOBEC workshop, in 1990. I remember talking with you at the poster session, discovering that we had similar interests in plankton dynamics, physical processes, and modelling, and coming away thinking that this is a person who has really good ideas. We kept in touch through various GLOBEC meetings, sometimes serving on the same committees, and found ourselves back on the Pacific coast. Eventually, in the late 1990's or very early 2000's, I managed to convince you to become a co-chair of the PICES Climate Change and Carrying Capacity program. You did an incredible job co-managing that program, and bringing it to a very successful conclusion. I am sure that experience (along with your experiences running the U.S. GLOBEC office) stimulated you to add "management of international marine science programs" to your resumé which, of course, led to your role as the Deputy Executive Secretary of PICES. As with all of your career, you have excelled at this latest job, and have had a significant positive impact to PICES and its international science reputation. I could not have attended as many Committee and Working Group meetings as you did! One of the true advantages of our work has been the opportunity to get to know wonderful people, both in meetings but also during the social activities outside of the meetings. With you, it has always been fun.*

*Now you can relax, my friend – you have earned it. I am learning that one of the great privileges of retirement is being able to do what you want, when you want - be it writing papers, bicycling, kayaking, or whatever you wish. Please be sure to keep in touch, and let's get together again when we can for new adventures. All my best wishes. Enjoy!*

*~ Ian Perry, Pacific Biological Station, Fisheries & Oceans Canada*



Dear Hal,

*Please accept my sincere congratulations on your retirement!*

*Yes, it was the PICES community, when we met each other and worked in different subsidiary bodies— sometimes apart, sometimes together. I remember we created "Sea Fame" abbreviation for the Climate Forcing and Marine Ecosystems Task Team. Unfortunately, it was relatively short-lived and gone, together with CCCC program, of which it had been a part. Nevertheless, nobody can say that CFAME disappeared as "sea foam". It contributed to the PICES process with a significant outcome under your leadership as the Co-Chairman of CCCC program and as Science Board member.*

*At one PICES Annual Meeting, possibly in China in 2002, a local photographer tried to give me your photos and was quite surprised when I rejected them with pointing that it is not me on images. Distrustfully, he stared at me wondering why I reject such high-quality photos. In those years, I was sure that you and I look absolutely different. Now, after a couple of decades, I almost ready to agree with that photographer.*

*In PICES we went shoulder-to-shoulder: joined Science Board in 2001, Governing Council – in the beginning of the past decade. Only considering working in the PICES Secretariat, did you beat me to it. In 2014, you joined the Secretariat of near and dear PICES, while I took a position in another secretariat. Therefore, I feel your retirement is well deserved while my stay at my position another year. I wish the same good things for you that I wish for myself: strong health, always good mood, kind people around you, bright events, and good luck! Happy retirement, my friend!*

Sincerely,

*~ Vladimir Radchenko, Executive Director, North Pacific Anadromous Fish Commission (NPAFC)*



June 10, 2021: Hal's PICES Secretariat outdoor socially-distanced retirement party  
L-R: Susan Hannah, Saeseul Kim, Edmand Fok, Alex Bychkov, Lori Waters, Christina Chui,  
Hal Batchelder, Ian Perry, Robin Brown, Sonia Batten. Missing: Rosalie Rutka.

*Congratulations and Happy Retirement, Hal! You will be missed!*



2018 Science Board meeting participants  
Standing, from left: Igor Shevchenko (representing Russia), Jennifer Boldt (MONITOR), Joon-Soo Lee (TCODE), Steven Bograd (FUTURE SSC), Keith Criddle (HD), Harold (Hal) Batchelder (Deputy Executive Secretary), Tetsuo Fujii (Governing Council, Japan), Sukyung Kang (FUTURE SSC), Motomitsu Takahashi (representing Japan), Junichiro Otaka (Governing Council, Japan), Ken Fujimoto (Advisor, Governing Council, Japan), Chieko Kondo (Advisor, Governing Council, Japan), Nobuaki Suzuki (F&A); sitting, from left: Se-Jong Ju (BIO), Thomas Therriault (Acting Chair, MEQ), Hiroaki Saito (Science Board Chair), Chul Park (PICES Chair), Xianshi Jin (FIS), Robin Brown (Executive Secretary). Missing: Emanuele di Lorenzo (POC), who participated in the meeting via WebEx.  
In the background, the Canadian Coast Guard Ship Sir Wilfrid Laurier is tied to the dock.

## The western North Pacific during the 2020/2021 cold season

Kazuhiro Nemoto

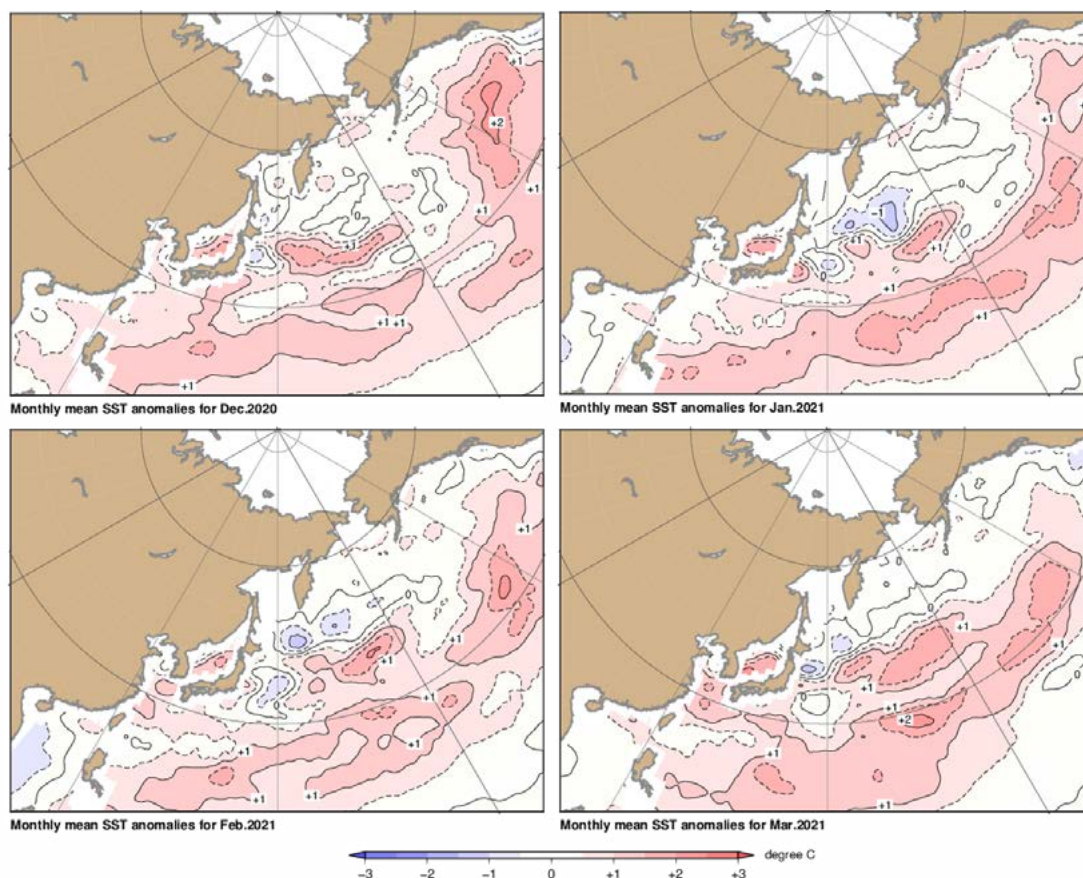


Figure 1. Monthly mean sea surface temperature anomalies from December 2020 to March 2021. Monthly mean SSTs are based on JMA's COBE-SST (centennial in-situ observation-based estimates of variability for SST). Anomalies are deviations from the 1981–2010 climatology.

The western North Pacific was characterized by positive anomalies of sea surface temperatures (SSTs) south of 40°N of this area, whereas negative anomalies of SSTs were observed in seas from 40°N to 50°N and between 150°E and 170°W, throughout the 2020/2021 cold season (Figure 1).

The winter maximum sea ice extent in the Sea of Okhotsk was 1.15 million km<sup>2</sup> in early March, which was around 98% of the 30-year average of 1.17 million km<sup>2</sup>, although which was larger than and greater than the long term linear trend. The seasonal maximum exhibits a long-term decreasing trend of 0.058 million km<sup>2</sup> per decade, which corresponds to 3.7% of the Sea of Okhotsk's total area (Figure 2).

To monitor the long-term variability of ocean acidification, JMA has analyzed monthly sea surface pH values since 1998 based on data from its oceanographic observations and related database content. The results show a clear trend of in-situ pH decrease in seas around Japan ranging from 0.017 per decade around Hokkaido and east of Japan to 0.026 per decade in the Seawest of Japan (Figure 3). The average

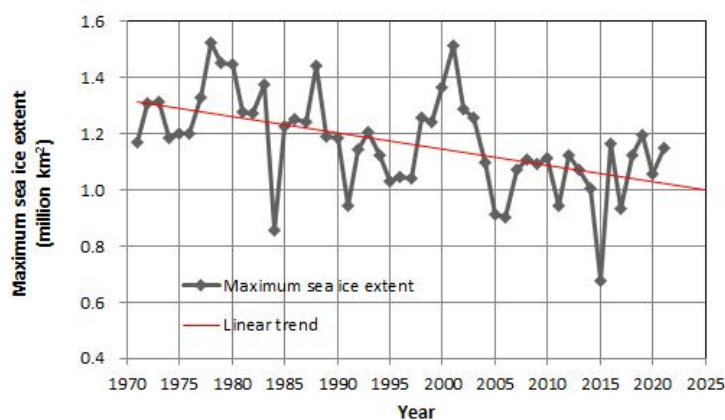


Figure 2. Time series of winter maximum sea ice extent in the Sea of Okhotsk from 1971 to 2021. The red line denotes the long-term linear trend.

trend in sea areas around Japan is 0.021 per decade. These values are similar to observed rates of pH decrease in the open ocean worldwide, open oceans as recorded in the IPCC special report (2019).



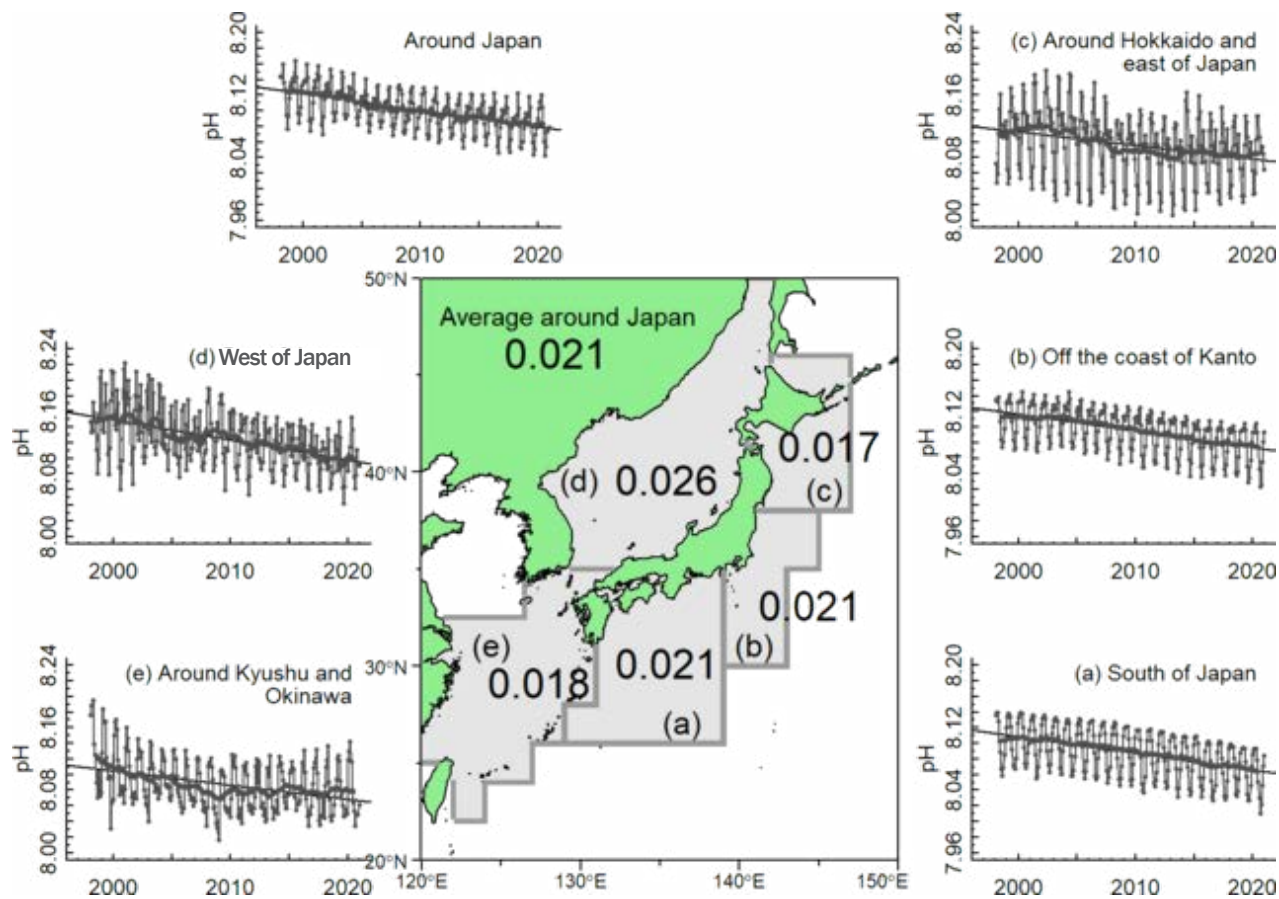


Fig. 3 Long-term trends of pH in sea areas around Japan. Black points with lines, bold lines and thin lines indicate average pH values, yearly running means and long-term trends in areas (a) to (e), and the average around Japan, respectively.

For more details, see JMA's websites: [https://www.data.jma.go.jp/gmd/kaiyou/english/oa\\_jpn/pHtrend\\_jpn\\_en.html](https://www.data.jma.go.jp/gmd/kaiyou/english/oa_jpn/pHtrend_jpn_en.html).

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JMA Headquarters moved about 3 kilometers southwest of its previous site on 24 November 2020. A white 14-story modern building in the picture is the new JMA Headquarters where the Marine Environment Analysis Centre is located on the 12<sup>th</sup> floor. The new office is large, fashionable and comfortable and the building has a seismic isolation structure, as Japan is prone to earthquakes.

Entering the building, you will find a big sphere-shaped structure, that occupies part of the first and second floors, and will wonder "What is this obstructive structure?"

The sphere structure is a museum of local government for children and includes a planetarium. At the 2nd floor, JMA also provides a small museum for learning about disasters.



## The Bering Sea: Current Status and Recent Trends

Edited by Lisa Eisner

### Climate

The Bering Sea experienced positive air temperature anomalies during the period of October 2020 through March 2021, with the greatest departures from normal exceeding 2°C over the northern Bering extending into the Chukchi Sea (Figure 1). This warmth relative to the climatological average (1981–2010) was higher than observed the prior fall and winter, but not as extreme as in the years of 2017–18 and 2018–19. The overall wind anomalies were from the southwest during October 2020 through March 2021, as implied by a sea level pressure (SLP) anomaly pattern with lower than normal pressure over the western Bering Sea and far-eastern portion of Siberia and higher than normal pressure south of Alaska (Figure 2). This distribution of SLP anomalies resembles that of the previous 3 years in a general sense, with differences in the exact position and strength of the anomaly centers. This consistency in the atmospheric circulation pattern is remarkable; October through March 2015–16 was the last time that the mean SLP distribution supported anomalies of winds from the north of the Bering Sea, east of the dateline. It bears noting that the mean winds (for years 1981–2010) during fall and winter are from the northeast; the anomalies from the southwest during 2020–21 imply weaker winds as a whole, of course interspersed with short periods of active weather associated with storms.

From a sub-seasonal perspective, the Bering Sea shelf experienced particularly warm weather during the months of October and November 2020, and again in February and March 2021. During the October through March period, St. Paul Airport in the Pribilof Islands had only 39 days with an average temperature below normal, with most of those days occurring in the months of December and January. As is becoming the climatological norm, a delayed onset of sea ice in the Chukchi Sea relative to long-term averages led to another late start to the development of sea ice in the northern Bering Sea. Along with the warm air temperatures and southwesterly wind anomalies, the consequence was a light sea ice year. The sea ice reached its maximum extent in early March 2021, remaining north of 60°N west of the dateline and reaching only 58–59°N near the coast of Alaska. The nearshore region of Bristol Bay on the southeast Bering Sea shelf had an especially light ice year relative to historical averages.

The months of April and May 2021 included a transition in the SLP anomaly pattern to higher than normal values in an arc extending from eastern Siberia through the Gulf of Alaska (Figure 3). This pattern resulted in a transition to moderate wind anomalies from the east of 1–2 m s<sup>-1</sup> across most of the eastern Bering Sea shelf. One result is that passive drifters in

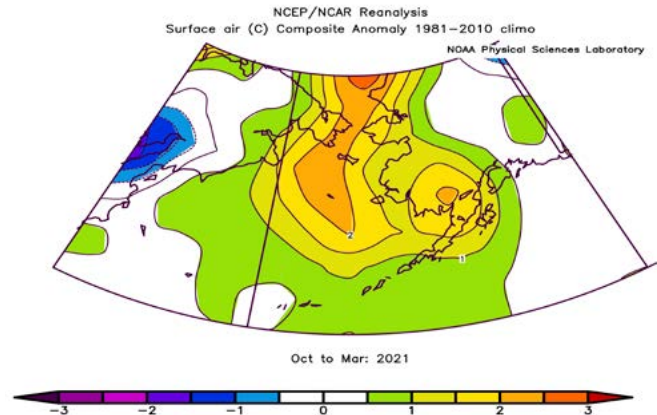


Figure 1. Mean surface air temperature anomalies (°C) from the NCEP/NCAR Reanalysis for October 2020–March 2021. Courtesy of Nick Bond, University of Washington (UW)/ Cooperative Institute for Climate, Ocean, and Ecosystem Studies (CICOES).

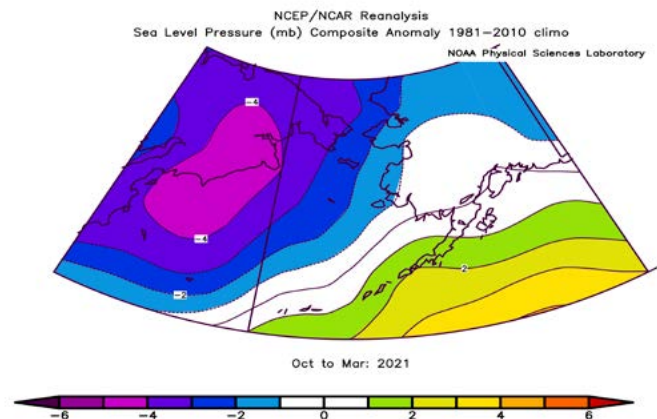


Figure 2. Mean sea level pressure (SLP) anomalies (mb) from the NCEP/NCAR Reanalysis for October 2020–March 2021. Courtesy of Nick Bond, UW/CICOES.

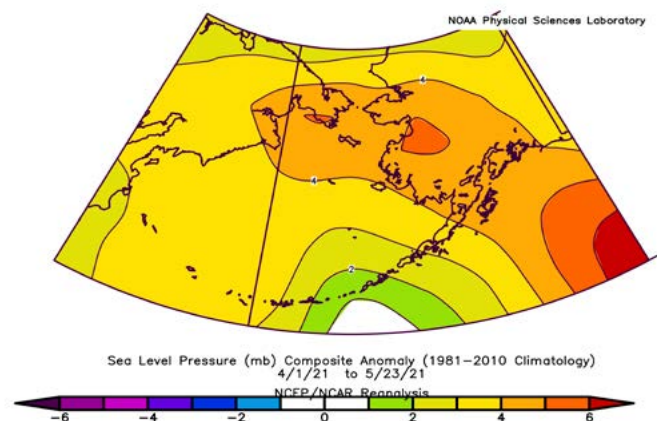


Figure 3. Mean sea level pressure (SLP) anomalies (mb) from the NCEP/NCAR Reanalysis for April 1–May 29, 2021. Courtesy of Nick Bond, UW/CICOES.

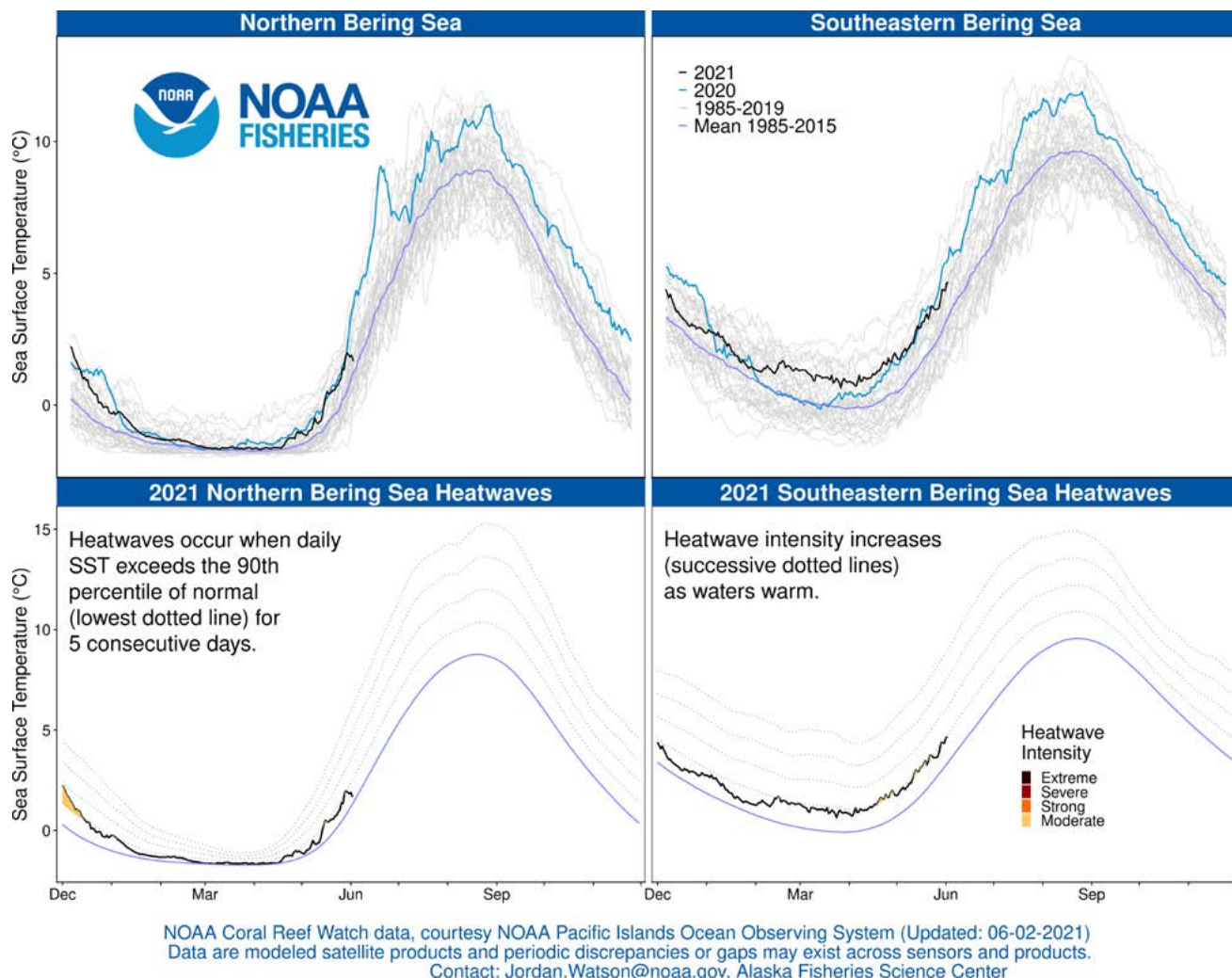


Figure 4. Satellite-derived daily SST data for the northern (60–65.75°N) and southeastern (AK Peninsula to 60°N) Bering Sea shelf (10m–200m). The purple line is the mean from 1986–2015 (i.e., the oldest 30-yr baseline period in the time series). Individual years shown in grey for 1986–2019 with 2020 in blue and 2021 in black. The marine heatwave panels show the strength of the heatwave based on the Hobday et al., (2018) intensity categories.

the upper part of the water column, including some species of ichthyoplankton, were likely transported more poleward than usual along the Bering Sea shelfbreak instead of cross-shelf towards shallower water.

### Sea surface temperature (SST) in the eastern Bering Sea

Satellite-derived SST data for the northern and southeastern Bering Sea were accessed via the NOAA CoastWatch West Coast Node ERDDAP server ([https://mattcallahan.shinyapps.io/NBS\\_SEBS\\_SST\\_MHW/](https://mattcallahan.shinyapps.io/NBS_SEBS_SST_MHW/), Figure 4). SST in winter and spring 2021 appear similar to 2020. In the northern Bering Sea, the 2021 time series began with warmer than average temperatures, cooling off near the start of January, with temperature above average again in May. In the southeastern Bering Sea SSTs for 2021 have been warmer than average (e.g., > 1°C in May), in concordance with the above average air temperatures observed over the Bering Sea during much

of the prior fall and winter (described earlier). A moderate marine heat wave (MHW) was observed in the northern Bering Sea in early December and in the southeastern Bering Sea in late April and May, with earlier months hovering just below the MHW threshold (Figure 4).

### Spring phytoplankton blooms in the eastern Bering Sea

Satellite chlorophyll-a (chl-a) data, a proxy for phytoplankton biomass, allows analysis of large scale patterns in phytoplankton dynamics. Near real time satellite chl-a for April and the first half of May (average of 1-day composites) from VIIRS<sup>1</sup> show noticeable open water phytoplankton blooms in the southeastern Bering Sea in spring 2021 (Figure 5). The inner shelf had elevated chl-a concentrations in April, while the middle shelf had increased levels in the first half of May. Vertical profiles of

<sup>1</sup><https://coastwatch.pfeg.noaa.gov/erddap/griddap/erdVHNchla8day.html>

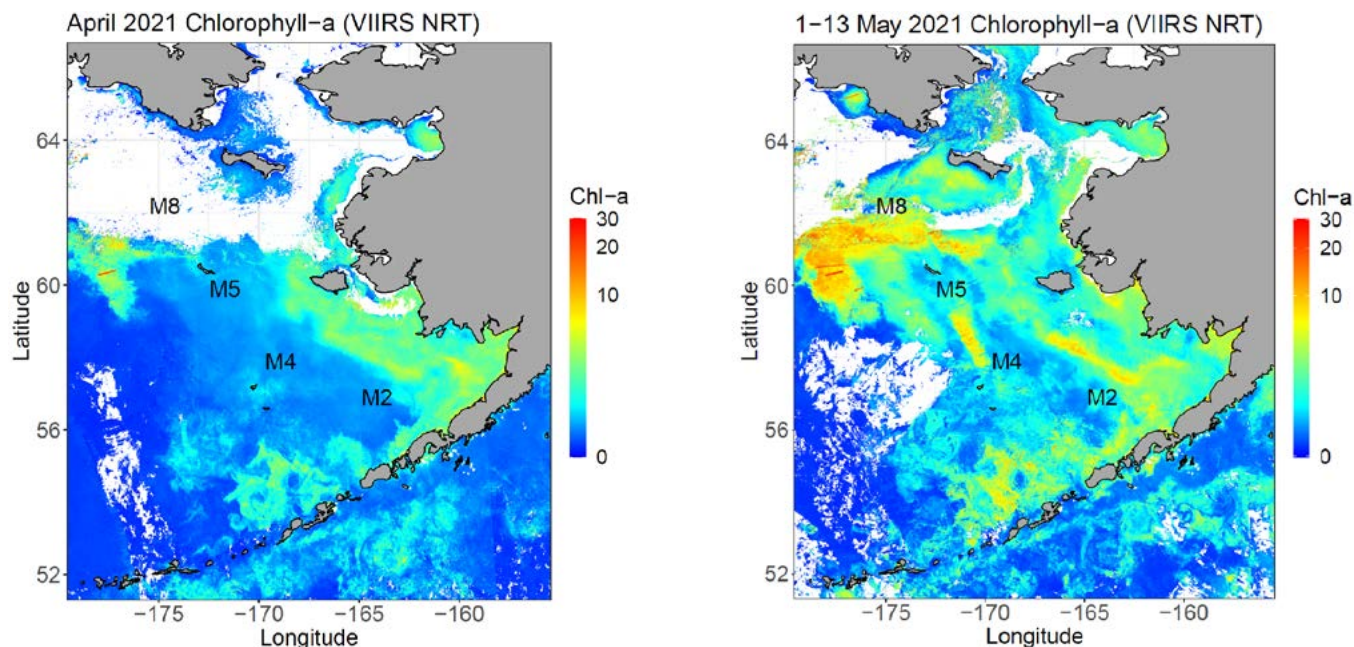


Figure 5. Satellite near real time chl-a data ( $\mu\text{g/l}$ ) from VIIRS for 1-30 April (left) and 1-13 May (right) 2021. M2, M4, M5, and M8 are oceanographic moorings. Courtesy of Jens Nielsen, UW/CICOES.

temperature and chl-a data at mooring 2 (M2) from a Prawler (Profiler + Crawler)<sup>2</sup> indicate that the open water bloom began to form after the surface water stratified, with high concentrations during 12-28 May (Figure 6). The chl-a data from satellite and Prawler observations, suggest that timing of the spring bloom was average for an ice free year on the southeastern middle shelf (Sigler et al., 2014). An ice edge bloom was also observed at  $\sim 62^\circ\text{N}$  near M8 in the northern Bering Sea in May (Figure 5); this bloom was confirmed on the annual NOAA Ecosystems and Fisheries-Oceanography Coordinated Investigations (EcoFOCI) spring mooring survey (see section on 2021 surveys). Survey data also suggest that the deep cold pool ( $< 2^\circ\text{C}$ ) will be smaller than average, and smallest by August (P. Stabeno, pers. comm.)

### Bristol Bay red king crab seasonal movement

The Bristol Bay red king crab population has been declining over the past decade, causing concern for stock sustainability. Yet, much uncertainty still exists on the distribution of these crab outside the summer survey period, making management challenging. Without year-round distribution information, it is difficult to delineate and protect crab habitat, define environmental predictors of abundance and distribution, and mitigate bycatch in other fisheries. To describe intra-annual distribution and movement, mature male red king crabs were tagged in June 2019 with acoustic tags that continuously transmit a unique identification number. To re-locate crabs, in October 2019 sailboat-like surface drones equipped with acoustic receivers were deployed to search for tagged

crabs by performing transects across Bristol Bay (Figure 7, more information [here](#)).

From summer into fall tagged crab moved as a cohesive group in a southwesterly direction. Importantly, most crab moved west of the Red King Crab Savings Area (an area closed to bottom trawling), where they were exposed to the risk of being caught as bycatch in trawl fisheries. To expand the study, additional male and female crab were tagged in 2020 at stations spread throughout Bristol Bay. A drone is currently searching for tagged crabs, which should help elucidate spring distribution patterns. Bristol Bay red king crabs typically mate and molt in the spring, making it a particularly interesting time period to study these crab.

### Preview of Ecosystem and Economic Conditions (PEEC)

NOAA AFSC in partnership with the Alaska Integrated Ecosystem Assessment Program, held a 3-day virtual workshop May 18-20, 2021. Over 80 researchers and stakeholders met to exchange information on early physical, biological, and economic conditions to inform the fall fisheries stock assessment cycle. The main objective was to identify any areas of concern or unusual conditions that may be relevant to stock and ecosystem assessments. These warning signals will be tracked through the summer. Those that continue to be of concern will be presented to the North Pacific Fisheries Management Council in October, when they begin to review the science supporting the annual groundfish stock assessments. The early warning and final ecosystem assessments will be included in the Ecosystem Status Reports of the eastern Bering Sea, Gulf of Alaska, and Aleutian Islands, available publicly in December 2021.

<sup>2</sup> <https://www.pmel.noaa.gov/edd/pmel-theme/prawler>

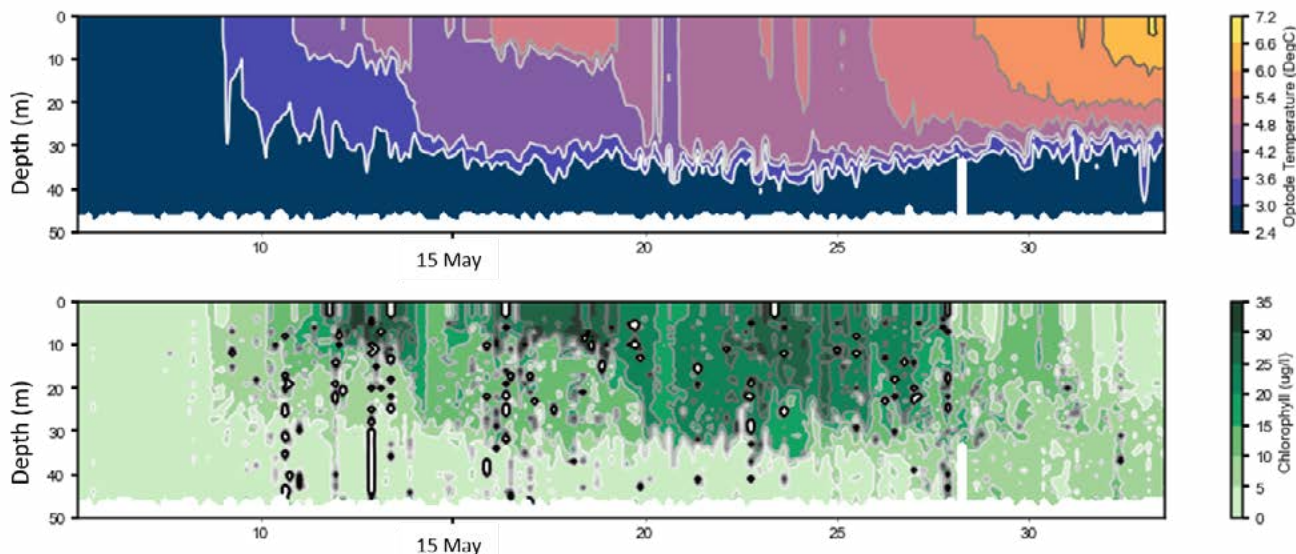


Figure 6. Prawler temperature (top) and chl-a fluorometer (bottom) data for M2 (56.87°N, 164.06°W) for 5 May to 2 June 2021. Courtesy of Phyllis Stabeno and Shaun Bell, NOAA, PMEL.

### 2021 surveys in Bering and Chukchi seas

- NOAA PMEL and AFSC EcoFOCI oceanographic/mooring survey in the eastern Bering Sea on the R/V Oscar Dyson, 1 – 20 May.
- NOAA AFSC longline stock assessment survey on the Bering Sea slope on the F/V Alaskan Leader, 30 May – 14 June. The main target is sablefish, with 8,100 hooks/day fished at 150-1000m depths.
- NOAA AFSC eastern Bering Sea (EBS) groundfish and crab bottom trawl survey on the F/V Vesteraalen, 25 May – 1 August, and on the F/V Alaska Knight, 28 May – 4 August. The Northern Bering Sea surveys will occur immediately after the EBS surveys on the F/V Vesteraalen, 2 August – 25 August, and on the F/V Alaska Knight, 5 August – 28 August.
- NOAA AFSC Northern Bering Sea surface trawl and ecosystem survey on the F/V Northwest Explorer, 27 August – 20 September.
- NOAA PMEL and AFSC EcoFOCI, and NOAA Arctic Research Program (Chief scientist J. Grebmeier, jgrebmei@umces.edu) will conduct benthic, marine mammal and oceanographic sampling, and mooring recovery and deployments in the eastern Bering Sea and at Distributed Biological Observatory (DBO) stations in the northern Bering and eastern Chukchi seas on the R/V Discovery, 20 August – 19 September.
- NOAA's Office of Coast Survey (via Terrasond Inc.) will operate four saildrones in the Bering Sea, July to September, to collect hydrographic data to update NOAA's nautical charts and make oceanographic and meteorological measurements, including CO<sub>2</sub> (with NOAA PMEL). Contact is LT Hadley Owen at Alaska.NavManager@noaa.gov.
- The Russian Fishery Agency is considering fisheries acoustic trawl and oceanographic surveys in the northwestern Bering Sea and the western Chukchi Sea, but their realization is still unclear.

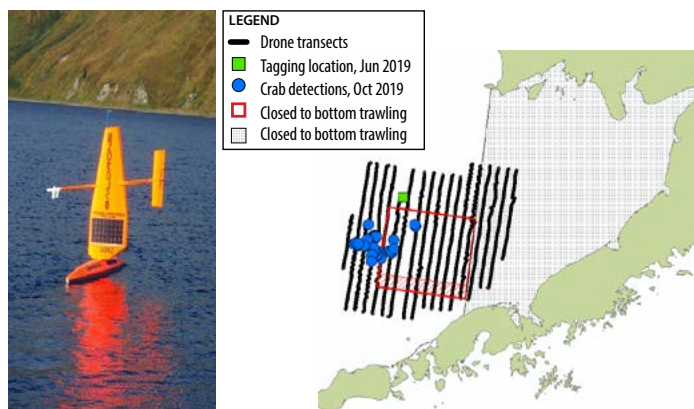


Figure 7. Uncrewed surface vehicle (Saildrone, Inc, left). Drone search grid for tagged crabs in October 2019 (right); Courtesy of Leah Zacher, NOAA, AFSC.

For more information on NOAA surveys, see:

- <https://www.fisheries.noaa.gov/feature-story/surveys-will-collect-data-crucial-managing-alaska-fisheries-and-monitoring-alaska>
- <https://www.pmel.noaa.gov/news-story/ecosystems-and-fisheries-oceanography-coordinated-investigations-ecofoci-begins-full-2021>



### Acknowledgements:

Many thanks to the scientists who helped create this report: Drs. Nicholas Bond and Jens Nielsen at UW/CICOES provided information on climate and satellite ocean color, respectively; NOAA AFSC scientists Drs. Jordan Watson, Leah Zacher, Elizabeth Siddon, Pat Malecha, Lyle Britt, and Jim Murphy provided information on satellite SST, red king crab movement, the PEEC meeting, the Bering Slope longline survey, Bering Sea bottom trawl surveys, and the northern Bering Sea surface trawl survey, respectively; Dr. Phyllis Stabeno, Shaun Bell, and Heather Tabisola at NOAA, PMEL provided the Prawler mooring information; Dr. Yury Zuenko at the Pacific Branch of Russian Research Institute of Fisheries and Oceanography (TINRO) provided information on potential northwestern Bering and Chukchi Sea surveys.



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 for the PICES MONITOR committee and a lead/co-PI on current (and past) eastern Bering Sea and Chukchi Sea research programs.

### References:

- Hobday, A. J., et al., 2018. Categorizing and Naming Marine Heatwaves. *Oceanography*, 31(2), 162–173.
- Sigler, M., et al., 2014. Spring and fall phytoplankton blooms in a productive subarctic ecosystem the eastern Bering Sea during 1995–2011. *Deep Sea Res II* 109:71–83.

## The Northeast Pacific: Update on Marine Heat Wave Status

Charles Hannah, Howard Freeland, Andrea Hilborn, Marie Robert, Tetjana Ross, Andrew Leising

Marine Heatwaves (MHW) have become a common feature of the Northeast Pacific Ocean (Bond et al., 2015; Amaya et al., 2020; Ross et al., 2019, 2021). They have become so common that the California Current Marine Heatwave Tracker website (CCMHWT)<sup>1</sup> uses automated methods to track them, and the large ones (area > 400,000 km<sup>2</sup>) are named. There were two large MHWs in 2020 (NEP20A, NEP20B) and so far there is one in 2021 (NEP21A). NEP21A started to grow in April 2021 and seemed to peak in late May 2021 when the maximum temperature anomalies in the area bounded by 35°–40° N and 138°–158° W were about 3°C (Figure 1). At this apparent peak, the northern edge of NEP21A reached the western end of Fisheries and Oceans Canada's Line P. By mid-June the area of warm water had largely retreated to the south and west and the MHW was encroaching on coastal California waters (Figure 1). Pockets of warm water persisted in the vicinity of Line P stations P20 and P26 and some anomalously warm water appeared at the eastern end of Line P (P4) encroaching on coastal British Columbia.

Satellite sea surface temperature (SST) anomalies were calculated on a weekly basis using daily NOAA Optimal Interpolation gap-filled SST (OISST) images, accessed via the NOAA CoastWatch ERDDAP server (<https://coastwatch.pfeg.noaa.gov/erddap/index.html>). Daily climatology and standard deviation maps were produced from the latest 30 years of data (1991–2020), and were compared to 2021 SST data to produce daily anomalies. Daily SST climatology, anomalies and standard deviation fields from each week were averaged together to produce weekly averages of these fields.

Calculating the area of a MHW requires first defining which pixels are in MHW status. This was done by identifying pixels above the threshold for MHW status as SST exceeding 1.29 times the standard deviation from a given date (following the CCMHWT method). Then, all pixels above this value were identified for all days and weeks in 2021 and the largest continuous region delineated within the area 170°–120° W, and 25° to 61.5° N defined the MHW. The area of the weekly MHW regions was calculated as the sum of the area of individual pixels within it, accounting for the different area each pixel covers on the earth surface (Figure 2). All calculations were performed using the R programming language.

<sup>1</sup><https://www.integratedecosystemassessment.noaa.gov/regions/california-current/cc-projects/blobtracker>

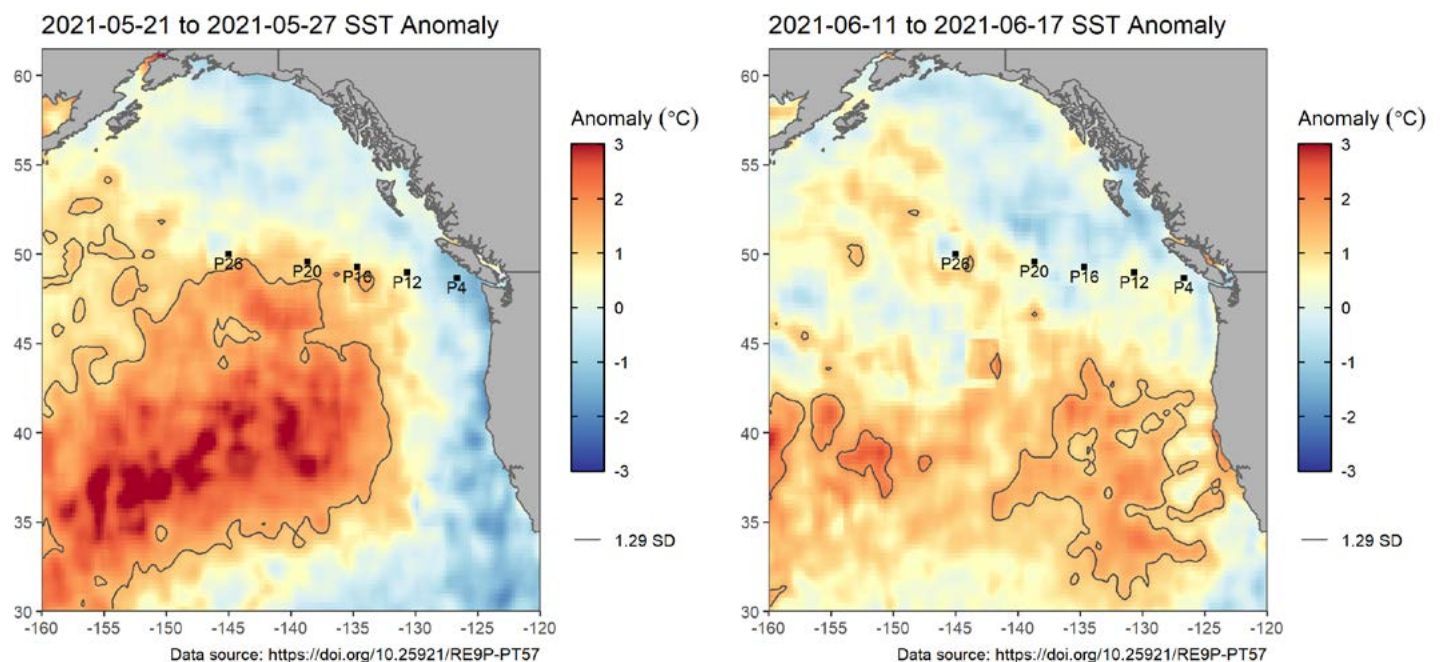


Figure 1. Weekly composite satellite SST anomalies. Left panel: 21–27 May 2021; right panel: 11–17 June 2021. Selected stations from the Line P monitoring program are shown.

Figure 2 shows the daily time evolution of the largest contiguous area in the northeast Pacific subject to marine heat wave conditions during 2021. The first part of the year is dominated by the decline of NEP20B. On 4 April 2021 NEP20B was declared 'no longer a large MHW' when the area fell below the threshold ( $>400,000 \text{ km}^2$ ). In May, a new large MHW (NEP21A) rapidly developed and reached a maximum later that month.

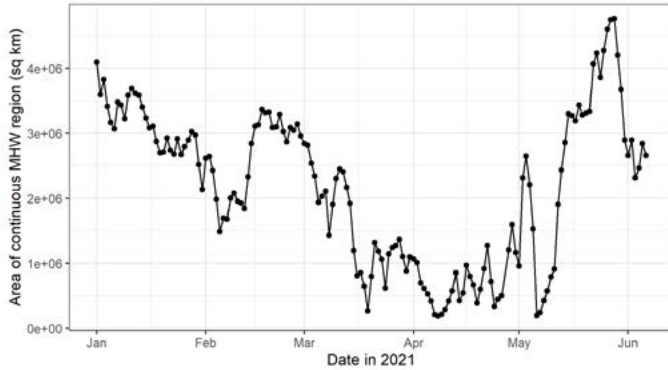


Figure 2. Area of the largest contiguous MHW in the North Pacific within the region bounded by  $25^\circ - 61.5^\circ \text{ N}$  and  $170^\circ - 120^\circ \text{ W}$ . This is the largest continuously connected area, not the area of all pixels in MHW status.

The temperature anomalies derived from the satellite SST are consistent with those derived from water column profiles taken on and around Line P from Argo floats (Argo 2020) and the DFO Line P monitoring program (<https://www.waterproperties.ca/linep/>). Argo data from May 2021 (Figure 3) show a broad region with temperature anomalies  $> 0.5^\circ\text{C}$  above 50 m and a region at the western end of the line with near surface anomalies  $> 1^\circ\text{C}$ . The higher spatial resolution in the Line P sampling from early May 2021 (Figure 4) shows more spatial structure than the Argo data, and in particular shows the cool water at the eastern end of the line which is missing from the Argo data, as Argo floats do not sample the upper continental slope and shelf. Overall, the near surface temperature anomalies are about  $1^\circ\text{C}$  at the western end of Line P in May (Figure 3) where the satellite SST shows the MHW just reaching the western end of the line (P20 and P26) and there are negative temperature anomalies at the eastern end (P4). In June the SST anomalies reduced, retreated southward, and warm water reached the California coastal zone. The anomalously cool water at the eastern end of Line P in the June Argo section (200-800 km in Figure 3) seems to represent the cool water just to the north of Line P. All of the data through mid-June indicates that NEP21A had largely stayed south of Line P.

Another feature that can be seen from the LineP and Argo observations is that the anomalously warm water ( $0^\circ - 0.5^\circ\text{C}$ ) extends down to at least 500 m along the entire length of the Line P. Thus, there is not a pool of anomalously cool water at depth to contribute to cooling the near surface waters during the fall storm season.

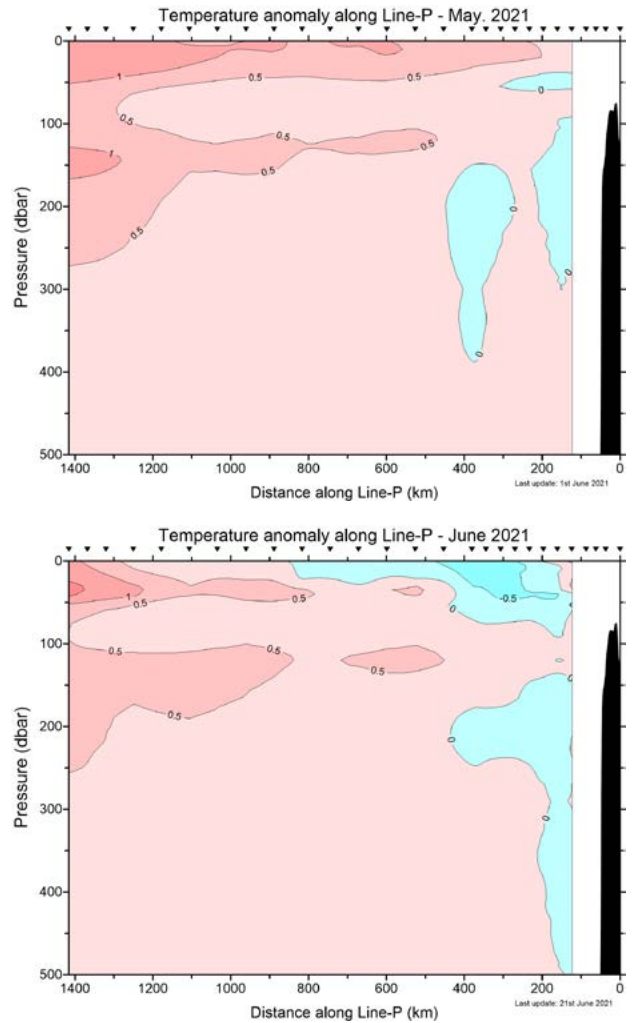


Figure 3. Temperature anomalies along Line P from Argo data. Sections are centred on the 15<sup>th</sup> day of each month and use data acquired in the Gulf of Alaska within 15 days of the centre date. North America is on the right. These data were collected and made freely available by the International Argo Program (part of the Global Ocean Observing System) and the national programs that contribute to it. (<https://argo.ucsd.edu>; <http://www.ocean-ops.org>).

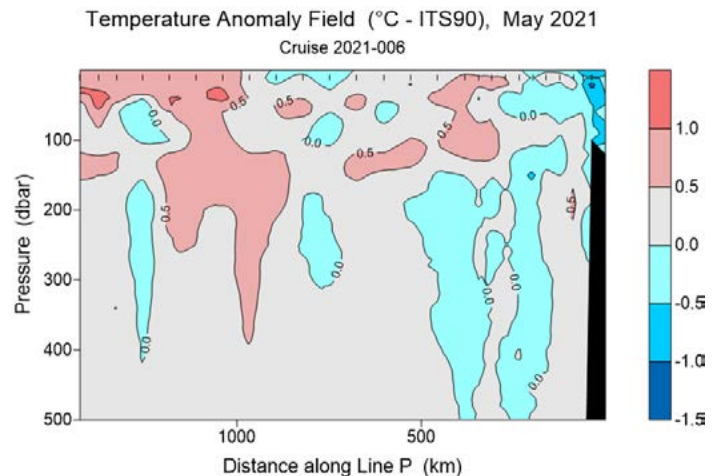


Figure 4. Temperature anomalies along Line P from shipboard profiles (2-11 May, 2021). The anomalies are relative to 1956–1991 averages. North America is on the right.



There are significant fresh anomalies in the upper ocean salinity field along Line P. The Line P data from May 2021 show typical anomalies of  $-0.3$  to  $-0.6$   $\text{gKg}^{-1}$  (Figure 5) in the upper 120 m (above the permanent pycnocline). Similar anomalies are seen in the Argo data for April, May and June (not shown). These salinity anomalies lead to a substantial low density anomaly in the upper water column with values ranging from  $-0.1$  to  $-0.3$   $\text{Kg m}^{-3}$  (Figure 6). The Argo data suggest that these anomalies have persisted since April, with a slight decline from May to June. These low density anomalies are a barrier to mixing and thus make the upper ocean temperatures more sensitive to atmospheric forcing. If this situation persists into the fall then the upper ocean can be expected to cool more slowly than normal and a fall MHW is likely to develop as it did in 2018 (Livingston 2018).

Large MHWs that stay far off-shore have limited impact on coastal ecosystems. The large societal impacts happen when the warm water 'comes ashore' and enters the coastal zone. For example, there were large offshore marine heat waves in 2004, 2005 and 2016 that went largely unnoticed, whereas, the Blob (2013–2016) is memorable because of the impacts that occurred when the warm water enveloped the coastal zone<sup>2</sup>. The problem of predicting whether an offshore MHW will impact the coastal zone has not been solved. One repeatable pattern is that if there is a large offshore MHW in the late summer, then one can expect it to 'come ashore' when the upwelling winds weaken in the late summer or early fall. Figure 7 illustrates this idea for coastal Oregon.

The decline in SST anomalies in June did not last very long. At the time of writing this article (24 June 2021), the region of elevated SST has expanded to the north and east (Figure 8). There are anomalously warm conditions along the west coast of North America from Alaska to California. These conditions are likely related to the high pressure system (a blocking high) that led to the forecast of a major heat wave for the west coast from California to British Columbia for 26–28 June 2021 and perhaps beyond (Mass 2021; Cappucci and Samenow 2021; Berardelli 2021). The story of the large marine heatwave of 2021 is still developing and the weather this summer will likely play a large role in determining whether the marine heat wave conditions will persist in the coastal zone.

<sup>2</sup> <https://www.fisheries.noaa.gov/feature-story/looking-back-blob-chapter-2-marine-heat-wave-intensifies-completely-chart>

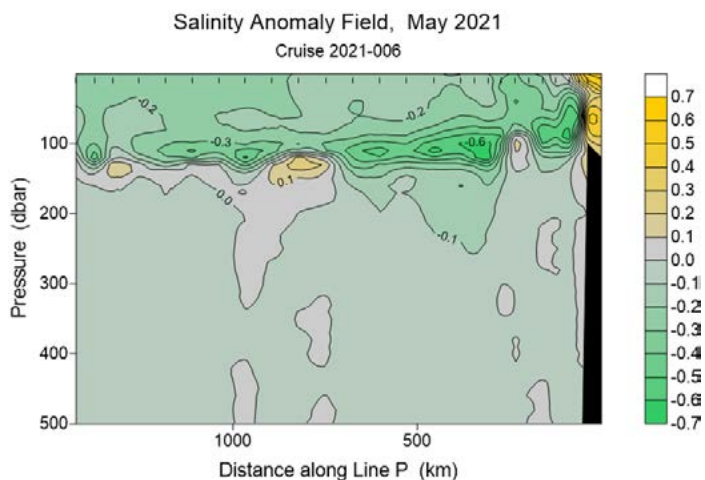


Figure 5. Salinity anomalies along Line P from shipboard profiles (2–11 May, 2021). Anomalies are relative to 1956–1991 averages. North America is on the right.

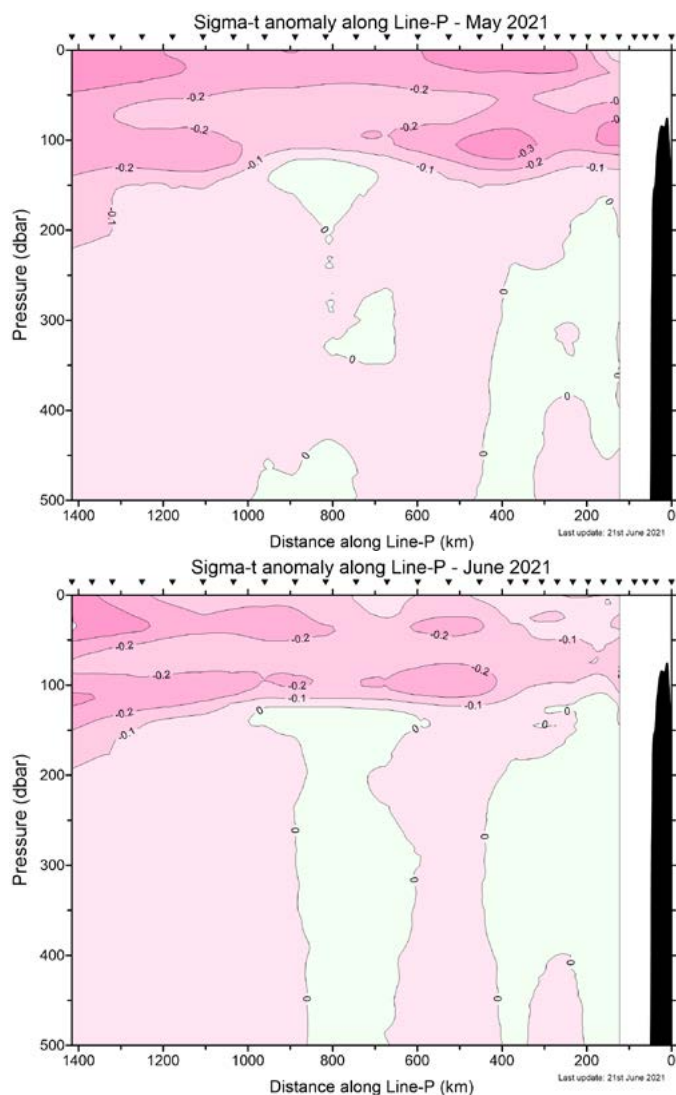


Figure 6. Density anomalies along Line P from Argo data for May and June 2021. North America is on the right. Sections are centred on the 15<sup>th</sup> day of the month and use data acquired in the Gulf of Alaska within 15 days of the centre date. June data only include profiles from 1–20 June 2021.

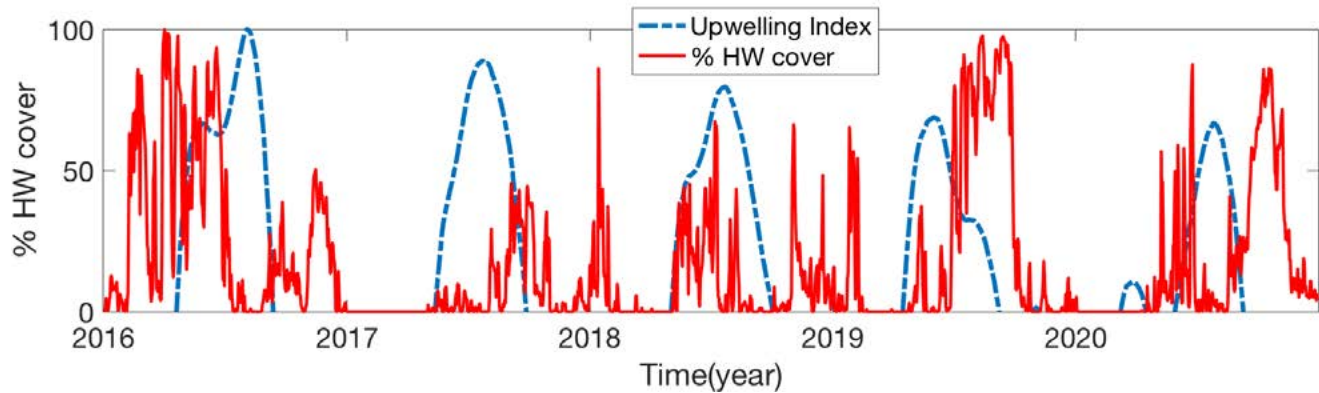


Figure 7. Scaled Bakun upwelling index (data from <https://coastwatch.pfeg.noaa.gov/erddap/tabledap/erdUI456hr.html>, smoothed with a 90-day gaussian running mean) for coastal Oregon and % MHW cover for coastal Oregon vs time. % MHW cover is the percent of the region (from Oregon state waters westward to the US EEZ; 200nm) in heatwave status (standardized SST anomaly > 1.29). Peaks in yearly % cover occurred immediately after the seasonal cessation of summer upwelling (noted by the rapid decrease in the upwelling index towards zero) in 2017, 2019, and 2020.

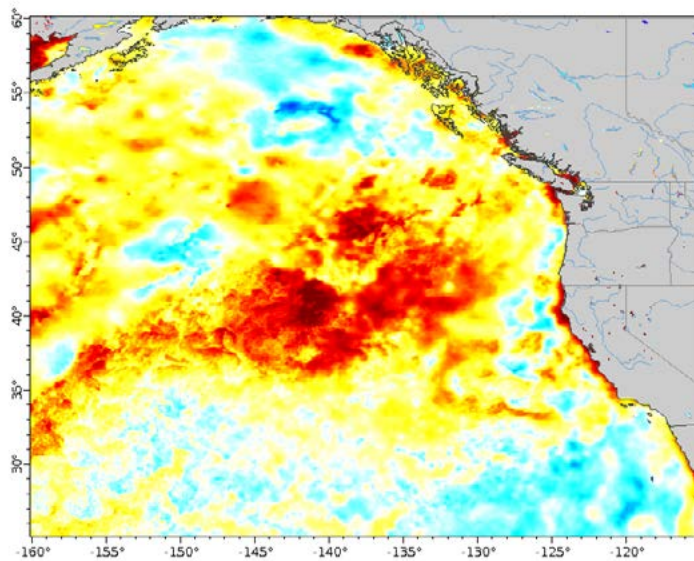


Figure 8. Satellite sea surface temperature anomalies for 20 June 2021 from the multi-scale ultra-high resolution (MUR) analysis.

### References:

- Argo (2000). Argo float data and metadata from Global Data Assembly Centre (Argo GDAC). SEANOE. <https://doi.org/10.17882/42182>
- Amaya, D.J., Miller, A.J., Xie, S.P. and Kosaka, Y., 2020. Physical drivers of the summer 2019 North Pacific marine heatwave. *Nature communications*, 11, pp.1-9.
- Beradelli, J. 2021. Pacific Northwest bakes under once-in-a-millennium heat dome. CBS News. <https://www.cbsnews.com/news/heat-dome-2021-seattle-portland-weather/>
- Bond, N.A., Cronin, M.F., Freeland, H. and Mantua, N., 2015. Causes and impacts of the 2014 warm anomaly in the NE Pacific. *Geophysical Research Letters*, 42(9), pp.3414-3420.
- Cappucci M., Samenow, J. 2021. Weather Service warns of 'dangerous' and 'historic' heat wave in Pacific Northwest. *Washington Post*. 23 June 2021. <https://www.washingtonpost.com/weather/2021/06/22/heat-wave-pacific-northwest-historic/>
- Livingston, I.. 2018. Persistent Alaska warmth this fall has brought back 'the blob.' If it lasts, it could mean a wild winter in the Lower 48. *Washington Post*, October 18, 2018. <https://www.washingtonpost.com/weather/2018/10/18/persistent-alaska-warmth-this-fall-has-brought-back-blob-if-it-lasts-it-could-mean-wild-winter-lower/>
- Mass, C. 2021. The Greatest Heat Wave in Northwest History?. *Cliff Mass Weather Blog*. 21 June 2021. <https://cliffmass.blogspot.com/>
- Ross, T., Hannah, C. and Whitney, F., 2019. The Northeast Pacific: Current status and recent trends. *PICES Press Vol. 27(2)*, pp: xx-xx
- Ross, T., Jackson, J. and Hannah, C., 2021. The Northeast Pacific: Update on marine heatwave status and trends. *PICES Press*, 29(1), pp.46-48.



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*Marie Robert is an oceanographer with the Institute of Ocean Sciences of Fisheries and Oceans Canada, and co-ordinates the Line P program. She leads three cruises per year sampling the Line-P long-term observation program, and in between these cruises she coordinates products and future research of this program.*



*Dr. Howard Freeland is a scientist emeritus at the Institute of Ocean Sciences in Sidney, BC. Despite his retirement, he maintains a keen interest in the Argo program and ocean climate change.*



*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 the Working Group on Mesoscale and Submesoscale Processes (WG-38).*



*Ms. Andrea Hilborn is a remote sensing biologist who has been working for Fisheries and Oceans Canada since 2019 with the operational remote sensing group at the Bedford Institute of Oceanography in Halifax, NS. She's currently collaborating with the Institute of Ocean Sciences in Sidney, BC and living in Victoria. Her current projects focus on evaluating and implementing ocean colour satellite algorithms in the Beaufort Sea, and satellite monitoring of temperature and productivity in the northeast Pacific. Outside of the office she is usually found cycling, snorkeling and exploring Vancouver Island.*



*Andrew Leising received his bachelor's degree in Biology and Marine Science from the State University of New York at Stony Brook, and his doctorate in Biological Oceanography from the University of California, San Diego, Scripps Institution of Oceanography. His research there focused on the ecology of marine crustaceans and their response to environmental variation. After graduate school, Leising conducted experimental fieldwork on the behavior of microzooplankton under varying food and temperature regimes, and modeling experiments of planktonic ecosystem responses to oceanic variability and climate change, at the University of Washington, Seattle. Currently, Leising works for the National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NOAA-Fisheries), at the Southwest Fisheries Science Center. His current work focuses on the responses of fish and zooplankton to climate variability, and the characterization of oceanic variability (i.e. marine Heatwaves), through his work as part of NOAA's California Current Integrated Ecosystem Assessment (CCIEA) team.*

## PICES by the numbers - Finding Balance

Sonia Batten

The United Nations Decade of Ocean Science for Sustainable Development (UNDOS) has recently been a major focus for PICES members, firstly in preparation for its launch over the past year and now developing those plans and activities as the Decade begins. Throughout the language of the UNDOS Challenges, Outcomes and Criteria are references to diversity and inclusivity to encourage “transformative ocean science that strives for generational, gender and geographic diversity in all its manifestations”. The PICES structure for Committee and other Expert Group memberships automatically builds in geographic balance and diversity across our member countries (members are requested from each country, Chairs and co-Chairs are chosen from opposite sides of the Pacific, and alternate for successive terms) but we must address the other areas too. We have in the past requested Early Career Scientists to identify themselves for reasons such as reduced meeting registration costs, eligibility for travel support, or for presentation awards, but this is not sufficient to be able to understand and track the contribution to PICES of Early Career Ocean Professionals (ECOP).

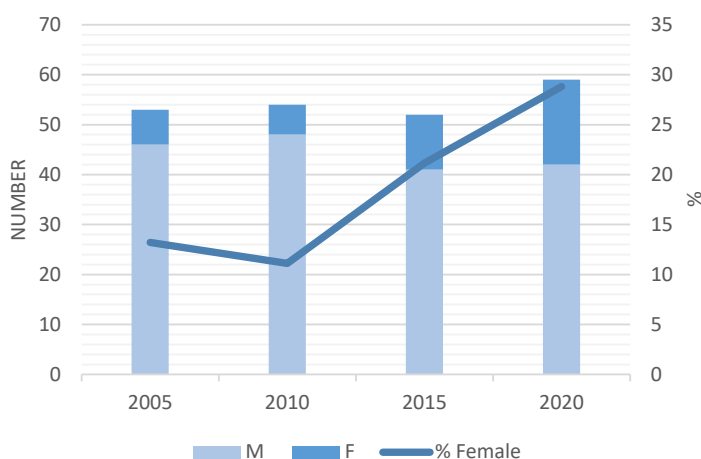
A recently released report commissioned by the Department of Fisheries and Oceans Canada (DFO); “Gender Equity in Ocean Science”<sup>1</sup> by CarolAnne Black highlighted that women are under-represented in ocean science globally, particularly in decision-making positions, and that ocean science benefits from gender equity. One recommendation of the report is that gender-disaggregated data are collected. The graph below shows the changes over time in gender balance of PICES Expert Group Chairs (including Vice Chairs and Co-Chairs):

There has been an improvement in representation by female Chairs over the last decade so that they currently occupy between a quarter and one third of these roles. In the *Global Ocean Science Report*<sup>2</sup> the reported proportions of female ocean researchers (Table 4.2) are similar, or slightly less, than the proportions of female PICES Chairs for the four countries with data presented. So, PICES is not doing worse than ocean science as a whole, but we should strive, of course, to do better. No one member country has ever exceeded 50% of Chair roles being held by women, but the USA is currently close with 47%.

These data were relatively straightforward to compile because total numbers are small, but to be able to track and report on changes in membership of PICES as a whole, and participation in our events over the duration of the UNDOS and beyond, we need the data to do so. You will soon see requests for voluntary information posed to you when you register for PICES events, or update your contact information. Requested information will likely cover gender, ECOP status and whether or not you are a member of an indigenous group. It will be kept confidential and only used to report aggregated statistics.

We will continue to ask National Delegates to consider gender equity and ECOP representation when appointing members to Expert Groups and we will be reporting on these metrics regularly as we progress through the UNDOS. We are also discussing ways to include indigenous knowledge and communities too and will partner with organizations and groups that can offer that perspective. PICES has always been a diverse community but we will work to make sure it is even more diverse, as well as more balanced and inclusive, by the end of the Decade.

PICES Gender balance of Chairs 2005-2020



<sup>1</sup> [https://publications.gc.ca/collections/collection\\_2021/mpo-dfo/Fs23-631-2020-eng.pdf](https://publications.gc.ca/collections/collection_2021/mpo-dfo/Fs23-631-2020-eng.pdf)

<sup>2</sup> OC-UNESCO. 2020. *Global Ocean Science Report 2020—Charting Capacity for Ocean Sustainability*. K. Isensee (ed.), Paris, UNESCO Publishing. More information on the *Global Ocean Science Report 2020* at:

<https://unesdoc.unesco.org/ark:/48223/pf0000375147>

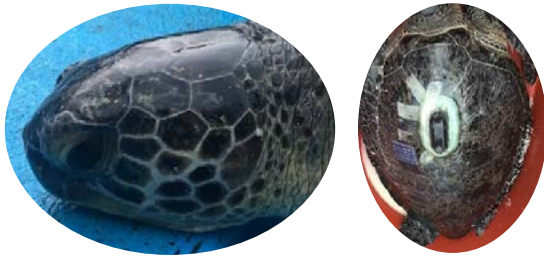
Your PICES science images- Feature: PICES Special Project: SEAturtle

# Seven sea turtles released with Iridium tags of PICES SEAturtle project in 2019 - 2020



**ID710313**  
First (green) sea turtle released in 2019

**ID710314 (released in 2019)**



PICES SEAturtle team in Korea released 7 sea turtles (6 greens and 1 loggerhead) with PICES iridium tags. In 2020, we ran a social media contest to name 5 of the released sea turtles. A total of 122 names were submitted by the public. Using this method, we were successful in increasing public awareness for the PICES SEAturtle project.

**ID718336\_Zevi (제비)**  
First loggerhead sea turtle



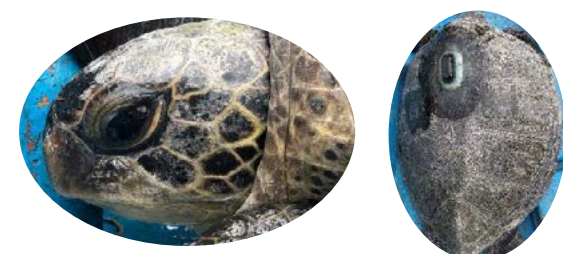
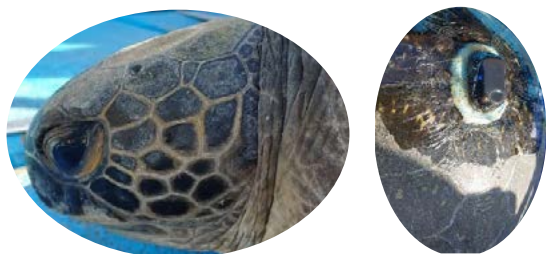
**ID710315\_Purunee (푸르니)**

**ID718338\_Bit-gyeol (빛결)**



**ID718339\_Parang (파랑)**

**ID718337\_Dol-mook (돌묵)**





Participants at PICES first MAFF project in 2009 practice their lab skills. Photo: Vera Trainer

### Call for images

People of PICES: do you have an interesting PICES science image to share in PICES Press? To have your image(s) considered, please email high-resolution .jpg or .tif files, along with a short caption and image credit to: [Lori.Waters@pices.int](mailto:Lori.Waters@pices.int)

Thank you!

### 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](#). Previous issues are online at: <https://pices.int/publications/pices-press/> Deadlines are June 1<sup>st</sup> and December 1<sup>st</sup> for Summer and Winter volumes, respectively.

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

**About PICES Press:** Published twice annually in July (Summer edition) and January (Winter edition), PICES Press is distributed globally to over 4500 PICES scientist members and institutions worldwide. Celebrating and highlighting the activities and achievements of PICES members - from participation in PICES-related programs and projects, to individual participation in PICES and PICES partner science symposia and other events - PICES Press is an important vehicle for sharing research and launching partnerships.

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