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2024 Intersessional Science Board Meeting - Note from the Science Board Chair

Sukyung Kang

Our annual intersessional Science Board meeting was held from May 7-9, 2024 virtually via zoom a month after the 2024 Ocean Decade Conference: initiating a new chapter of global ocean action in April 2024. The 3-day affair was attended by 11 SB members in addition to 3 Governing Council (GC) members, 8 invited guests, and 3 representatives from the PICES Secretariat. The Science Board (SB) welcomed two new committee chairs, Dr. Jackie King - FIS (Fisheries Science Committee) and Dr. Thomas Therriault - MEQ (Marine Environmental Quality Committee).

The first item on the Science Board meeting agenda was to look at the progress made to date by PICES' FUTURE (Forecasting and Understanding Trends, Uncertainty and Responses of North Pacific Marine Ecosystems) Scientific Steering Committee (SSC). The SSC reported the progress of their synthesis paper "Climate Variability and Ecosystem Resilience in the North Pacific: Lessons Learned from the

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PICES FUTURE Program" to be submitted to ICES Journal of Marine Science. The objectives of the paper include to evaluate the success of FUTURE in addressing a scientific plan, to identify gaps in scientific advancement, and to determine the cause of gaps to provide lessons learned for larger scale science programs. They also reported the planning of the FUTURE symposium to be held on Monday, October 28, following the Opening Ceremony at PICES 2024 annual meeting. The FUTURE symposium plans to review its past, assess the present, and discuss the future of FUTURE to better observations, improved awareness of mechanisms of change, and ultimately science for sustainability along with the United Nations Decade of Ocean Science for Sustainable Development and the mission of developing "the science we need for the ocean we want". They also emphasized bringing Early Career Ocean Professionals (ECOPs) into the future SSC membership for the success of FUTURE Phase III.

The United Nations Decade of Ocean Science for Sustainable development (UNDOS) (2021-2030) is approaching its halfway point. Sustainability of Marine Ecosystems through Global Knowledge Networks (SmartNet), the flagship ocean decade program of the International Council for the Exploration of the Seas (ICES) and PICES, has been very active since the last PICES annual meeting. SmartNet participated in workshops and conferences at the 2024 Ocean Decade Conference to refine and publish white papers addressing major ocean challenges and to promote the integration of different stakeholders in ocean science. They conducted global surveys to understand public perceptions and concerns about the ocean, which helps align UNDOS activities with public interests. In collaboration with other programs, SmartNet hosted monthly webinars to disseminate knowledge and foster discussions on the climate-fisheries nexus. Now, SmartNet is working on two papers. One is for a special issue on "A Vision for Capacity Sharing in the Ocean Sciences" of Oceanography Magazine and the topic is "Capacity building and capacity sharing programs: examples and best practices". The other is an article for ICES Journal of Marine Science 'Food for Thought' on Advancing Solutions for the Climate-Fisheries Nexus in the UN Decade of Ocean Science.

Updates also were provided by the two PICES Projects FishPhytO and BECI - Basin Scale Events to Coastal Impacts. FishPhytO is a follow-up project to the Ciguatera project (2020-2023). The primary objective of the project is to support coastal community fishermen, particularly small-scale fishermen in developing states, by providing them with a smartphone application. The project developed a smartphone app for fishermen to monitor fish and the coastal ecosystem. This app enables fishermen to record catch statistics and other relevant data from the coastal areas. Despite the successful setup in the first year, the project faced funding issues. I hope this will be solved smoothly.

Dr. Kathryn Berry, newly appointed as the BECI Science Director, reported updates of the BECI Project. There has been lots of progress this year. BECI is an initiative led by PICES and the North Pacific Anadromous Fish Commission (NPAFC) and is endorsed by the UNDOS. The primary goal of the BECI project is to enhance the understanding of the effects of climate change on North Pacific Ocean fish and fisheries, supporting forward-looking decision-making for fisheries and communities facing changing climate conditions. The project has received $1.1 million in funding from the British Columbia Salmon Restoration and Innovation Fund (BC SRIF) through the Government of Canada to set-up an initial project office and prepare science and implementation plans for BECI. The SB has expressed a few concerns to ensure the successful implementation and sustainability of the BECI project; redundancy with Ocean Decade Programs with similar terms of reference and deliverables, funding and implementation challenges etc.

A significant part of the meeting was dedicated to reports from the chairs of all PICES Scientific and Technical Committees about their activities since the PICES 2023 Annual Meeting. The SB reviewed the progress and planned activities of each Committee's subsidiary bodies. I am pleased to report that all Committees are doing well, except for a few delays. We also reviewed and evaluated 3 new expert group proposals (Advisory Panel on the Arctic Ocean and the Pacific Gateways (AP-ARC), Working Group on Sustainable Pelagic Forage Communities (WG SPF), Working Group on Ocean Carbon Negative Emissions for Carbon Neutralization (WG ONCE-CN)) and

recommended GC for approvals. The SB also recommended 6 months extension of its term of SG-GREEN (Generating Recommendations to Encourage Environmentally-Responsible Networking).

As the extent of PICES' science increases, we have had a number of collaborations and partnerships with other organizations. ICES is one of our longest and strongest partner organization relationships. ICES and PICES have collaborated on many activities over the past 30 years, including jointly sponsored symposia series such as the very successful 7th Zooplankton Production Symposium, which was held March, 2024 in Hobart, Australia (see the article related to this symposium in this PICES Press). In addition, PICES co-sponsored the Marine Socio-Ecological Systems Symposium (MSEAS) on "Managing for sustainable use of the Earth's marine and coastal systems" held June 3-7, 2024 in Yokohama, Japan with the ICES, NOAA Fisheries and FRA. The SB also reviewed collaborative frameworks with other international organizations: the International Pacific Halibut Commission (IPHC) and North Pacific Fisheries Commission (NPFC). Since the current MoU between IPHC and PICES was valid until January 14, 2024, FIS committee has reviewed the revision and SB recommended the renewed MoU to GC for approval. We also discussed the next cooperation with NPFC. The 5-year term of the PICES-NPFC framework for Scientific Cooperation will end at PICES-2024. NPFC Scientific Committee and relevant PICES Committees (FIS and BIO) shall work together on the revision of the framework to seek SB recommendation/GC approval at PICES-2024 and approval of NPFC Commission in close proximity.

The SB reviewed the new protocol for PICES 2025 Session and Workshop selection. We used to take workshop and session proposals for the following year during our annual meeting. However GC approved a new process for 2024 whereby the Session and Workshop proposal deadline be set two weeks after the end of the PICES Annual Meeting (GC decision 2023/S/14). I believe that the modified protocol will allow PICES experts sufficient time for the discussion and development of emerging ideas to be developed into proposals for the following year. So, I invite you to submit more intriguing proposals for the 2025 PICES Annual Meeting.

PICES has a beautiful tradition of recognizing our colleagues that have contributed significantly to PICES science. The Technical Committee on Data Exchange (TCODE) proposed the new PICES Award called "PICES Open Data Excellence Award" (PODA) to promote data sharing among PICES communities. SB regarded the establishment of the new award as beneficial for PICES science, and recommended to GC to approve the new PICES Award "PODA". I hope that more PICES' data related activities will be acknowledged through this award.

Finally, the next Annual Meeting (PICES-2024) will be held from October 28 - November 1, 2024, in Honolulu, USA. The overall theme of PICES-2024 is "The FUTURE of PICES: Science for Sustainability in 2030". We will organize this year's Annual Meeting a little differently. As I wrote earlier, the FUTURE symposium will be held on Monday (October 28) and the Special Panel on "PICES Science in the Next Decade" is scheduled before the closing ceremony (November 1). During the special panel, we will discuss future science priorities for PICES. The SB unanimously stressed the importance of synergy in the designs and outcomes of the FUTURE Symposium and the Special Panel. So, PICEANS! Please bring your novel and fresh ideas for the next steps of PICES science. I look forward to seeing you in Honolulu where interesting sessions and workshops, covering a wide range of topics, awaits!

Sukyung Kang
Science Board Chair

PICES at the United Nations

Sonia Batten and Enrique Curchitser

PICES received an invitation earlier this year from the United Nations (UN) Department of Ocean Affairs and Law of the Sea (DOALOS) to submit contributions outlining views on the topic "Sustainable fisheries management in the face of climate change" relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks, in preparation for the 17th round of informal consultations of States Parties to the Agreement, to be held at the UN headquarters in May.

As this topic is highly relevant to PICES, the Secretariat reached out to PICES expert groups seeking input on key findings related to the categories that DOALOS had provided, which were:

1. Experience in sustainable fisheries management in the face of climate change, including in relation to:
    a. Assessing the impacts of climate change in fisheries
    b. Addressing the impacts of climate change on fisheries
    c. Accounting for cumulative impacts
    d. Application of an ecosystem approach and the precautionary approach in the face of climate change.
    e. Incorporating economic, social and cultural aspects into sustainable fisheries management in the face of climate change.
2. Lessons learned, best practices, and challenges in sustainable fisheries management in the face of climate change
3. Actions needed to further strengthen sustainable fisheries management in the face of climate change, including to address particular challenges faced by developing countries through capacity-building.

We received comprehensive input from the following groups; WG34 (Joint PICES/ISC Working Group on Ocean Conditions and the Distribution and Productivity of Highly Migratory Fish), WG45 (Joint PICES/ICES working group on Impacts of Warming on Growth Rates and Fisheries Yields), FUTURE Science Program (Forecasting and Understanding Trends, Uncertainty and Responses of North Pacific Marine Ecosystems) and WG41 (Working Group on Marine Ecosystem Services) and were able to submit a report that summarized key findings and pointed to PICES products, papers, and reports produced by these groups. If you are interested in seeing the report, or for additional information, please contact Sonia.batten@pices.int and in due course it will be made publicly available as part of the proceedings.

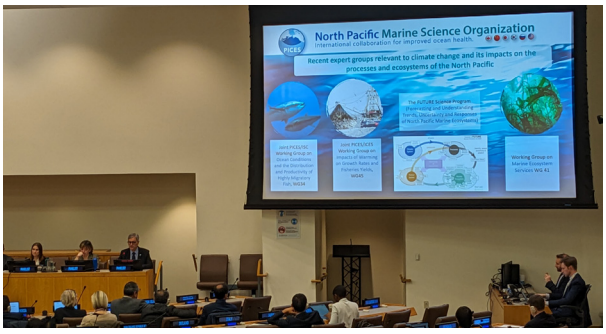
On the strength of this contribution, PICES was then encouraged to nominate someone to participate in a panel at the meeting that took place at the UN headquarters in New York. Since Governing Council have been considering applying for Observer status with the UN we decided this would be worthwhile, and in fact the PICES Chair was selected to join the discussion panel (one of five) on "Understanding the impacts of climate change on fisheries".

Traveling into New York, navigating the subway, obtaining security passes and then actually getting into the building was all part of the experience. It was clear that PICES activities are very relevant to this UN high-level activity. Other PICES members, Kirstin Holsman and Hannah Lachance, were also there in their national capacity representing NOAA and the US State Department. Professor Curchitser's panel presentation introduced PICES and some of its activities to many of the participants and covered the main messages from the PICES report. There was active discussion following the panel on various aspects of the challenges imposed by climate change on fisheries, including small scale fisheries. As Ratana Chuenpagdee from Memorial University, Canada, said, these are "too big to ignore and too important to fail".

A significant part of the panel discussion was on whether past fishing practices are a useful guide in the face of climate change. It was also acknowledged that transdisciplinarity includes indigenous, traditional and small-scale fishers' knowledge. Member states noted that incorporating environmental information into stock assessments can slow down the decision-making process and posed a question on how to deal with this. One answer, which came up in discussions more than once, was via partnerships and that continuing to build working relationships between social scientists, indigenous communities, government agencies, and between regional fisheries bodies can tackle the inclusion of climate change into management decisions and improve response times. Building and maintaining partnerships is central to PICES mission and its importance was reinforced by this UN meeting.

Sonia Batten
PICES Executive Secretary

Enrique Curchitser
PICES Governing Council Chair



PICES GC Chair, Enrique Curchitser, presenting at the UN

7th International Zooplankton Production Symposium

7th International Zooplankton Production Symposium: New Horizons for Zooplankton

Akash Sastri, David Kimmel, Toru Kabari, Hongsheng Bi

The 7th ICES/PICES Zooplankton Production symposium was held March 17-22, 2024 in Hobart, Australia. Attendees were from 38 countries and over half of the 318 participants were early career ocean professionals (ECOPs). This most recent gathering of marine zooplankton scientists was delayed by the Covid pandemic but typically takes place at 4-5 year intervals and was last convened in Bergen, Norway in 2016. The meeting focused on traditional disciplines and evolving themes in marine zooplankton research as reflected in the meeting theme, "New Horizons". The meeting consisted of five workshops and 16 topical sessions covering a variety of themes such as zooplankton time series and productivity, plankton imaging, emerging molecular applications, and functional and trophic ecology. PICES members were well represented in most sessions as presenters and/or session/workshop convenors.

The five workshops were held in advance of the opening ceremony and focused on bringing the zooplankton research community together around several themes. Workshops focused on developing reference databases for DNA sequences, time-series comparisons, morphological identification, tools and data resources for researchers, and improving access to zooplankton trait data. The workshops prepared the attendees for the opening plenary speaker, Dr. Angus Atkinson of the Plymouth Marine Laboratory, UK (Figure 1), who gave a talk titled "New dawn fades – returning to dark data during a zooplankton revolution." Dr. Atkinson focused upon the exciting role emerging technology is going to play in zooplankton research into the future, while also acknowledging the importance of our shared research history. Dr. Atkinson argued that new technology and traditional methods should complement one another and warned of a new dark age of data if we don't work to place our data into easily accessible and standardized environments. Of particular note was his observation that older, paper data were easier to work with than older, digital data.

As the meeting progressed, we observed emerging themes that appeared to cut across all of the sessions. There were many research presentations on how global warming is affecting plankton ecosystems and what will happen to these ecosystems in the future. The number of presentations regarding global warming in the present symposium was greater than those in the previous symposiums held in Hiroshima (Japan), Pucón (Chile), and Bergen (Norway). It is clear that the increasing number of such presentations is the result of the ecosystem changes becoming more apparent in the 2020s compared with prior symposia. Warming in polar regions made up a considerable portion of the research presented and,

Figure 1: Keynote speaker, Dr. Angus Atkinson

Session and Workshop List

Quote from a participant: "*Being in an interactive workshop beats jet lag*"

Session 1: Roles of gelatinous zooplankton in ecosystems: Production, population dynamics, trophic interactions and biogeochemical cycling

Session 2: Interactions between zooplankton and pollution in a changing ocean

Session 3: The role of zooplankton in the Biological Carbon Pump

Session 4: Shedding new light on zooplankton: Unveiling communities, ecology, and evolution through integrated approaches

Session 5: Zooplankton diets: Advancements in methods, models, and applications

Session 6: Applications of time series to track changes in zooplankton communities and impacts on ecosystem structure and function

Session 7: The role of microzooplankton in biogeochemical cycling and food webs

Session 8: Get it from the image: In situ imaging and spatially detailed observations of zooplankton for ecosystem studies

Session 9 and Session 12 merged: Impacts of zooplankton production and trophic interactions on fisheries recruitment in the ocean

Session 10: Zooplankton in changing polar oceans

Session 11: Advancements in zooplankton censusing and monitoring technologies

Session 13: Dynamics and role of diapausing copepods in marine ecosystems

Session 14: The role of zooplankton (including Antarctic krill) in Southern Ocean ecosystems in a changing world: Integrating across scales, disciplines, and methods

Session 15: Recent advances in global euphausiid ecology

Session 16: Improving zooplankton representation in models

Session 17: CANCELLED The forgotten plankton - Neuston

Session 18: General Session: Zooplankton production in the Anthropocene

Workshop 1: Reference sequence databases for global zooplankton biodiversity: Optimization, applications and user guidelines

Workshop 2: Today I Learned: Useful tools and data resources that every researcher should know

Workshop 3: Global plankton time series synthesis and comparisons

Workshop 4: Zooplankton morphological identification. Is it still necessary?

Workshop 5: Approaches towards findable, accessible, interoperable and reusable (FAIR) zooplankton trait data as stepping stones to improved functional ecology

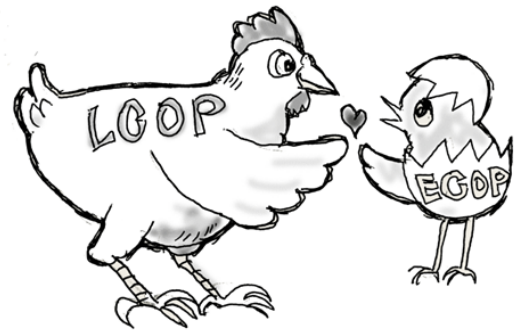
given Tasmania's proximity to the Southern Ocean, it was unsurprising that several sessions focused on Antarctic zooplankton research in general and krill in particular.

Research equipment, analysis techniques, and database access have advanced dramatically in recent years and a variety of new methodologies and approaches have emerged. In particular, zooplankton imaging systems combined with artificial intelligence/deep learning for data processing are being used across a variety of ecosystems to address ecological questions. Imaging technologies have uncovered phenomena that have not been recognized or evaluated before. We expect that these efforts will result in shifting paradigms in the coming years. A trend perhaps coincident with the increased use of imaging systems was the increase in presentations focusing on gelatinous zooplankton. Rather than being presented as trophic dead ends or a symptom of stressed ecosystems, gelatinous zooplankton presentations highlighted the important role these creatures play in trophic structure and dynamics of marine ecosystems.

Finally, there was also a clear reduction in the number of presentations focused on individual zooplankton or microzooplankton taxa and an increase in focus on zooplankton functional traits. These included talks on environmental DNA, size spectra, biochemical composition, and better approaches to incorporating zooplankton information into modeling. Improving zooplankton representation in models was a particular focus as zooplankton remain the largest source of uncertainty for the marine carbon cycle. A topic session addressed this directly, covering such diverse issues as constraining zooplankton grazing, modeling zooplankton from the stoichiometric perspective, and increasing interactions between observationalists and modelers. All of these new approaches are fascinating, but also present numerous challenges (integration into existing methods, data management, standardization, etc.) that will surely be the focus of much research in the coming years.

We noticed a very active and vibrant Early Carrier Ocean Professional (ECOPs) contingent at the meeting. In fact, over 50% of the participants were ECOPs. These early career professionals were present not only at the sessions and workshops, but also at numerous networking events and excursions (Figure 2). Compared with the previous symposium, this event provided many chances for ECOPs to interact with each other, network, and share their experiences.

Finally, we would like to say great thanks to the Local Organizing Committee, Scientific Steering Committee and PICES/ICES Secretariat for their great effort at the 7th Zooplankton Production Symposium. The Symposium was exceptionally well organized and executed in the limited time schedule. In particular, the local students and ECOPs provided great help and effort not only to support various social events but also to stimulate connections and discussions among participants. After COVID-19, all participants realized how critical meeting face-to-face is to advance our shared love of zooplankton research.

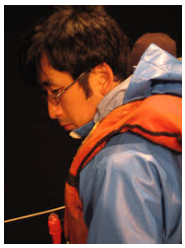


While new technologies are complementary and NOT replacing older technologies, ECOP are complementary and ARE replacing LCOP. And that's a good thing!

Figure 2: ECOPs

David Kimmel
(BIO, WG48 co-chair)
National Oceanic and Atmospheric Administration, USA

Hongsheng Bi
(WG48 co-chair)
Chesapeake Biological Laboratory , USA



Toru Kobari
(BIO)
Kagoshima University , Japan

Akash Sastri
(BIO, AP-NPCOOS, WG48)
Fisheries and Oceans Canada, Canada

7th International Zooplankton Production Symposium: We met again in Hobart-Nipaluna!

Sanae Chiba and Sonia Batten

Fifteen hours non-stop flight from Vancouver to Sydney, and one more hop to the heart-shaped southern island, Tasmania. How grand our Pacific Ocean is! PICES and ICES co-convened the 7th Zooplankton Production Symposium (ZPS) at the Hotel Grand Chancellor right next to the Waterfront Harbour of Hobart-Nipaluna, Tasmania.

The participants' diversity was well-balanced in terms of gender and age. Interestingly, more than half of the female participants were ECOPs, while only about one-third of the male participants were. This indicates a common demographic shift towards gender balance in the STEM field (Figure 1).

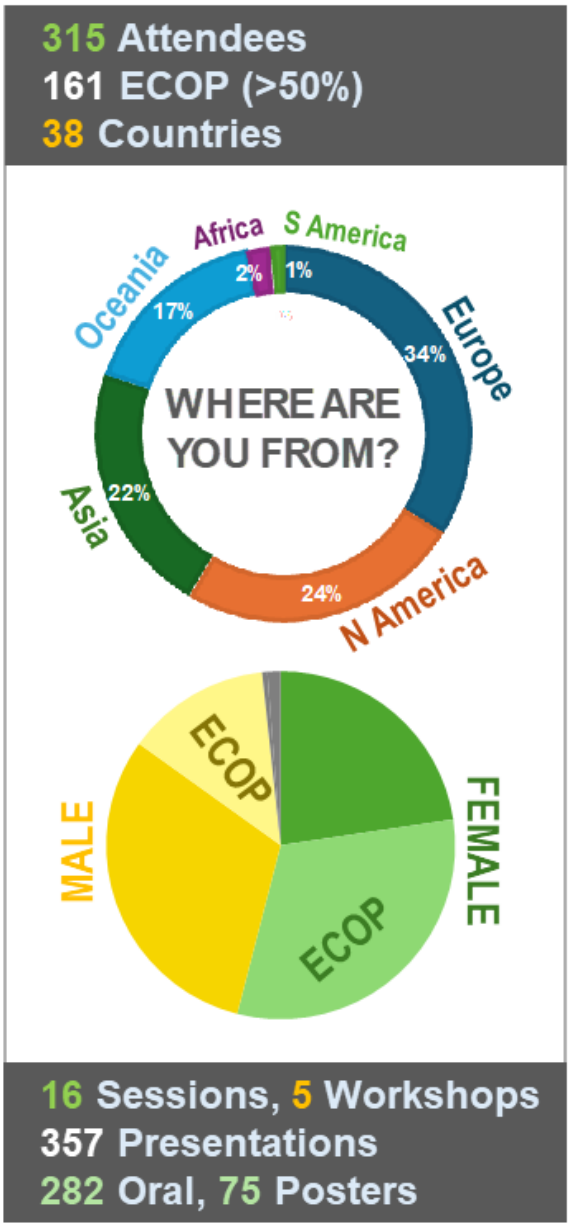


Figure 1: ZPS7 by the numbers

Evolution of ZPS

The history of ZPS dates back to 1961 in Charlettenlund, Denmark. It was revived in Plymouth, UK in 1994 and became a regular conference series after the 2003 meeting in Gijon, Spain. Subsequent meetings were held in Hiroshima, Japan in 2007, Pucón, Chile in 2011, and Bergen, Norway in 2016. The 7th meeting was held for the first time in Oceania.

The biology and ecology of zooplankton have been extensively studied as indicators of fisheries productivity since the early days. Over the past few decades, there has been a transformation in global ocean science-policy initiatives, as demonstrated by the evolution of GLOBEC to IMBeR, IPCC, and the Global Biodiversity Framework. This trend has broadened the focus of zooplankton science, expanding from their role in coastal and pelagic food webs and biogeochemical cycles to include their use as indicators of climate and anthropogenic impacts on marine biodiversity and ecosystem health.

How have hot topics in zooplankton science changed in the past decade? We analysed the words used in the presentation titles at the Pucón meeting in 2011 and at this meeting. It is no surprise that microplastics and DNA metabarcoding are popular terms in 2024. Also, language related to methodology and approaches such as "monitoring", "assessment", "data", "functional", and "indicator" became "hot". In contrast, the taxonomic names which were commonly used in titles in 2011 are less popular in 2024, suggesting a clear shift in the community's interests from understanding species to understanding the system and applications of data. To our regret, Session 17: The forgotten plankton – Neuston, was cancelled at ZPS7. We hope they are not forgotten.

Take home messages

Surprisingly, the key note speaker, Angus Atkinson, mentioned that accessing old data from paper-based records is.....much easier compared to digital data. This is because digital media technology changes rapidly (remember floppy disks?) and it's challenging to access the contents once the necessary readers become unavailable. The worst-case scenario occurs when the data are stored only in the original database and are at risk of being lost forever in a "data black hole" (Figure 2). The lesson learned from this is to share the data in a globally standardised format in a global data hub before it's too late; in other words, ensure the FAIR (findable, accessible, interoperable and reusable) data principle. Not surprisingly, Angus's messages "new technology and traditional methods can be complementary, not a replacement" and "share your data before it's too late" were reiterated throughout the symposium sessions.

1. New technologies and traditional methods as complementary

We see the ZPS community as a crucial place to develop and maintain the bridge combining data collected by new

Once upon a time, video killed a radio star, and more recently Netflix killed DVD...
New tech comes and goes quickly. Share your data before they are sucked into a data black hole.

Figure 2: Data black hole

technologies and traditional methods. New in situ imaging techniques are beneficial for analysing detailed variability on a small spatio-temporal scale, while traditional methods can reveal large-scale phenomena. Morphological taxonomy is still necessary to validate advanced molecular-based taxonomy.

Quote from a genetics expert "We need [microzooplankton taxonomic] experts!"

2. FAIR data principle in the zooplankton Big Data Era

New in-situ imaging technology coupled with AI approaches and molecular-based analysis enabled scientists to gather a large volume of taxonomic-level and/or trait-based data of high spatial resolution in a relatively short period. The soundscape technique helps us to reveal "what they do in the shadows" for even individual zooplankton. Image banks and trait-based databases are being developed. The Big Data Era has come to zooplankton science. But this presents new challenges: how can we make full use of massive, complex data and ride the wave (Figure 3) (hello TCODE!)? Data sharing, standardisation and interoperability are crucial for advancing not just zooplankton science, but also ecosystem change studies. It's worth noting that four out of five workshops highlighted, or were relevant to, the FAIR data principle.

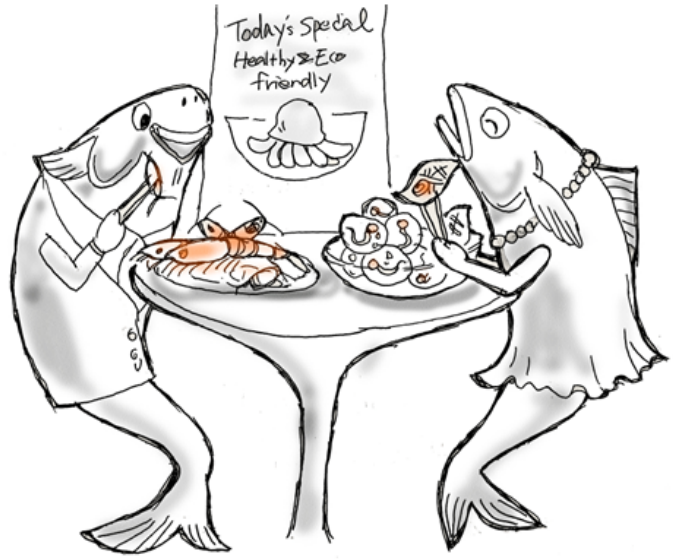
3. Gelatinous is not a dead-end of the food web

Gelatinous zooplankton biology and ecology are not a new topic at ZPS, particularly regarding negative impacts on fisheries and the association with ocean warming of their mass occurrence. However, ZPS7 suggested that the view on their ecological roles is transforming from being considered a dead end of the food web to an alternative trophic pathway in a warming, oligotrophic world (Figure 4). Gelatinous zooplankton comprise one-third of the Arctic's biovolume and are a major food

component of fish larvae. Increased collaboration between ichthyoplankton and zooplankton experts is needed to incorporate zooplankton including gelatinous data into stock assessment analysis. We may need to reconsider the representation and parameters of the "Z" boxes of nutrient-phytoplankton-zooplankton-detritus (NPZD) models.

We are in an era of big data, how can we make full use of this complex data and ride the wave?

Figure 3: Big Wave is coming



Gelatinous zooplankton is not the end of the food web, maybe an alternative trophic pathway in a warming, oligotrophic world?

Figure 4: Trendy new seafood

Sanae Chiba
PICES Deputy Executive Secretary

Sonia Batten
PICES Executive Secretary

To Fill the Big "Z" and Zooplankton Strike Back

by Sanae Chiba

One of the most crowded presentations at ZPS7 was the Invited talk by Anthony Richardson "Global zooplankton trends over the past 90 years." Back in 2010, I was struck by Boyce's paper on the global decreasing trend of phytoplankton production using a historic observational dataset (Boyce et al. 2010, doi:10.1038/nature09268). Many zooplankton scientists thought "We should do the same for zooplankton". But zooplankton were collected for various purposes, and there are no standardised methods to measure its production on a global scale. We cannot even use remote-sensing techniques to observe zooplankton. Therefore, it was my great pleasure to learn that Richardson's group took the challenge and adjusted the measurement differences, aiming to standardise several hundred thousand measurements of zooplankton biomass collected globally.

Zooplankton functional diversity has been an obstacle for the earth system model. In the mid-2000s, I was appointed to lead the marine ecosystem model group although I was a zooplankton biologist with zero experience in developing models. The group was developing large-scale biogeochemical process and prediction models coupled with a global change scenario. The scientists tried to break down each component of the P (phytoplankton) and Z (zooplankton) boxes of the NPZD model based on the plankton traits for better parameterisation of complex biological processes. Different from P, phytoplankton, zooplankton trophic levels vary depending on the species and life stages and even an individual animal changes their feeding traits, from plant eater to omnivore to predator, depending on environmental conditions. How can we model zooplankton production and its role in the global biogeochemical cycle? My instinct said the attempt would just increase uncertainty. "Z" is still a huge black box of the earth system model today. However, creative solutions may be brought but only when we become able to effectively navigate the big zooplankton data era and ensure the FAIR data principle.

On a side note, when I was feeling stuck studying zooplankton in the context of the biogeochemical cycle and ecosystem modelling, a senior colleague gave me a pearl of wisdom "There are other ways to enjoy zooplankton". Soon after the premonition, the Census of Marine Life 2010 was kicked off. Following a recommendation of the Convention on Biological Diverisy signatories at Nagoya, the United Nations declared 2011 to 2020 as the United Nations Decade on Biodiversity and the Convention's Strategic Plan for Biodiversity 2011-2020 shed new light on zooplankton diversity as a natural asset to preserve. Zooplankton strike back!

7th International Zooplankton Production Symposium: ECOP Experience

Alexis Bahl, Patrick Pata, Junya Hirai, Andreas Novotny, and Jeong-Hyun Kim

About your research

Alexis A. Bahl gave two talks and one poster presentation at ZPS7. Her first talk, in Session 14, focused on Southern Ocean salp species, *Salpa thompsoni*, stage and size-specific migration and its influence on carbon flux in four distinct areas of the Southern Ocean. Alexis stated that "this work is still in progress but I hope it sheds light on the role of *S. thompsoni* on biogeochemical cycling in the Southern Ocean and the importance of representing life cycle stage, which was found to result in significant estimate variations." Her second talk, in Session 1, showcased the extensive Antarctic Krill literature review she conducted with her colleagues affiliated with the Integrating Climate and Ecosystem Dynamics in the Southern Ocean (ICED) working group.

Patrick Pata presented in session 16 and talked about how the Global Zooplankton Trait Database he compiled during his PhD could be used to evaluate model outputs by allowing users to delineate zooplankton functional groups, provide model parameterization, and estimate community-level processes from empirical data. Patrick also co-organized Workshop 5 on Approaches towards findable, accessible, interoperable and reusable (FAIR) zooplankton trait data as stepping stones to improved functional ecology. Patrick states that " during the workshop, I presented some insights from my PhD research, but I mostly facilitated the activities and inspired discussions between the participants about traits and data."

Junya Hirai gave two oral presentations at ZPS7 titled 'Reference sequence data for marine zooplankton in the era of high-throughput sequencing' in Workshop 1 and 'Copepod-virus interactions revealed by molecular and morphological approaches' in Session 4. Junya states ,"I introduced my ongoing research for zooplankton diversity using molecular approaches, including DNA metabarcoding and genome skimming." The other presentation focused on the possible impacts of marine viruses on the population dynamics and physiology of copepods, highlighting how unexplored they are. Junya is motivated to reveal marine virus diversity and ecological roles using both morphological and molecular methods.

Andreas Novotny presented results from both his PhD project and ongoing postdoc. Both projects focused on how sequence abundance data from DNA metabarcoding can be used to make meaningful conclusions about marine communities. In the methods-focused session 4, Andreas showed how eDNA-indices can be used to accurately study the seasonality and depth structure of zooplankton. He also co-convened session 5, which focused on zooplankton diets, stating, "here I demonstrated how DNA metabarcoding of zooplankton diets can provide a quantitative measure of active feeding selectivity, thereby adding functional diversity to food web models. For instance, when accounting for zooplankton feeding selectivity in a Baltic Sea food web model, cyanobacteria are revealed as the main source of primary production in the food web."

Jeong-Hyun Kim attended ZPS7 with the PICES travel grant for ECOPs (Early Career Ocean Professionals) and gave an oral presentation in Session 3 titled, "Long-term monitoring of zooplankton-mediated fecal pellet carbon fluxes in the Pacific Arctic region". This work presented the contribution of fecal pellet carbon fluxes to the particulate organic carbon fluxes using the long-term sediment traps deployed over the East Siberian and Chukchi Sea slopes from August 2017 to August 2019. One of the key findings was the enhanced export of fecal pellets over the Chukchi Sea slope in the presence of ice. Jeong-Hyun said, "this suggests that overwintering copepods were grazing on particles laterally transported, and fecal pellets were occasionally an important carbon source during the ice-covered period."

Science: What was your highlight of the meeting, what did you like and not like?

The Symposium offered a wealth of scientific insights and professional opportunities, leaving all scientists with much to reflect upon. Alexis Bahl found particular joy in the extensive research on salps, a subject close to her heart. She was thrilled by Paola Batta-Lona and Svenja Mueller's talks on salp transcriptomics and metabarcoding of diets and how the speakers highlighted the advanced understanding we are gaining on salps and their role in ocean food webs and carbon cycling. Alexis highly valued the conversations she had with long-admired experts and colleagues she had worked with online for years but never met in person. Similarly, Junya Hirai stated "It is difficult and challenging to have a deep discussion on molecular ecology of marine zooplankton in a domestic conference in Japan; however, during ZPS7, I had a lot of opportunities

Beach in Hobart-Nipaluna, Tasmania

to talk with zooplankton experts working on zooplankton diversity using molecular techniques."

During the symposium, many exciting presentations sparked curiosity for the scientists, making it difficult to narrow down key highlights, they all mentioned. Jeong-Hyun Kim was most impressed by a presentation given in Session 10, which presented the results of the MOSAiC Expedition led by the Alfred Wegener Institute, revealing surprising insights into the zooplankton in the central Arctic Ocean during the polar night. He said, "one finding was that minor calanoid copepods in deep waters are more active and mature year-round, suggesting their important role in the plankton community." The symposium also highlighted some great initiatives for increased reproducibility and collaboration, such as the Metazoogene working group for DNA sequencing, and the workshop on FAIR zooplankton trait databases, as said by Andreas. The workshop mentioned was co-organized by Patrick Pata, a highlight for him during the Symposium, stating "We were wonderfully surprised that about 50 participants were very engaged and the energy in the room was up the entire day, despite most of us feeling jet lagged." He went on to say that "it was heartwarming to see everyone from different career stages get excited, interact, and discuss supportively. I am very thankful to my co-organizers and all the participants. I hope that many fruitful collaborations come out of this workshop. It would be awesome to have a similar workshop and a session on trait-based approaches during the next Zooplankton Production Symposium."

The diversity of talks interested Alexis, Patrick, Junya, Andreas, and Jeong-Hyun, leaving each of them inspired and eager for the future of zooplankton research.

More than Science: What was your highlight of the meeting, what did you like and not like?

ECOP Social event

More than the science, ZPS7 offered personal experiences that left all scientists with enriching discussions and lasting memories. Jeong-Hyun Kim said enthusiastically, "ZPS7 was like a concert for zooplankton scientists!" His primary goal was to find an international mentor who could provide ongoing support, especially since this was his first time traveling alone to another country. A suggestion by Jeong-Hyun for future symposia included organizing a mentor-mentee matching system to better support ECOPs looking for guidance. Alexis shared a similar sentiment, "Being amongst hundreds of zooplankton experts was amazing! I've been fortunate enough to attend a handful of conferences throughout my PhD, but at these conferences, rarely were there more than 20 zooplankton experts people in attendance." Doing a PhD during the pandemic - an experience shared by Alexis, Andreas, and Patrick - limited in-person engagement. Andreas said, "this was the first real opportunity for me to present my results to the scientific community and network with zooplankton ecologists. It was great to meet with zooplankton fantasts, get some faces to the familiar names, and start building a network". Getting to meet many familiar names and hanging out with fellow ECOPs was a highlight for Patrick Pata, stating that he wished "there were a few more areas to decompress or casually chat at the venue, but overall, the space and food was great."

The Symposium Dinner took place on Thursday, commencing with a boat ride that occurred at sunset, allowing for incredible views. Particularly memorable was all of the dancing that took place that night. Patrick said, "I think that how people have fun at a party is a great way to get to know someone and I'm very pleased to see that many zooplankton scientists know how to bust a move!" It's fair to say that for all attendees like Alexis, Patrick, Andreas, and Jeong-Hyun, the sense of community, opportunities for networking, and memorable social events left a lasting impression.

What would you do, be, hope to do, hope to be in the next 5 years?

Junya Hirai responds, "Technologies are rapidly developing, and I cannot imagine what I will do in the next 5 years. However, I hope I can continue my own research into 'molecular ecology of zooplankton' and reveal mechanisms of global diversity of marine zooplankton." He says when speaking about reaching this goal, "This is not possible only by myself, and It's nice if I can have a lot of collaborations with other researchers in the world. I also hope to develop my research field of molecular ecology of zooplankton by teaching and mentoring students. Finally, I definitely wish to present some of my future research at the next zooplankton production symposium."

"Oh goodness, the golden question", says Alexis, "This is still difficult for me to answer because 5 years ago I never imagined myself even giving a talk at a conference like the Zooplankton Production Symposium - my path has so many more surprises than I ever could have dreamed." Alexis is motivated to first, finish her PhD, and afterward, continue Southern Ocean-focused research with a focus

on improving the representation of zooplankton in biogeochemical models. She also loves teaching and mentoring and is seeking a future position that would allow for tandem research and teaching.

Similarly, Jeong-Hyun Kim hopes to complete his PhD within the next two years, and once he graduates would like to find a postdoctoral position at an institute or university, preferably overseas. He goes on to say, "The opportunity to communicate with experts from different countries during ZPS7 motivated me to go abroad. Given the large scale of the ocean, I believe that international experiences can provide more and better ideas."

Patrick Pata says, "I want to expand my research on trait-based approaches and engage in new questions and collaborations. I hope to facilitate how more researchers can utilize and contribute trait data with the Global Zooplankton Trait Database. Other than that, my work so far has been focused on the North Pacific Ocean and I would love to explore the rest of the other oceans!"

As Andreas Novotny starts to build his own research group, his 5-year goal is "to focus on bridging the gap between molecular ecology and food web modeling, to better understand the role of plankton diversity in food web structure and functioning." He also stated, "In five years, at ZPS8, I hope to meet many well-known faces and colleagues that I have kept contact with and started fruitful collaborations with."

Where will zooplankton science go in the next 5 years?

The next five years in zooplankton science will be transformative, driven by advancements in imaging technology, data accessibility, FAIR data standards for improved reproducibility, and interdisciplinary collaborations. All scientists mentioned imaging techniques as a pivotal tool that will be incredibly useful for uncovering the diversity and organismal traits of zooplankton, especially gelatinous organisms in mesopelagic and bathypelagic zones, and an opportunity to better understand behavior. Similarly, the increased use of eDNA has helped us to better understand the patchiness of zooplankton and what processes are driving their distribution, stated Andreas Novotny, and agreed by Jeong-Hyun Kim. Junya Hirai highlighted the combination of imaging techniques and high-throughput sequencing as important for providing new ecological insights and addressing environmental issues. With that said, all scientists stressed the importance of complementing new techniques with traditional ones. Andreas Novotny commented, "I hope that we have not broken the continuity of the traditional sampling methods, but rather that we better appreciate how methods can complement each other." Jeong-Hyun Kim made a similar comment referencing keynote speaker, Dr. Angus Atkinson, and how during his talk in the opening ceremony, he highlighted the value of traditional methods and the need to complement the new techniques with the traditional. Alexis Bahl thinks that, in the next 5 years, zooplankton science will play a significant role in strategizing effective management, informing the designation of marine protected areas, and aiding in forecasting the ocean's response to ongoing environmental pressures. Junya Hirai had a similar comment, stating the importance of thinking about how zooplankton researchers can contribute to solving new environmental problems such as the rise of microplastics and heatwaves. Now, more than ever, all scientists said that international collaborations, such as working more closely with physical and chemical oceanographers, developing new insights into how zooplankton adapt to changing environmental pressures, and the influence this has on fisheries and climate. A key part of improving the science over the next 5 years is increasing the accessibility and interoperability of data and methods, producing reliable and reproducible data that are shared openly and transparently, and increasing the necessary funding to conduct field, lab, and computational zooplankton research.

If you were a zooplankton, which species you would be and why?

Patrick Pata would be a *Clione limacina* - "It is so gorgeous, specialized, and fierce. I even have a tattoo of it!" Andreas Novotny says, "after a full lifetime fighting deadlines in academia, I need to be reborn as the moon jellyfish, *Aurelia aurita*." Jeong-Hyun Kim answered saying, "if I were a zooplankton, I would belong to the copepod genus Paraeuchaeta. They are known as carnivores, which means they have passionate activity towards targets. I am always taking on challenges to achieve my dream. My visit to ZPS7 was like active feeding for me. I am deeply grateful to PICES/ICES, organizers, and others for providing me with such a remarkable experience."

Alexis A. Bahl is a Ph.D. Candidate and Four-Year Scholar with the University of British Columbia's Department of Earth, Ocean, and Atmospheric Sciences and a 2022 National Geographic Explorer. Her dissertation research analyzes field-collected Southern Ocean salp net and optic data with statistical and individual bioenergetic modeling methodological approaches. In addition to this research, Alexis serves an active role with the Integrating Climate and Ecosystems Dynamics (ICED) in the Southern Ocean working group where she collaborates with an international community on research projects centered around improving the scientific understanding of Antarctic Krill to support improved fisheries management in the Southern Ocean. In her previous Research Assistant role with Johns Hopkins University Earth and Planetary Sciences Department, she examined the influence varying isopycnal parameterizations have on ocean deoxygenation in a suite of Earth System Models. She holds an M.Sc. in Environmental Sciences and Policy from

Johns Hopkins University and a B.Sc. in Environmental Science from Loyola University Chicago.

Patrick Pata is a biological oceanographer who grew up in the Philippines and is currently based in Vancouver, Canada. He completed his Ph.D. in 2024 at The University of British Columbia. Patrick is most interested in understanding the oceanographic and ecological drivers of zooplankton distributions and how the emergent spatiotemporal trends translate into ecosystem functions and services.

Junya Hirai is an assistant professor at the Atmosphere and Ocean Research Institute, The University of Tokyo. He obtained his B.Sc. from the University of Tokyo and M.Sc. from University of Southampton. He completed his Ph.D. in 2014 at Atmosphere and Ocean Research Institute, The University of Tokyo. Subsequently, he did his postdoctoral research at the Japan Fisheries Research and Education Agency for three years. Junya's work aims to uncover zooplankton diversity in the global oceans, and a major part of his research is on large-scale genetic and species diversity of zooplankton using cutting-edge molecular techniques. He is also interested in revealing prey-predator relationships of zooplankton in marine food webs using his molecular techniques. He is a member of the Scientific Committee on Oceanic Research working group #157 MetaZooGene, collaborating globally with other zooplankton molecular ecologists.

Andreas Novotny is a marine molecular ecologist and postdoctoral researcher at the University of British Columbia. Andreas completed their Ph.D. at Stockholm University in 2021 researching the functional diversity and feeding behavior of zooplankton using DNA metabarcoding. In their current research project, Andreas uses eDNA to study all components of the marine food web (from bacteria to fish) and is especially interested in the application of DNA techniques for ecosystem-based monitoring and management.

Jeong-Hyun Kim (jeonghkim@kopri.re.kr) is a Ph.D. student at the Korea Polar Research Institute campus of the University of Science and Technology, South Korea. His research is focused on the contribution of zooplankton in the biological carbon pump and the zooplankton image analysis using an in situ imaging sensor.

ZPS7 attendee group photo

Ocean Decade Conference - Barcelona
10-12 April 2024

Ocean Decade Conference - Barcelona:
PICES at The Barcelona Conference of the UN Decade of Ocean Science for Sustainable Development

Steven J. Bograd, Enrique Curchitser, Juri Hori, Shin-ichi Ito, Khushboo Jhugroo, Mitsutaku Makino, Raphael Roman, Naya Sena, and Pengbin Wang

The UN Decade of Ocean Science for Sustainable Development (Ocean Decade; 2021-2030) held an international Conference in Barcelona, Spain, in April 2024, where 1,500 attendees from 124 countries (and 3,000 virtual participants) gathered to assess Ocean Decade progress and establish priorities for the remainder of the Decade. Here we present a few highlights and describe the roles and activities that PICES members played at the Conference (Figure 1).

The Conference was hosted by the government of Spain and co-organized by the Intergovernmental Oceanographic Commission of the UN Educational, Scientific and Cultural Organization (IOC-UNESCO). The main Conference was held at the Barcelona International Convention Centre on April 10-12th, and, in addition, there were more than 100 satellite events held in the Convention Center and at venues around Barcelona throughout the week. A primary objective of the main Conference was to review and provide input on a set of 10 draft White Papers associated with the 10 Ocean Decade Challenges, which were prepared by 10 corresponding Working Groups prior to the Conference (IOC-UNESCO 2024a). These white papers identify Ocean Decade priorities for generating knowledge and science-based solutions for each Challenge. Each day of the main Conference focused on a subset of these Challenges, with plenary speakers and panel discussions in the morning and parallel sessions on the white papers in the afternoon. The Decade Challenge sessions included a brief review of the draft white paper, a few short presentations associated with the theme of the Challenge, and a moderated discussion with Session participants to provide input on the white papers. Steven Bograd (Co-Chair of PICES Advisory Panel on the UN Decade of Ocean Science, AP-UNDOS) and Rebecca Martone (Executive Director of the Northeast Pacific Decade Collaborative Center) helped to moderate the sessions focused on Challenge 2, 'Protect and restore ecosystems and biodiversity'. Shin-ichi Ito contributed to Challenge 1, 'Understand and beat marine pollution', Yoko Tamura contributed to Challenge 3, 'Sustainably feed the global population', and Raphael Roman contributed to Challenge 9, 'Skills, knowledge and technology for all', as speakers and panelists of the parallel sessions. PICES members also served on several of the Ocean

Figure 1: PICES members at the UN Decade of Ocean Science for Sustainable Development Conference in Barcelona, Spain, in April 2024 (not shown: Juri Hori and Naya Sena).

Decade Working Groups: Sonia Batten and Fangli Qiao on Challenge 5, 'Unlock ocean-based solutions to climate change'; Erin Satterthwaite on Challenge 7, 'Expand the global ocean observing system'; and Li Li on Challenge 9.

In addition to the main event, PICES members co-organized and participated in a number of the satellite events held in conjunction with the Ocean Decade Conference. PICES member Mitsutaku Makino organized a **SmartNet** (Sustainability of Marine Ecosystems through global knowledge networks) sponsored satellite event titled 'What is the Ocean We Want? A Global S-urvey to Understand Perspectives on Ocean Decade Outcomes', which was held at the Barcelona Biomedical Research Park of Institut de Ciències del Mar Barcelona on April 9th, 2024 (Figure 2). Event organizers provided an overview of the SmartNet Program, described the objectives of the SmartNet-led 'Ocean We Want' global survey, and reported on results from the pilot surveys held in the USA, Japan, France, and Australia. This was followed by a scoping panel attended by several ICES/PICES members: Yutaka Michida, Steven Bograd, Olivier Thebaud, and Naya Sena, and moderated by ICES General Secretary Alan Haynie.

The **SUPREME** (SUstainability, Predictability and REsilience of Marine Ecosystems) Program co-sponsored a satellite event, organized by Yuntao Wang from the Second Institute of Oceanography of China and the Decade-endorsed MoNITOR (Mitigation of Natural Incidence to Ocean Resilience) Project, titled 'Promoting a Healthy and Sustainable Marine Ecosystem along the Coastal Regions by Developing Observing and Modelling Systems', which was also held at the Barcelona Biomedical Research Park of Institut de Ciències del Mar Barcelona on April 9th, 2024. Steven Bograd gave a brief overview of SUPREME and Yuntao Wang gave a presentation on the progress and plans of the MoNITOR Project.

PICES members participated in a number of other satellite events, including as an invited participant in 'Shaping IPOS: Southern Perspectives on Optimising the Science-Policy Interface', organized by the Intergovernmental Panel on Ocean Sustainability and attended by Khushboo Jhugroo, Steven Bograd, and Enrique Curchitser, PICES Chair. This event was designed to hear perspectives and insights from Global South and other marine experts on how best to advance the ocean knowledge-decision interface.

A vital component of SmartNet and AP-UNDOS (PICES Advisory Panel on United Nations Decade of Ocean Science), and of PICES more broadly, is the inclusion of Early Career Ocean Professionals (ECOPs) in all of our activities. SmartNet served as co-sponsor of two well attended satellite events organized by the Ocean Decade Global ECOP Programme: 'Building Ocean Leadership: Fostering Networking, Creativity, and Resilience' and 'The Inclusivity We Need for the Ocean We Want' (Figures 3,4). PICES also supported the Conference participation of two ECOPs, Khushboo Jhugroo and Naya Sena, who represented PICES at several Conference events. Khushboo, Naya and Raphael Roman, the Ocean Decade ECOP Coordinator for Asia and Co-Chair of PICES AP-ECOP, participated in the Conference

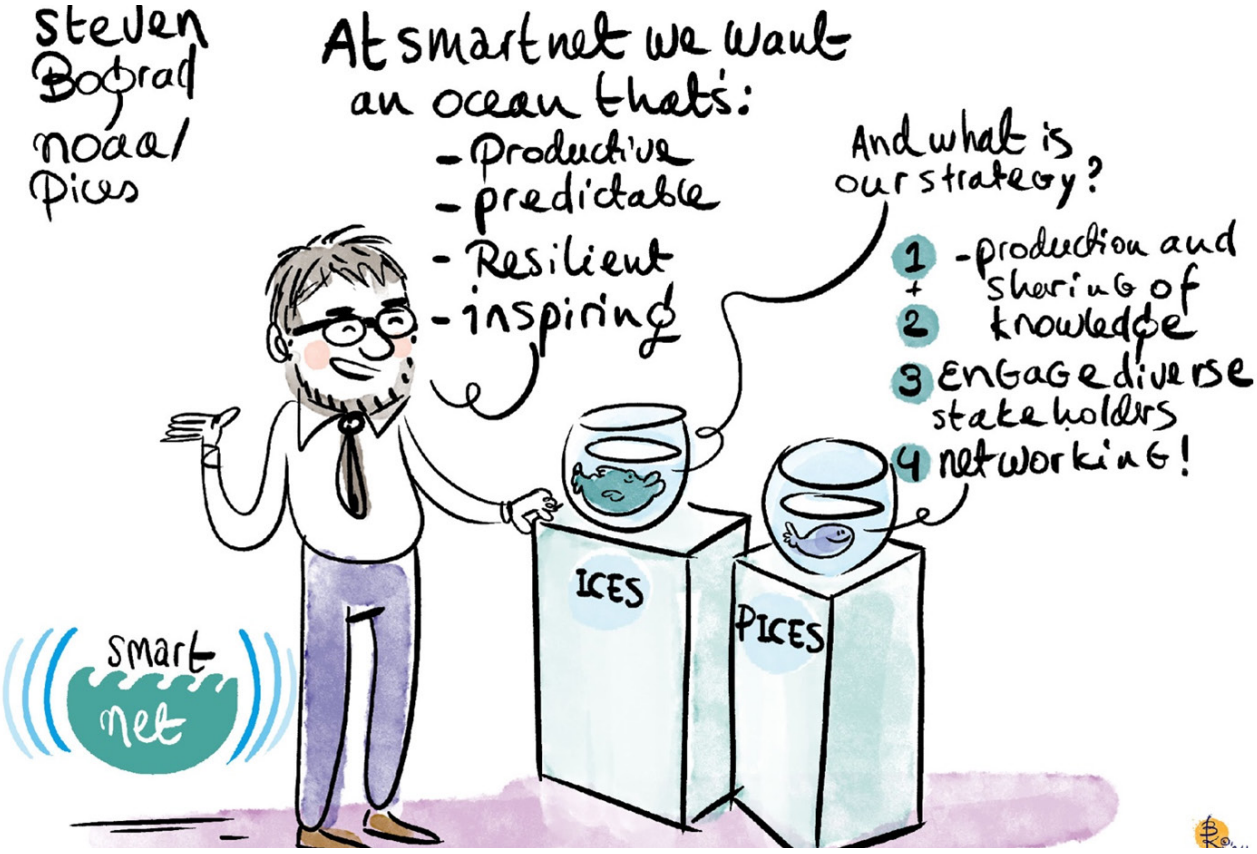


Figure 2: One of the illustrations created at the SmartNet 'Ocean We Want Survey' satellite event by artist Bass Kohler.

The inclusivity we need for the Ocean we want

Tuesday 9 April

14:30 - 16:30

Barcelona Capital Nautica

37 Passeig Marítim de la Barceloneta, Barcelona, CT 08003

This satellite event seeks to identify the systemic barriers that lead to the exclusion of underrepresented groups and communities, thus preventing true inclusivity in ocean conservation and governance. On that basis, the event will facilitate discussions around concrete ways to include and amplify the voices of underrepresented groups in high-level national and international fora, spanning from nations in the Global North and the Global South. A major outcome of this discussion is a list of joint statements and recommendations to be considered in high-level processes.

RSVP: https://inclusivity.splashthat.com

RSVP

Figure 3: Poster for the UN Ocean Decade Conference satellite event 'The Inclusivity We Need for the Ocean We Want', which was organized by the Ocean Decade Global ECOP Programme and co-sponsored by SmartNet.

in numerous capacities, including as session speakers and event panelists (see their accompanying article in this issue of PICES Press; Figures 4,5). In addition, Naya organized and moderated meetings between ECOP groups from Africa and the Global Coordinator of the ECOP Program, Evgeniia Kostianaia. She also had the opportunity to meet informally with the President of Cabo Verde, the inaugural speaker of the Opening Ceremony and the current Patron of the Ocean Decade Alliance. All three ECOPs actively engaged with Conference attendees, contributed to many satellite events, amplified the voices of other ECOPs, and expanded their networks and opportunities for collaboration. Khushboo, Naya and Raphael are key players in developing transformative science in support of SmartNet, AP-UNDOS, the Ocean Decade, and PICES.

The Ocean Decade Conference culminated in the Barcelona Statement, which synthesized Conference activities and discussions to identify future priorities for ocean knowledge, science generation, and uptake; priority ocean science infrastructure needs; and priority cross-cutting issues (IOC-UNESCO 2024b). A critical component of these priorities focuses on the needs of Small Island Developing States (SIDS), Least Developed Countries, and under-represented communities. With these priorities identified, the Ocean Decade made several major announcements and commitments at the Conference:

- Launch of new Ocean Decade programs on sustainable ocean planning, and on sustainable ocean management in Africa.
- Commitment by the Barcelona City Council and the Port of Barcelona to develop a Decade Collaborative Centre focusing on sustainable ocean economy.
- Launch of the Ocean Matcher Tool to enhance opportunities for philanthropic funding to Decade Actions.
- Launch of new funding opportunities for Africa through the Belmont Forum and SIDS through the Marine Institute, Ireland.
- Launch of the Cities with the Ocean Platform to enhance the use of science for policy and decision making by coastal cities, including the offer of Qingdao Municipality to host the first Ocean Decade Coastal Cities Conference in 2025.

Finally, Conference organizers closed with the following Call for Action:

- Engage strongly in the Ocean Decade including through the proactive development of partnerships and collaboration for the co-design and co-delivery of transformative Decade Actions that translate the priorities identified during the Conference to tangible action.
- To significantly increase investment of in-kind and financial resources in ocean science, including the development of policies and innovative financial instruments, thus ensuring the sustainability of existing and future Decade Actions, structures, and processes that are collectively working to fill the priorities identified during the Conference.
- Seize all opportunities to raise awareness and visibility of the Conference outcomes and The Barcelona Statement as an essential guiding framework for global ocean science and knowledge priorities in the lead-up to the 2025 United Nations Ocean Conference.

PICES has an important and leadership role to play in advancing these priorities and ensuring that the Ocean Decade succeeds in leading us towards the 'ocean we want'.

Figure 4: ECOP organizers and participants in the UN Ocean Decade Conference satellite event 'The Inclusivity We Need for the Ocean We Want', which was organized by the Ocean Decade Global ECOP Programme and co-sponsored by SmartNet.

Figure 5: Raphael Roman giving a presentation at the Challenge 9 Session at the UN Ocean Decade Conference in Barcelona, Spain, on April 12th, 2024.

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IOC-UNESCO (2024b). 2024 Ocean Decade Conference – The Barcelona Statement, https://oceanexpert.org/document/34098.

Ocean Decade Conference - Barcelona:

PICES ECOPS at The Barcelona Conference of The UN Decade of Ocean Science for Sustainable Development

Khushboo Jhugroo, Naya Sena, Raphael Roman, and Steven J. Bograd

The Barcelona Conference of The UN Decade of Ocean Science for Sustainable Development (Ocean Decade; 2021-2030) served as a milestone to assess the progress of the Ocean Decade and to establish priorities for the remaining years. In addition to the main Conference, there were more than 100 satellite events held throughout the week. One of these events was sponsored by SmartNet, a joint ICES/PICES endorsed Programme under the Ocean Decade. Five other events were co-led by the Global ECOP Programme, with two of them receiving support from SmartNet.

PICES played a significant role in the conference. For a more general summary of activities that all PICES members who attended the conference participated in, please refer to the accompanying article titled "PICES at the Barcelona Conference of the UN Decade of Ocean Science for Sustainable Development" in this issue of the PICES Press. This article highlights and focuses on the roles and activities that PICES Early Career Ocean Professionals (ECOPs) played at the conference.

Emphasizing ECOP Engagement

A vital component of SmartNet and PICES more broadly, is the inclusion of ECOPs in all their activities and organizational processes. At the Barcelona Conference, PICES co-sponsored two well-attended satellite events organized by the Global ECOP Programme: "Building Ocean Leadership: Fostering Networking, Creativity, and Resilience" and "The Inclusivity We Need for the Ocean We Want."

PICES, through recommendations provided by the Advisory Panel on ECOPs (AP-ECOP), supported the participation of two ECOPs, including Khushboo Jhugroo and Naya Sena, who are both originally from Small Island Developing States (SIDS), namely Mauritius and Cabo Verde respectively. Raphael Roman, who is the ECOP Programme coordinator of the Asia node and one of the co-chairs of AP-ECOP, also participated at several of the conference events. This article highlights their experiences and various engagements at the Ocean Decade conference in Barcelona.

High-level Exposure and Networking

Naya, Khushboo, and Raphael engaged in high-level discussions and panels with a diverse array of conference attendees, including ECOPs (Figure 1), the scientific community, industry professionals, government representatives, NGOs, civil society organizations, philanthropic entities, and UN bodies. This unique gathering provided a rare opportunity for cross-sectoral dialogue and collaboration. The conference offered numerous opportunities for Khushboo, Naya, and Raphael to network and establish meaningful connections. Engaging with senior scientists and policymakers allowed the ECOPs to gain insights into the latest research and policy developments, as well as to discuss potential collaborations on future projects.

Figure 1: ECOPs group photo at the Ocean Decade Conference in Barcelona, Spain in April 2024.

Naya Sena

Naya Sena was one of the ECOPs supported by PICES to attend the UN Ocean Conference. As a member of the ECOP program and coordinator of ECOP Cabo Verde, Naya participated in different events and activities. Naya participated as a panelist at a satellite event titled "Scaling up global ocean action and innovation through inter-generational collaboration to bridge science gaps – Knowledge sharing with SIDS, Least Developed Countries (LDCs), ECOPs and youth," at Port Olympic Auditorium on April 9, 2024. The event was organized by NOOA Oceanic and Atmospheric Research and Peace Boat U.S. The goal of the event was to create dialogue and knowledge sharing across generations, organizational schemes, and geographies to celebrate the achievements and reflect on the challenges surrounding Ocean Decade Actions.

Naya was also a panelist on the hybrid satellite event "What is the ocean we want? Global survey to understand perspectives on Ocean Decade Outcomes", promoted by SmartNet (ICES & PICES) and France's Priority Research Program, Ocean of Solutions (IFREMER & CNRS). The event was also held on April 9, 2024. The objectives of the satellite event were to get public input on the "Ocean We Want", promote the UN Ocean Decade Program "SmartNet" , and facilitate networking with its existing and potential partners. The event had the special participation of the artist Bas Köhler, who produced several cartoons, based on the discussions held during the event (Figure 2).

As part of science outreach and communication, Naya presented a poster on her research titled "Identifying the Ocean Decade challenges: A Common Framework for Small Island Developing States". The poster was exhibited throughout the Conference and Naya made several informal presentations during the week, as there was no official poster presentation session.

On April 10, 2024, Naya took part in the informal meeting with the President of Cabo Verde, his Excellency José Maria Neves, who made the inaugural speech at the Conference Open Ceremony and is currently the Patron of the Ocean Decade Alliance. The President met with all researchers and delegates from Cabo Verde with the goal to show support for the work done and to discuss future collaborations (Figure 3).

Naya organized and moderated the meeting between ECOP Africa representatives and the Global Coordinator of the ECOP Program, Evgeniia Kostianaia on April 11, 2024. This meeting served as a platform to evaluate the work done so far, resolve conflicts, and define future strategies and plans (Figure 4).

On April 12, 2024, Naya participated in different activities organized by the Virtual Early Career Ocean Professional (V.ECOPs), from interviews to online discussion panels.

Figure 2: Cartoon portraying some of the discussions held at the SmartNet side event, made by artist Bas Köhler.

This virtual initiative had a series of livestream events showcasing testimonials of change in applying science and knowledge to ocean sustainability from the global community of ECOPs.

Finally, on April 12, 2024, Naya also participated as a speaker on the on-site satellite event "Looking SEAWARD: African oceans and the Ocean Decade narrative", organized by the African Ocean Decade Taskforce and the ECOP Africa Program. The event intended to show different African perspectives on achieving a sustainable ocean, through story-telling, and engaging fireside chat with Intergovernmental Oceanographic Commission - Africa, FAO, GEOMAR, Ocean panel, and Belmont Forum on shaping partnerships for the science Africa needs.

Khushboo Jhugroo

As the other supported ECOP, Khushboo participated as a speaker and panelist for the satellite event "The Inclusivity We Need for the Ocean We Want" (Figure 5). This event was held at the Barcelona Capital Nautica on April 9, 2024. The event focused on the geopolitical and intersectoral aspects of inclusivity, highlighting significant challenges faced by geopolitically underrepresented voices. Khushboo brought a perspective of struggles from SIDS. The main issues discussed included economic limitations to attend events, political marginalization, and lack of access to regional data. The panelists and event attendees' combined proposals to address these challenges, which included:

Figure 3: Informal meeting between the President of Cabo Verde and the Cabo-verdeans researchers and delegates.

Figure 4: Meeting between ECOP Africa representatives and the Global ECOP Program Coordinator.

Figure 5: Khushboo Jhugroo speaking at the "The Inclusivity We Need for the Ocean We Want" Satellite Event on April 9, 2024.

- Changing Event Locations: Hosting events in locations that are more accessible to participants from both the Global North and South.
- Decentralized Communication: Improving communication strategies with coastal communities.
- Flexible Funding: Eliminating restrictive funding requirements that marginalize certain communities, countries, and regions.
- Incentivizing Intersectoral Solutions: Promoting programs and projects that offer intersectoral solutions to intersectional problems.
- Community-Centric Circularity: Ensuring communities are core beneficiaries in the transition to circular economies.
- Collaborative Solution Design: Encouraging collaboration across various sectors and lived experiences.

Additionally, Khushboo participated in the "Shaping IPOS: Southern Perspectives on Optimizing the Science-Policy Interface" workshop (Figure 6). This workshop was held at Moll de Xaloc on April 9, 2024. The event aimed at collectively brainstorming key design elements for an optimized knowledge-decision interface, actively integrating insights and perspectives from Global South experts and practitioners. Khushboo participated in a working group focusing on identifying key ocean sustainability knowledge priorities and best practices for the transmission of knowledge into action at the event.

Lastly, Khushboo actively engaged and connected with ECOP attendees from the various nodes throughout the week, with especially productive connections with representatives from the Africa and Central America nodes, leading to ongoing discussions and collaborations.

Raphael Roman

AP-ECOP co-chair and AP-UNDOS member Raphael Roman gave a presentation on "Taking stock of the regional achievements of ECOP Asia (2021-2024) and paving the way forward to 2030 and beyond" in one of the parallel sessions focused on Ocean Decade Challenge 9: "Skills, Knowledge and Technology for All" (Figure 7). His presentation showcased the remarkable expansion and diversification of the ECOP Asia community, which has grown fivefold since April 2022, and now spans 35 countries across all Asian subregions. ECOP Asia, as a dynamic "network of networks", comprises eight national nodes – Japan, China, Republic of Korea, Malaysia, Bangladesh, India, Thailand, and Philippines – and one working group on Ocean Literacy.

Through seven national and regional needs assessment surveys, ECOP Asia identified the following topics as top priorities for capacity strengthening: (1) Marine Pollution, (2) Ocean-Climate Nexus, (3) Marine Biodiversity, and (4) Sustainable Ocean Economy. Raphael also highlighted structural barriers that remain pervasive across Asia, such as a lack of professional and social networks, limited job opportunities and low salary prospects, and insufficient

Figure 6: Khushboo Jhugroo with the participants of the "Shaping IPOS: Southern Perspectives on Optimizing the Science-Policy Interface" workshop on April 9, 2024.

training programs and funding, especially regarding research grants, scholarships, and travel expenses. ECOP Asia strives to address these challenges through a diverse portfolio of activities, which so far includes 12 workshops, 3 symposiums, 5 webinars, and 1 free virtual training session on ocean data analysis. These efforts aim to meaningfully engage ECOPs and give them a greater sense of ownership with the UN Ocean Decade. In the near future, ECOP Asia will continue to push for greater representation and participation of Asian ECOPs in high-level dialogues and conferences, while helping them develop their leadership skills, build trust, and co-design impactful initiatives with various ocean rights holders and stakeholders.

Raphael also presented a poster on "A global comparative analysis of ECOP needs, priorities, and engagement levels within the UN Ocean Decade – Insights from 2022-2024 surveys" (Figure 8). This poster was a collective effort to consolidate key insights garnered from the 13 multilingual needs assessment questionnaires circulated by the ECOP Programme in Africa, Asia, Canada, Central America, and Europe. The results were broken down by region and focused on (i) sectoral representation among ECOPs, which is dominated by Research and Science; (ii) Ocean Decade awareness levels, which are above 75% on average but significantly lower when it comes to actual participation of ECOPs in related activities and programs; (iii) barriers and challenges, which mirror those identified in Asia earlier; and (iv) Ocean Decade Outcomes that ECOPs are involved in or wish to be, with a "Healthy and Resilient Ocean" (65%) and a "Clean Ocean" (47%) being the most popular, while a "Safe Ocean" (31%) was the least cited outcome.

Conclusion and Future Directions

The Ocean Decade Conference culminated in the Barcelona Statement (IOC-UNESCO 2024), which identified future priorities for ocean science and knowledge generation, focusing on the needs of SIDS, Least Developed Countries, and under-represented communities. The call to action emphasized the importance of strong engagement, increased investment in ocean science, and raising awareness of the conference outcomes. More details about these priorities can be found in the "PICES at the Barcelona Conference of the UN Decade of Ocean Science for Sustainable Development" article in this issue of PICES Press, and in the Barcelona Statement.

PICES, with its active inclusion of ECOPs, is poised to play a contributing role in advancing the Ocean Decade's priorities, ensuring the Ocean Decade leads us towards the 'ocean we want.' The participation of Khushboo Jhugroo, Raphael Roman, and Naya Sena at the Barcelona Conference highlights the significant impact that early career professionals can have in shaping the future of ocean science and policy. Moving forward, PICES aims to:

- Continue supporting and expanding the role of ECOPs in all activities, ensuring their voices are heard and their contributions are valued.
- Build on the connections and collaborations established at the conference to foster interdisciplinary and cross-sectoral partnerships.
- Advocate for the inclusion of underrepresented communities in all aspects of ocean science and policy, addressing the challenges highlighted at the conference.

By fostering a collaborative and inclusive approach, PICES and its ECOPs are committed to advancing the objectives of the Ocean Decade, leading us towards a sustainable and equitable future for our oceans.

Figure 7: Raphael Roman giving a presentation at the Challenge 9 Session at the UN Ocean Decade Conference in Barcelona, Spain, on April 12th, 2024

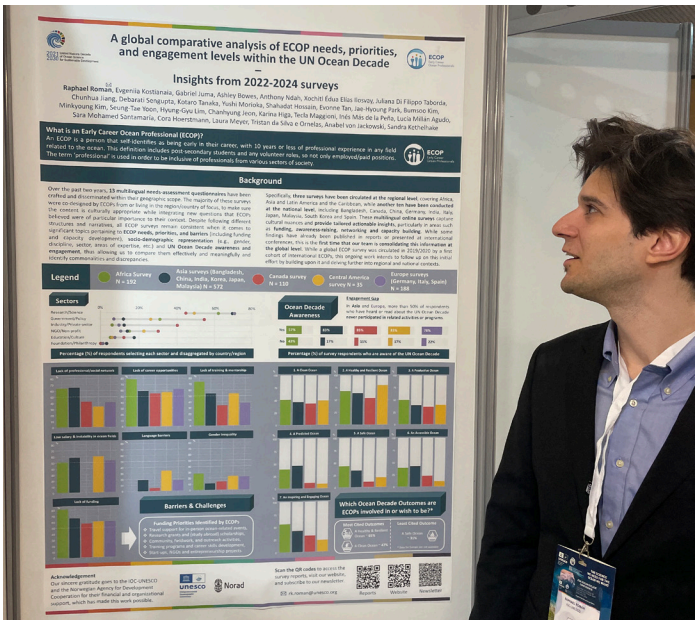
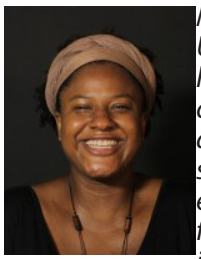


Figure 8: Raphael Roman introducing his poster at the UN Ocean Decade Conference in Barcelona, Spain, on April 10th, 2024

References

IOC-UNESCO (2024). 2024 Ocean Decade Conference – The Barcelona Statement, https://oceanexpert.org/document/34098.

Khushboo Jhugroo is an environmental consultant at Hatch Ltd in Vancouver. Her work spans evaluating the social and environmental benefits and impacts of projects across infrastructural and renewable energy sectors. Originating from the island of Mauritius, Khush's early exposure to the unique oceanic challenges faced by Small Island Developing States and Least Developed Countries ignited her passion for ocean sustainability. She strongly advocates for geopolitical inclusivity in recognizing the importance of diverse perspectives in solving global oceanic issues. She is passionate about human-ocean interactions and sustainability, and enjoys bridging connections between information and people to foster change, solve problems, and find sustainable solutions. She holds an MSc from the University of Cape Town and a PhD from the University of Auckland, where she explored the interplay between terrestrial and marine environments using underwater gliders.
Contact: khush.jhug@gmail.com



Majored in Biological Sciences by the University of Cabo Verde, Naya Sena has worked on sea turtles and seabirds conservation projects in different protected areas in Cabo Verde. During her Masters, she researched marine plastics and their effects on seabirds. Naya's Doctoral research focused on coastal sustainable development in Small Island Developing States (SIDS), with a particular emphasis on community participation in decision-making processes and community empowerment. Currently, she is post-doc researcher at the University of Tokyo working on Nature-based Solutions for climate-resilient societies in Pacific SIDS. Moreover, She is coordinating the launching of ECOP Cabo Verde Node and is also part of ECOP Africa.
Contact: ncorreiasena@gmail.com

Raphael Roman has a BSc in Economics from the University of Montreal and a Master of Public Policy and Global Affairs from the University of British Columbia. His interests are broad and range from new economic thinking and social-environmental well-being, to sustainable ocean governance and biodiversity conservation. He is passionate about interdisciplinary research approaches and about engagement at the science-policy interface, where I believe early career ocean professionals (ECOPs) have a key role to play.

As such, and in the context of the UN Decade of Ocean Science for Sustainable Development (2021-2030), he hopes to increase representation of the social sciences within the themes of the conference, while encouraging more inter- and transdisciplinary sessions and workshops that can offer intellectually stimulating exchanges across disciplines, sectors and geographies.

Steven Bograd, a senior oceanographer at the NOAA Southwest Fisheries Science Center in Monterey, CA, has been part of the PICES community his entire career, since attending the 1st PICES Annual Meeting in Victoria, BC, in 1992. Steven serves as Co-Chair of the PICES flagship science program, FUTURE, and the Advisory Panel in the UN Decade of Ocean Science for Sustainable Development (AP-UNDOS Steven also co-leads two United Nations Decade of Ocean Science Programmes (SmartNet and SUPREME) and is Editor-in-Chief of the journal Fisheries Oceanography. Steven's research interests are in the climate impacts on marine ecosystems, with a focus on eastern boundary upwelling systems. He has also won 3 NOAA bronze medals in his career. Steven received a B.S. in physics (University of Arizona), a M.S. in atmospheric sciences (University of Washington), and a PhD in physical oceanography (University of British Columbia). He did a post-doc at Scripps Institution of Oceanography before joining NOAA in 2001. Steven was born and grew up in Mississippi, USA, but has spent most of his adult life on the West Coast.

Marine Socio-Ecological Systems Symposium (MSEAS) 2024
3-7 June 2024 - Yokohama, Japan

2021 2030 United Nations Decade of Ocean Science for Sustainable Development

#MSEAS2024 – A UN Ocean Decade Event

Marine Socio-Ecological Systems Symposium

MSEAS 2024

Navigating global change in the marine environment

3 –7 June 2024 | Yokohama Japan

MSEAS 2024 symposium will focus on the integrated assessment of multiple ocean uses across sectors, including: fisheries, renewable energy, coastal development, oil and gas, transport, and the need for conservation. Emphasis will be on the methodological and empirical challenges involved in including the human dimensions in integrated ecosystem assessments.

Understanding these complex social-ecological systems is a challenging new area of research that combines multidisciplinary, interdisciplinary and transdisciplinary components. The integrated marine focus is relatively new, as previous research efforts have either been terrestrially focused or dealt primarily with single sectors.

MSEAS 2024 is endorsed as an official activity of the UN Decade of Ocean Science for Sustainable Development UNDOS.

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MSEAS 2024:
Summary Report - Marine Social Scientists Reunited

Sanae Chiba

Rise of Marine Social Science

PICES co-convened the Marine Socio-Ecological System Symposium in Yokohama, Japan, June 3-7, 2024. With the main theme "Managing for sustainable use of the Earth's marine and coastal system", the symposium aimed to address various challenges in enhanced, sustainable and equitable use of the oceans in the current and future growth of the blue economy and development of coastal livelihoods. This is the second conference in the series that began in 2016 in Brest, France, entitled "Understanding marine socio-ecological systems – including the human dimension in integrated ecosystem assessment." The Brest meeting coincided with the year of the establishment of PICES new standing committee for Human Dimensions, and the committee's vision underpinned by marine social science became the crucial element of the newly developed FUTURE Framework for the North Pacific Social-Ecological-Environmental System (SEES).

Although originally planned for 2020, the MSEAS Yokohama meeting was cancelled due to the COVID-19 pandemic, just a few months before the meeting when all the arrangements, including the program, speakers, and logistics, were already identified. While waiting for the opportunity to resume the meeting, the symposium organisers hosted the online MSEAS Teaser Event in 2021 to keep the community communicating. In the same year, the United Nations Decade of Ocean Science for Sustainable Development (UNDOS) was launched, emphasizing the need to improve multidisciplinary approaches and involve multiple stakeholders and communities in sustainable management and policymaking for marine and coastal socio-ecological systems. Collaboration between natural and social scientists is now more crucial than ever.

The venue of MSEAS-2024, PACIFICO Yokohama North, is located in the waterfront area of the historic port of Yokohama. Eight years since the last symposium, 201 participants representing 31 countries (Figure 1) celebrated reuniting at the long-awaited MSEAS in a pleasant, sunny week following the passing of the first typhoon of the year (luckily!).

Sessions

Every morning started with inspiring plenary talks that represented the respective session topic.

The 10 Sessions covered various aspects of socio-ecological and marine ecosystem management, including socio-ecological modelling, interdisciplinary marine governance, sustainable ocean development, and risk assessment. It also addresses integrating human dimensions in spatial planning, stakeholder engagement, marine biodiversity indicators, coastal community support, and adaptation to climate change for resilient marine systems. Many sessions adopted interactive approaches including group discussions and practices that helped active engagement of all participants.

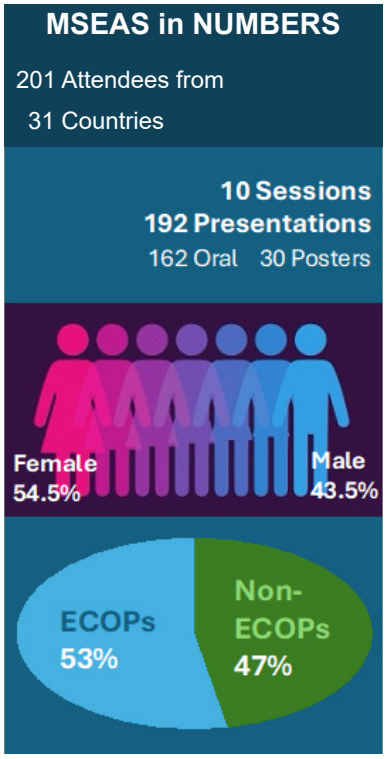


Figure 1: MSEAS in numbers.

List of Sessions

Session 1: Running the Gamut Gauntlet: Socio-ecological modelling in a complex world

Session 2: Improving marine governance with interdisciplinary research and cross-sectoral approaches

Session 3: Sustainable Ocean Development

Session 4: Risk perception and assessment for marine ecosystem-based management

Session 5: Mapping human dimensions onto seascapes: Progress and challenges in integrating and applying human dimensions data in spatial considerations for marine ecosystem-based management

Session 6: Social-ecological systems thinking: From ecosystem services perspectives

Session 7: Co-production of knowledge, participatory approaches and engagement with stakeholders

Session 8: Applying and integrating marine biodiversity indicators and assessments to evaluate progress towards policy goals

Session 9: Emerging conditions and transformations for coastal communities – The role for supporting science and assessment

Session 10: Vulnerability of marine SES to climate change and anthropogenic pressures: Adaptation as a pathway to resilience

Session Take-Home Messages from Co-Convenors

Session 1 - Running the Gamut Gauntlet: Socio-ecological modelling in a complex world

Co-convenors: Geret DePiper, Tyler Eddy, Steven Saul and Olivier Thebaud

Session 1 highlighted that the theoretical gains from coupled models have begun to be realized through the delivery and employment of actionable management advice, with examples including setting recreational fishing regulations, developing sustainable cruise line policies, and strategically assessing rising challenges and opportunities for scientific institutes, among others. Despite these gains, the majority of coupled models developed for management purposes continue to be static in nature, an abstraction which excludes the feedback loops that constitute the greatest strength of coupled modeling approaches. In addition, coupled models necessitate sound theoretical reasoning and careful assessment to ensure the relevant system components are captured, as omitted components can severely bias results. Nevertheless, the momentum towards coupled models is gaining in the management context in order to allow a holistic assessment of challenges ranging from Covid 19 impacts on marine tourism, to climate impacts on species, habitat, and fisheries dynamics. Through these coupled modeling exercises, management metrics of success are expanding well beyond single species reference points into business profitability and stability, nutrition, protected species viability and values, and a host of other criteria which allow for not only a more accurate accounting of trade-offs, but also better management of our critical marine resources.

Session 5 - Mapping human dimensions onto seascapes: Progress and challenges in integrating and applying human dimensions data in spatial considerations for marine ecosystem-based management

Co-convenors: Karma Norman, Kirsten Leong and Jamie Tam

This session addressed issues in conflicts over marine spaces and in aligning law and policy to Ecosystem-Based Management (EBM). It also highlighted equity, environmental justice and inclusivity in defining spatially explicit social-ecological system indicators. There are a wide variety of spatially located ocean uses and ecosystem services that can be spatially synergistic or antagonistic such as offshore wind energy, oil and gas, aquaculture, Marine Protected Areas (MPAs), fisheries, and transport. As such, human dimensions data may be diverse and nuanced, and integration with spatial analyses in ecosystem contexts therefore relies on carefully defining human dimensions components, including fishing communities, fishing practices, markets, target species and relevant socio-cultural contexts to ensure equitable representation. Social-economic indicators are useful for defining a broader understanding of operational objectives for EBM within the context of social-ecological systems and help make implicit assumptions explicit. These require mixed methods using both qualitative and quantitative data, with participatory mapping as a potentially useful method among these since it offers the possibility of sense-of-place measures. Ecosystem approaches that are meant to both integrate human dimensions and inform management require attention to appropriate management scales, as ecological, social, and legal or political processes may occur at different scales.

Session 8 - Applying and integrating marine biodiversity indicators and assessments to evaluate progress towards policy goals

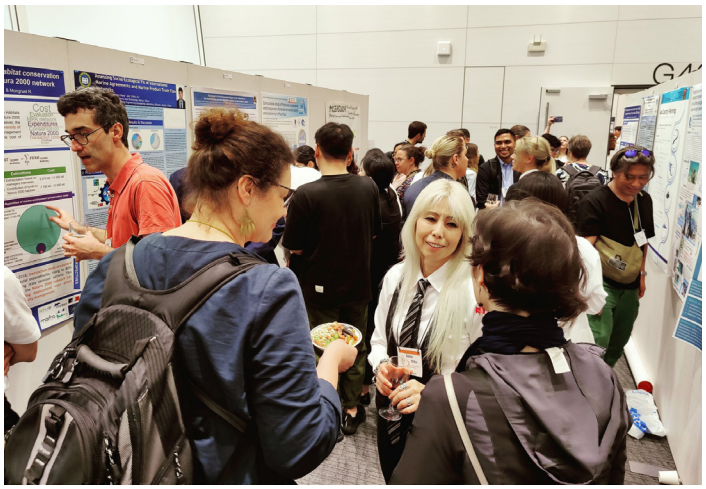
Co-convenors: Abigail McQuatters-Gollop, Laurent Guerin, Cristina Vina Herbon, Amber Himes-Cornell, Saskia Otto, and Jake Rice

- Setting thresholds remains challenging
- Lack of biodiversity data is challenging. Much of the data we use wasn't collected for assessment – it's opportunistic. However, it's the best we've got so we have to find a way to use it.
- Policy goals are imposed on ecology which is challenging for assessment – how good is good?
- Integrating across indicators is still hard – and maybe not possible for all indicators.
- Ecosystem service data are still lacking – most are about fishing. However, we still need to use the ESS data we have to link to changes in state.

Outside the venue


Symposium Banquet at Royal Hall Yokohama


Welcome Reception


Poster session

ECOPs at MSEAS

Side Events

There were a couple of side events during and after MSEAS-2024.

1. ECOP Evening Workshop:

The special evening workshop for Early Career Ocean Professionals (ECOP) took place at the Nippon Maru Memorial Park with the aim of fostering future leadership in the marine industry. 45 ECOPs participated to learn and discuss the effective science-policy interface and international collaboration, how to ensure interdisciplinary and promote career development through engagement in international frameworks and organisational processes. See the details of the workshop in a separate article titled "ECOP Evening Workshop" by Hana Matsubara in this issue.

2. Graphic Recording

Given its impact at MSEAS 2016 (Thebaud et al, 2017, https://doi.org/10.1093/icesjms/fsw252), Graphic Recording was adopted again at MSEAS 2024 to convey major messages and challenges of the meeting to wider audiences. The artist Mary Tomita will create a series of illustrations based on the key takeaway messages and new insights collected from symposium participants (Figure 2). Two ECOPs, Hana Matsubara (Japan) and Abigayil Blandon (Sweden) who coordinated the survey during the MSEAS will help Mary and publish the product as a journal paper in the MSEAS special publication of ICES Journal of Marine Science. We are excited to see how the key messages and challenges have changed during the past eight years through the form of the arts.

3. Art of the Mother Ocean

The plenary speaker of Session 9, Aoi Sugimoto (Japan) and local art collaborators in Japan organised the series of art-science collaboration programmes "Art of the Mother Ocean". Ocean-themed artworks created by local artists and citizens were presented at the conference venue (Figure 3). MSEAS participants together with the artist and citizens were engaged in the interactive dialogue on Arts, Zen and traditional music performances. The weekend after the MSEAS, dozens of MESAS participants enjoyed a one-day excursion to visit the local fishery town and experience Zen meditation (Figure 4). Selected participants further deepened their experience by co-creating artwork and engaging in dialogues for science-art collaboration with artists and locals (Figure 5). This event was funded by the "International Conference Impact Expansion Demonstration Project" of the Japan Tourism Agency.

Figure 3: Plenary speaker Aoi Sugimoto showing ocean theme artworks by local artists and citizens

Figure 2: Graphical artist rendering of MSEAS 2024 by Mary Tomita. Note image is the original rough sketch and a completed version in color will be published soon, along with other graphics.

Figure 4: Excursion to meet with the only female fisher in Hayama (left) and a sustainable fish shop focused on education (right)

Figure 5: Artwork created by participants of the Intesnive Art-Science collaborative workshop.

Thank You and See you Again

We are delighted to receive much positive feedback from the symposium participants regarding the organisation of the meeting. As the conference organisers, there is nothing more rewarding than seeing active discussions during the sessions and big smiles during the social events (including Karaoke sessions). We would like to thank the host city of Yokohama and symposium sponsors for their unwavering support even after its lengthy postponement, and science steering committee members, session convenors and all presenters who made the MSEAS-2024 fruitful. We must not forget the tireless six years of dedication from Rich Little (Australia), the lead convenor of MSEAS, who led the organising team to the end but could not make it to Yokohama (Figure 6). And last, let's give a round of applause to the local organisers (Japan Fisheries Research and Education Agency and the University of Tokyo) for their excellent teamwork and "Samurai-blue spirit" in having left the venue spotless and food waste-free (Figure 7)!

Sanae Chiba
PICES Deputy Executive Secretary

Figure 6: Rich Little joined the MSEAS organiser team at the symposium banquet (on mobile screen).

Figure 7: Local organisers cleaning up after ECOP event (above), and taking home leftover sweets (right).

MSEAS 2024:

Workshop for ECOPs - "An Evening with the Global Ocean"

Hana Matsubara, Olivier Thébaud, Jake Rice, Stewart Frusher, and Hélène Buchholzer

At MSEAS 2024, Early Career Ocean Professionals (ECOPs) comprised 53% of the participants (106 out of 201). ECOPs actively participated in discussions during each session, in addition to giving oral and poster presentations on their research.

During the symposium, an ECOP Evening Event was held (Figures 1-3), with 45 ECOPs from over 22 countries participating. This event featured five panelists representing international organizations and processes related to global ocean policy. The panelists presented overviews of these organizations and processes, of the ways researchers and ECOPs can get involved, and of the challenges they face.

The Invited Speakers

- Dr. Yutaka Michida, chair of UNESCO's Intergovernmental Oceanographic Commission spoke about the IOC & the UN Decade for Ocean Science
- Dr. Sonia Batten, Executive Secretary of the North Pacific Marine Science Organization spoke about the North Pacific Marine Science Organization (PICES)
- Dr. Alan Haynie, General Secretary of the International Council for the Exploration of the Sea spoke about the International Council for the Exploration of the Sea (ICES)
- Dr. Amber Himes-Cornell, Fishery Officer in the National Planning and Development Support Team of the Fisheries and Aquaculture Division of the UN's Food and Agriculture Organization spoke about the Food & Agricultural Organization (FAO)
- Dr. Jake Rice, Chief Scientist-Emeritus Retired for the Department of Fisheries and Oceans, Canada, Ottawa spoke about the International Environmental Assessment Processes (including UN-DOALOS World Ocean Assessments, IPCC Assessments & UNEP Global Environmental Outlooks)

Dr. Andrea Belgrano, Associate Professor, Swedish University of Agricultural Sciences; and the Swedish Institute for the Marine Environment (SIME), University of Gothenburg, provided information about The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) and Dr. Joachim Claudet, Centre national de la recherche scientifique provided the information on The International Panel on Ocean Science towards the event.

Figure 1. ECOP event participants at Nippon Maru Memorial Park

Open Discussion on 4 themes

Prior to the workshop, the ECOP's were asked to identify key issues that they would like more information on. These were grouped into 4 themes that formed the second part of the workshop. Key issues that emerged from the open discussions within each theme included:

Theme 1: Science to Policy: How can researchers contribute to policy development & implementation?

Developing the science-policy interface: Participants stressed the need for scientists to translate the knowledge they produce into formats that can be incorporated into policy-making processes. In doing so, scientists may need to be willing to speak to the least convinced most skeptical stakeholders, as the science which will end up being used is the one knowledge that people trust. The tasks that support policy uptake (e.g., education programs, outreach activities, workshops, etc.) are not necessarily taken into consideration for career building in science and academia, and should be the focus of dedicated training. The panelists stressed the diversity of career paths at the science-policy interface. Outside academic institutions, there is growing flexibility in job descriptions and value placed on multi-skilled professionals. Within academic institutions, there is still a strong emphasis on the publication of research articles with Academia providing growing space for interdisciplinary science but recognition of these policy-uptake tasks in career advancement is lagging.

Theme 2: International Collaboration: How can we promote international research collaborations?

Importance of networking, and of fostering collaboration between the global south and the global north: Panelists highlighted the importance of international networking, and of having global north institutions support and collaborate with global south researchers (including ECOPs), and also supporting research done by global south researchers in the global south. International organizations (e.g., FAO, PICES, ICES, the IOC) are working to foster such collaborations. We need to ensure that these collaborations are supported by genuine intentions and understanding of the aspirations of the global South so as to generate genuine commitment, which is important for building trust and ensuring durable scientific cooperation.

Theme 3: Interdisciplinarity: How can we promote interdisciplinary research?

What is an interdisciplinary researcher?: An interdisciplinary researcher is not necessarily a researcher with strengths in multiple disciplines. It is in fact important that an interdisciplinary researcher be strong in at least his/her own discipline, while also having a basic understanding of other disciplines. When working in an interdisciplinary team each researcher is expected to contribute their own disciplinary strength as well as partake in discussions across disciplines, and follow alternative explanations of available evidence, including her/his own contributions.

Figure 2: Discussions during ECOP Evening Workshop

There is not a single recipe: Proactive networking often requires researchers to step outside their comfort zones. If possible, it is good to have an understanding of what types of interdisciplinary projects you can get involved in. Most researchers from other disciplines are often as interested in forming partnerships as you are.

Work shoulder to shoulder from the beginning: It is important to include the different disciplinary researchers from the start (conceptual design) of a project. All disciplinary researchers should be treated as equal partners in the research and although the approaches may differ, one should trust the other's research approaches and methodologies.

Despite the transaction costs, interdisciplinary research is what is most suited to address the current challenges of ocean governance, and it can be very rewarding as it provides opportunities to see how these challenges are viewed through the lens of different disciplines. And collectively build a broader shared understanding of the challenge and possible pathways forward.

Theme 4: Career Development: Tips/Advices for career development

Step out from a comfort zone: Never be afraid to reach out to colleagues of multiple disciplines, and to approach/ask questions to a medium/late career scientist during conferences/workshop/symposium, even when you may feel a bit intimidated.

Strengthen multiple skills: Multiply and diversify working experiences and research collaborations in multiple languages.

Join an international working group: This can serve as an entry point for ECOPs for gaining professional experience, although it often involves unpaid work which may be seen as a financial challenge. The ideal approach to contributing to such groups is to seek to align one's contributions to the group with one's research activities.

Enjoy the processes: Think about what motivates you in your daily work, and follow the path that provides you with the greatest satisfaction. If you are truly engaging in such collaborations, the thrill of the process can be greater than the value of the final product.

One of the important key messages that was repeatedly emphasized is the importance of stepping out of one's comfort zone, both in one's career and disciplinary work, for future research activities and career development of ECOPs. Additionally, it was suggested that it is crucial to strengthen the mutual benefits whereby international organizations/processes can provide opportunities for ECOPs in terms of career development and networking, while ECOPs can contribute to their initiatives and take on future leadership roles. PICES and ICES each have internal organizations that support the professional experiences of ECOPs and welcome contact from ECOPs interested in participating. The FAO provides internships, although applicants need to be at least bilingual. It is important to identify researchers within these organizations and make contact with them prior to applying for internships or positions in working groups.

Hana Matsubara is a PhD candidate at the Graduate School of Agriculture and Life Sciences, University of Tokyo. Conducting study on interaction between gender equality in coastal communities and community-based sustainable marine resource use.

Olivier Thébaud is a Senior scientist with Ifremer's joint research unit AMURE. Olivier's research focuses on the use of economic concepts, methods and tools, in connection with knowledge from other disciplines of marine sciences, to inform the management of marine and coastal resources.

Jake Rice is Quasi-retired after 34 years with DFO in Newfoundland, Pacific, and Headquarters Regions, including 12 years as Chief Scientist. He has been on author teams for two IPCC assessments, four UNEP Global Environmental Outlooks, the Group of Experts for three world Ocean Assessments, and co-chair of the IPBES Americas Regional Assessment,

Stewart Frusher is Adjunct Professor of Marine Science at the University of Tasmania. Inaugural Director of the Centre for Marine Socioecology. Co-developer of the Australian Blue Economy Cooperative Research Centre.
Hélène Buchholzer is a PhD student at the University of Western Brittany. Helene's research focuses on a better understanding of fishing activities, using economic concepts.

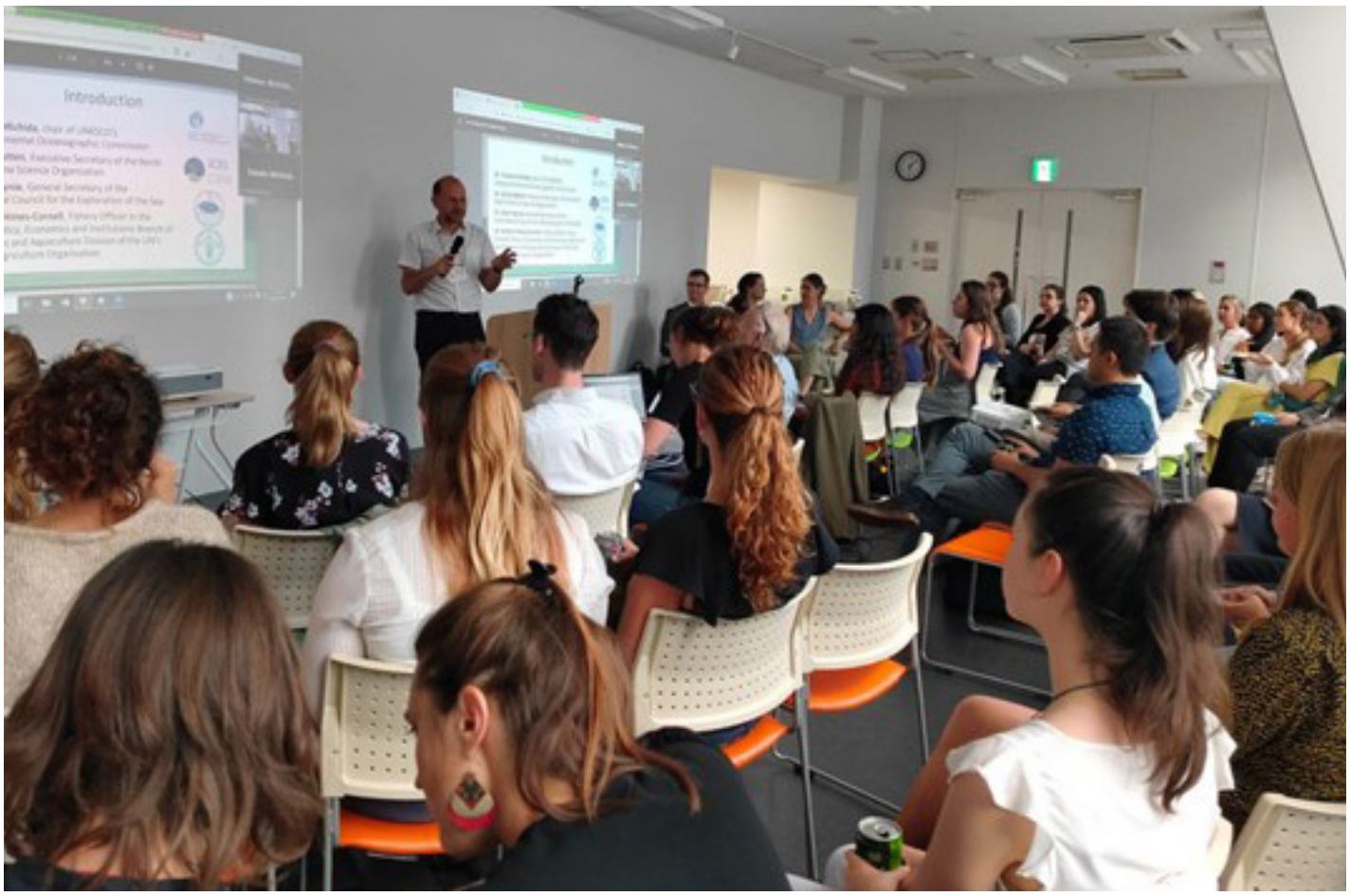


Figure 3. Invited speaker discussing key issues at the ECOP Evening Workshop

MSEAS 2024: ECOP Voices

Julia Bingham, Emma Chiaroni, Nozomi Ihara, Hana Matsubara, and Isie Ran

Early Career Ocean Professionals (ECOPs) were valuable participants at MSEAS 2024, and play a large role in the current and future world of Ocean Science. We asked some attending ECOPs to share more about their research, their experience at MSEAS 2024, and what direction they see their careers and Marine Socio-Ecological Systems Research going in the next 5 years.

Julia Bingham

I had the opportunity to give two presentations at MSEAS 2024. The first was on an ongoing project I am supporting in collaboration with NOAA Fisheries and the Responsible Offshore Development Alliance to develop indicators for an Integrated Ecosystem Assessment of interactions between fisheries and offshore wind energy development in the Gulf of Maine. The second was on work conducted in partnership with five Nuu-chah-nulth First Nations on the role of knowledge and governance pluralisms in supporting co-management of salmon and furthering Indigenous assertion of fishing rights and governing authority in British Columbia.

While these respective projects draw from diverse fields, MSEAS was a fantastic venue for engaging with other researchers with shared interests and facilitating dynamic discussions on governance, community partnerships and collaborative research, and "integrative" approaches to knowledge co-production and indicator assessments highly relevant to both bodies of work. The smaller size of the conference and the emphasis on supporting Early Career attendees both facilitated making important network connections with time to have meaningful conversations, which I greatly appreciate as I often find larger conferences to be a difficult space to keep such priorities.

I also particularly enjoyed the incorporation of the "Art for Mother Ocean" initiative, the opportunities for MSEAS participants to participate in art-oriented workshops together with local artists, and especially the group excursion to Kamakura and Hamaya after the conference sessions ended. I think such efforts are vital to facilitating thoughtful, reflective, and intentional engagement with ourselves, our work, and the location and people hosting the meeting. The excursion was one of the most thoughtfully organized and rewarding beyond-the-conference engagement opportunities I've had the pleasure of participating in, and helped to build friendships with new colleagues with whom I hope to remain in contact and potentially work together with in the future.

I found MEAS 2024 as a whole a refreshingly rewarding conference as an early career researcher hoping to continue prioritizing community partnerships in applied interdisciplinary work alongside teaching and artwork in my future career. I hope to see Marine Socio-Ecological Systems Research continue exploring how to meaningfully incorporate considerations of equity across disciplines and areas of research, ethical approaches to community partnerships, creating spaces for Indigenous-led discussions (particularly when we are spending increasing amounts of time attentive to knowledge co-production and equity concerns), and prioritize engaging research contributors and collaborators beyond our primarily academic and western management agency circles in applied work and in venues like the MSEAS symposium. I believe such interdisciplinary approaches with attention to social and ecological dynamics are growing in priority across many institutions; I hope this will come with an effort to take the timely growth in MSEAS-relevant research as an opportunity to build reflexive and ethical praxis.

Julia is an interdisciplinary social scientist studying the intersections of social, ecological, and political dimensions of fisheries and coastal management. They are currently a postdoctoral fellow at the University of Rhode Island Coastal Resources Center and is part of the RI Sea Grant Extension team. Julia is working with NOAA Fisheries' Northeast Fisheries Science Center and the Responsible Offshore Development Alliance (RODA) to identify interactions between fisheries and offshore wind development in the Gulf of Maine through an integrated ecosystem assessment (IEA) built through community engagement with attention to local ecological knowledge. Julia received a PhD in Marine Science and Conservation from Duke University in 2023. Their dissertation work focused on governance transitions in Canadian and Nuu-chah-nulth rights-based salmon fisheries on the west coast of Vancouver Island, focusing on knowledge pluralisms and working in partnership with Tla-o-qui-aht First Nations and Ha'oom Fisheries Society. Julia also holds a Certificate in College Teaching from Duke University. Prior to their doctoral studies, Julia was a research assistant at the University of Oregon's Institute of Marine Biology. Julia holds a B.S. in Biology and a B.A. in International Studies from Oregon State University.

Emma Chiaroni

It was a pleasure attending MSEAS 2024 in Yokohama! This was my first international conference and my first time presenting my ongoing dissertation research. I gave an oral presentation on an aspect of my dissertation research examining the role of social learning in an emerging collaborative governance relationship between several Indigenous Nations and the National Oceanic and Atmospheric Administration's Office of National Marine Sanctuaries in Central California, USA. A scientific highlight of the meeting was hearing about all of the great research being conducted around the world, especially the research being conducted by the other ECOPs. Hopefully in the future, more scientists and ECOPs from developing countries can attend MSEAS, I think that would foster some great collaborative relationships. I think a boost in attendance can help improve the ECOP experience.

The ECOP program in the evening was a bit lacking, so I think the presence of more later career scientists invested in ECOP experience would improve the experience for everyone. Another highlight of the meeting was connecting with other ocean-minded folks on a personal level, both ECOP and established career professionals. Going out to great restaurants during lunch really helped with the bonding experience, especially trying to translate menus using Google together. I had a great time going out and connecting with the other ECOPs and I tried to envision us as future colleagues attending MSEAS events.

MSEAS inspired me to look beyond my professional boundaries. Although my doctoral program does a decent job at exposing us to careers outside of academia, it was really nice connecting with established professionals working for the United Nations and large international NGOs at the conference. In 5 years I hope to be conducting community-based research with Indigenous Nations in the United States, particularly as the state and federal governments enter this era of attempting co-management of natural resources with tribes. I'm not sure what that will look like in terms of a professional role, but I know a component of it will have an international orientation, given the many connections I made at MSEAS that will grow into stronger professional connections.

I think we are living in a revolution for Marine Socio-Ecological Systems research. Globally, I think nations are coming to a reckoning that people are nature (something that Indigenous people have known forever) and that any climate change policy or strategy must have environmental justice at the core. I think we will see the field expand immensely, but not without growing pains. Luckily, it seems like folks in this field are really focused on improving opportunities for marginalized groups to attend, particularly scholars from the Global South, which I think isn't the case in exclusively natural science or economics fields. However, I believe as scholars in this boundary space that is rapidly expanding in the international arena, we have a duty to call out governments and corporations that actively work against furthering environmental justice and climate research.

I feel honored to have attended MSEAS 2024 as an ECOP! I've made so many friends and connections through the conference and I can't wait to attend the next conference 4 years from now! Crossing my fingers that it's someplace with as good of food as Yokohama, although that's hard to beat!

Emma Chiaroni - I am a third year PhD candidate in Rural Sociology & Human Dimensions of Natural Resources and the Environment at Pennsylvania State University and a Visiting Scholar at University of California Santa Cruz. Based in Central California, my research examines the dynamics of collaborative governance relationships between Indigenous Nations and marine resource managers with a particular focus on the self-determination of federally and non-federally tribes in California. Amidst the background of marine renewable energy development, my research specifically looks at the case study of the proposed Chumash Heritage National Marine Sanctuary, where I am conducting community-informed research on the evolving governance process.

Nozomi Ihara

At MSEAS 2024, I presented my research findings on small-scale fishing communities in Japan. My study area is the Shiretoko Peninsula on the coast of the Sea of Okhotsk in Hokkaido, the northernmost prefecture of Japan. This area is a UNESCO World Natural Heritage site and is the southernmost limit where sea ice reaches in the Northern Hemisphere. Notably, it is one of the regions with the highest fish catch volumes in the world, recognized for coastal management and conservation by local fishermen. I have been examining the functions and values of the "banya," which are fishermen's work huts in this area. These banyas are located in one of the most severe natural ecosystems on the peninsula, where economic activities by fishermen have coexisted with strict natural preservation. However, in recent years, due to the advancement of fishing vessels and changes in the natural environment of the Sea of Okhotsk, these banyas have been abandoned. Therefore, this study aimed to clarify the current state of banyas and examine the relationship between the socio-economic system and natural ecosystem surrounding the coastal area. By doing so, we were able to identify the linkage between the abandoned banyas and the natural ecosystem, suggesting that banyas are necessary for the Shiretoko World Natural Heritage site. This contributes to understanding the characteristics of the socio-ecological system of the Okhotsk Sea coast in Japan and will be useful for future heritage management.

In presenting these research findings, I was able to receive feedback from researchers from various fields, including not only coastal ecologists but also economists and others. This feedback sparked new inspirations and ideas for my future research activities. The reason I love MSEAS is that researchers from different disciplines gather under the marine domain to engage in passionate discussions to protect the ocean they love. Additionally, as data from past PICES PRESS issues show, the gender ratio of ECOPs in Japan is low, with a very small percentage of female researchers. As a result, I had developed a gender-biased mindset. However, at the conference, I was able to interact with researchers who had diverse perspectives, regardless of nationality, age, or gender, which allowed me to envision a very positive future.

Moreover, the use of the online app "Whova" for communication during the conference was revolutionary. It not only allowed for smooth scheduling management and tracking of presentation details but also facilitated the exchange of contact information and active engagement in conference activities.

Finally, over the next five years, I aspire to actively present at interdisciplinary conferences like MSEAS and become

a leading researcher in the socio-ecological systems of Japan's coastal areas. Currently, in Japan, quantifying the impact of marine environmental changes on socio-economic systems is a critical issue. In this context, the stance on changes in both natural and social aspects of the fisheries sector will be increasingly scrutinized. In other words, coastal socio-ecological research will undoubtedly become a field of great interest in Japan. To approach these discussions, expertise in individual fields alone will not suffice. Therefore, I aim to become a scientist who communicates with researchers from various disciplines and proposes more flexible and comprehensive scientific approaches. Participating in MSEAS 2024 has been a milestone, allowing me to identify challenges for myself both within and outside of my research. I hope that when I read this again in five years, my future self will affirm that this was a very valuable experience.

Thank you very much for allowing me to participate in MSEAS 2024 as an ECOP. It was an invaluable experience. I extend my heartfelt respect to the organizers, staff, and all involved parties.

Nozomi Ihara - I grew up in Fujisawa, which is just a 20-minute train ride from Yokohama, where MSEAS 2024 was held. Fujisawa is a beautiful city overlooking Sagami Bay, and the sea has been an inseparable part of my life since childhood. During my student years, I participated in field studies and expeditions in various aquatic environments, including rivers and the deep sea. These experiences led me to the realization that, on Earth, humans and nature cannot be considered separately in any environment. This sparked my interest in coastal areas where human activities and the natural environment coexist prominently.
During my undergraduate studies, I researched the reproductive behavioral ecology of salmon in Hokkaido, Japan, which has a significant impact on both food resources and culture. For my master's research, I focused more on human activities, studying the relationship between fisheries and the natural environment. Now, as a first-year doctoral student, I plan to research the future of coastal socio-ecological systems in Hokkaido, Japan.
Although I am a novice in the field of socio-ecological research and I expect to face many challenges and failures, I am determined to conduct research that I can be proud of as an ECOP, representing Hokkaido to the world.

Hana Matsubara

My name is Hana Matsubara, and I am a PhD candidate at the University of Tokyo, Japan. At the MSEAS conference, I presented part of my dissertation titled "Synergies between Gender Equality and Sustainability in Coastal Fisheries Resource Use: Case Study of Malaita Province, Solomon Islands." The primary focus of my doctoral research is to explore how efforts to promote gender equality in coastal communities interact with the sustainable use of coastal fisheries resources. In my presentation, I reported on changes in both resource management sustainability and gender equality as Gender Inclusive Community-Based Fisheries Management (CBFM) advanced in Malaita Province, Solomon Islands, one of the SIDS in the South Pacific region. The results revealed that promoting gender cooperation improved the resilience of resource management and enhanced women's capacity building and access to decision-making. However, there were also qualitative insights suggesting the need for further research on how gender-differentiated impacts and perspectives are reflected in the decision-making for CBFM, as some different negative impacts were still mentioned based on gender.

At this MSEAS, I had the opportunity to listen to reports closely related to my study. For instance, I learned about the multifaceted views on the nature and evaluation of CBFM and the idea of assessing gender equality efforts using not only SDG 5 but also SDG 10. Additionally, I considered that to make stakeholder insights a form of knowledge co-creation rather than just "provided" information, it is necessary to share objectives among stakeholders and undertake initiatives that share both processes and benefits.

Moreover, at this MSEAS, besides my presentation, I had the opportunity to serve as a co-convenor for the ECOP Evening event and gather information for Graphical Recording. These roles significantly increased my interactions with other participants, and experienced researchers who collaborated with me attended my presentation and provided feedback. Recently, opportunities for ECOPs to participate in such experiences at conferences have been increasing, and I strongly felt that taking on roles significantly expands networking during conferences. I serve as a co-chair of the ECOP Advisory Panel at PICES, where I support ECOPs within and outside of PICES to engage more in professional experiences using PICES as a platform. At this MSEAS, I had the opportunity to experience firsthand how such participation amplifies capacity building and networking for early-career researchers.

In the future, I aim to obtain my PhD and, leveraging my knowledge and research methods related to fisheries and gender, engage in development and practical fields. I also intend to participate in future MSEAS as a platform to report on my work and receive feedback. I sincerely thank PICES for financially supporting my participation in MSEAS and providing various opportunities during the symposium.

Hana Matsubara is a Ph.D. candidate at the Graduate School of Agriculture and Life Sciences, University of Tokyo conducting study on interaction between gender equality in coastal communities and community-based sustainable marine resource use. Experienced working as Associate Expert for international cooperation in fisheries development at Japan International Cooperation Agency (JICA) for a year and JICA volunteer for the promotion of Community-Based Resource Management in the Solomon Islands for two years. Currently the co-chair of the Advisory Panel on ECOPs (AP-ECOP).

Isie Ran

At the MSEAS 2024 symposium, I presented my research on the regional management of marine tourism and the implementation of an "Entrance fee" system. My research aims to address the dual challenge of promoting marine tourism while ensuring sustainable environmental and regional resource management. Specifically, the study focuses on the case of Taketomi Island in Japan, where an entrance fee was introduced to help fund conservation efforts and manage the impacts of tourism. This research is crucial as it highlights both the benefits and drawbacks of marine tourism and offers insights into the potential of entrance fees as a tool for sustainable tourism management.

While the development of marine tourism has significantly contributed to the revitalization of remote island economies, it has also led to challenges in managing regional resources and the environment. My study aimed to clarify the history and mechanism of the entrance fee introduced on Taketomi Island and explore its functions and issues as a means of securing financial resources for regional management. This involved both a literature review and field research to provide a comprehensive understanding.

Due to COVID-19, I was unable to attend the symposium in person and instead presented my research via a video introduction. Despite my absence, the virtual format allowed for meaningful engagement with the audience through the Whova app. This platform enabled me to answer questions, receive feedback, and engage in discussions, which was invaluable for refining my research.

The Whova app provided a rich platform for gathering information and networking. I accessed summaries of other researchers' work, which broadened my understanding of various topics in marine socio-ecological systems. The symposium also offered local cultural experiences and job opportunities, which were highlighted through virtual tours and informational sessions. These elements added significant value to the overall experience, allowing for cultural exchange and professional growth even in a remote setting. This workshop provided practical tips on working effectively across different scientific domains, which I found extremely beneficial for my current and future research endeavors. Additionally, the networking opportunities facilitated by the app enabled me to connect with fellow researchers, fostering potential future collaborations.

In the next five years, I aspire to complete my Ph.D. I hope to continue contributing to the field through innovative research and collaboration with international partners. Additionally, I aim to be actively involved in policy advisory roles to help translate scientific findings into actionable policies for sustainable marine tourism and conservation. My goal is to bridge the gap between research and practical implementation, ensuring that my work has a tangible impact on marine conservation efforts.

I think Marine Socio-Ecological Systems Research is poised for significant advancements in the next five years. I foresee increased interdisciplinary collaboration, leveraging new technologies such as AI and remote sensing to enhance our understanding of marine ecosystems. There will likely be a greater focus on integrating socio-economic factors with ecological data to develop holistic management strategies. This will be crucial in addressing the complex challenges posed by climate change, overfishing, and unsustainable tourism practices.

I believe that the field will also see more robust stakeholder engagement, with scientists, policymakers, and local communities working together to develop and implement effective management plans. This collaborative approach will be essential for creating sustainable solutions that balance the needs of both human and ecological systems.

Isei Ran is a Ph.D. student at Tokyo University of Marine Science and Technology. Specializing in the regional management of marine tourism, Ran's research focuses on sustainable tourism practices and their impact on local economies and ecosystems. Ran has presented work at various national and international conferences. Passionate about marine conservation, Ran aims to bridge the gap between research and policy to promote sustainable tourism practices globally.

Yokohama City at night

Yokohama Chinatown

Monitoring Harmful Algal Biotoxins in British Columbia Coastal Waters

Andrew Ross and Mackenzie Mueller

Marine phytoplankton or microalgae are microscopic plants that form the basis of the oceanic food web. Rapid growth of these organisms can result in large accumulations or 'blooms' of algal cells, some of which can be harmful to other marine life.

In 2015 an extraordinary phytoplankton bloom occurred along the continental shelf of western North America including the coastal waters of British Columbia (B.C.), Canada. The bloom contained species of the pennate diatom *Pseudo-nitzschia* that, under certain conditions, produce the neurotoxin domoic acid. This algal biotoxin is responsible for amnesic shellfish poisoning (ASP) in humans and has been associated with illness and mortality in marine mammals.

In 2016 Fisheries and Oceans Canada (DFO) Scientist Dr. Ian Perry and co-workers at the Institute of Ocean Sciences in Sidney, B.C. began monitoring levels of particulate domoic acid in the waters off Canada's west coast. Results showed that domoic acid tends to reach higher concentrations in B.C. coastal waters than offshore, particularly along the west coast of Vancouver Island (Perry et al., 2023). These waters include critical habitat for endangered Southern Resident Killer Whales and Pacific salmon as well as aquaculture facilities that have been negatively impacted by harmful algal blooms (HABs).

In 2019 we began a research project to study domoic acid and other algal biotoxins including those responsible for paralytic (PSP) and diarrhetic shellfish poisoning (DSP) near fin-fish aquaculture facilities, in partnership with B.C. salmon farmers. This project included the development of new methodology for measuring dissolved, particulate, and total biotoxin concentrations in seawater (Ross et al., 2023) in collaboration with Blair Surridge at M.B. Laboratories in Sidney, B.C.

In 2020 we began collaborating with Pacific Salmon Foundation (PSF) biologist Svetlana Esenkulova (a member of the PICES Section on the Ecology of Harmful Algal Blooms, or S-HAB) and the PSF Citizen Science Oceanography Program (https://www.marinescience.ca/citizen-science-programs/) to monitor and compare marine biotoxins, harmful algae, and environmental conditions in the Salish Sea. This led to the establishment of DFO's Marine Biotoxin Monitoring Program (https://waves-vagues.dfo-mpo.gc.ca/library-bibliotheque/41199248.pdf) which includes long-term biotoxin monitoring sites in the Salish Sea and in Clayoquot Sound on the west coast of Vancouver Island (Figure 1).

In 2022 the Program was expanded to include samples collected by DFO three times a year during Salish Sea Biophysical Surveys and twice a year during La Perouse surveys on Vancouver Island's west coast. Since fall 2023 samples for biotoxin analysis have also been collected in Barkley Sound, as part of DFO's Pacific Salmon Strategy Initiative, and by the Snuneymuxw First Nation Marine Division at monitoring stations near Nanaimo on the east coast of Vancouver Island.

To enable monitoring of dissolved and particulate biotoxins, seawater is first collected from a depth of up to 5m using a Niskin sampling bottle or other suitable container. Samples for biotoxin analysis are obtained by using a filter holder and vacuum pump to draw up to 1 litre of seawater through a filter and collect the filtrate. Biotoxins are recovered from the filter using solvent extraction and from the filtrate by solid-phase extraction. The extracts are then analyzed for biotoxins using high-performance liquid chromatography combined with tandem mass spectrometry (Figure 2). Filter and filtrate measurements are used to investigate the distribution of dissolved and particulate biotoxins, or are combined to obtain the total concentration of biotoxins in seawater.

Analysis of samples collected at long-term monitoring sites reveals seasonal trends in biotoxin concentrations that reflect those of the harmful algae that produce them. For example, the concentration of ASP toxin domoic acid at Malaspina Channel in the Salish Sea tends to peak in April, following the regular spring phytoplankton bloom, whereas PSP toxins in Clayoquot Sound reach a maximum in September when algae of the genus *Alexandrium*,

Figure 1: Locations where surface seawater is collected for algal biotoxin analysis in the coastal waters of British Columbia, Canada. Long-term monitoring sites in Malaspina Strait (IS-2), Cowichan Bay (CBE-2) and Clayoquot Sound (Farms A and B) are highlighted in yellow. Barkley Sound is shown by the dashed box and Southern Resident Killer Whale critical habitat by the dashed circle.

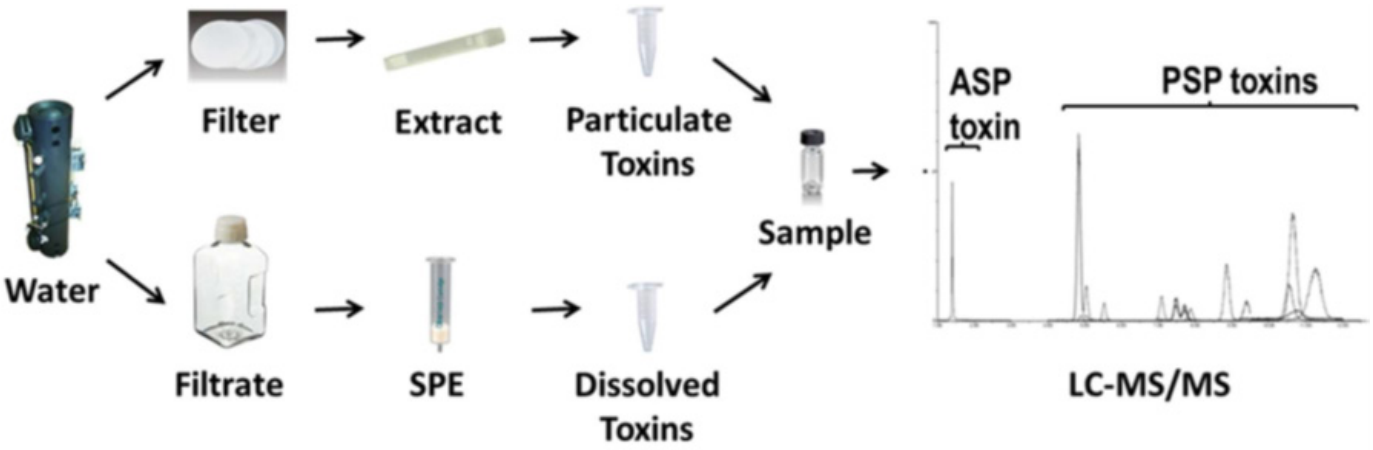


Figure 2: Procedure for the analysis of dissolved and particulate biotoxins in seawater. About one litre of surface seawater is drawn through a filter under vacuum and the filter and filtrate analyzed separately by liquid chromatography-tandem mass spectrometry (LC-MS/MS). Amnesic (ASP) and paralytic shellfish poisoning (PSP) toxins are analyzed together, as are diarrhetic shellfish poisoning (DSP) and other toxins.

which produce these toxins, are present (Figure 3). This information can be used to help predict when and where marine mammals, fish and sea-birds may be exposed to harmful algal biotoxins in B.C. coastal waters.

The presence or absence of algae that produce biotoxins can be inferred from the analysis of filter and filtrate samples. For example, up to half the total amounts of domoic acid and PSP toxins measured near the entrance to Barkley Sound on the west coast of Vancouver Island (Figure 1) in summer 2023 were in filter samples. This suggests that harmful algal cells, along with any other particles carrying these toxins, were present at the time. However, biotoxins are often found only in filtrate samples, suggesting that they can persist in the marine environmental after the HABs that produced them have dispersed.

As well as supporting aquaculture management and citizen science, data from the DFO Marine Biotoxin Monitoring program is being used to assess the risk posed by HABs to wild fish and marine mammals. For example, levels of domoic acid and PSP toxins in the Salish Sea tend to be higher within an area identified as critical habitat for endangered Southern Resident Killer Whales (Figure 1), particularly in the fall (Ross et al., 2023). In Barkley Sound, an area of high importance to west coast Vancouver Island Chinook salmon, PSP toxins measured in September 2023 reached some of the highest concentrations we have seen in B.C. coastal waters (over 4,000 ng/L) while levels of domoic acid (up to 100 ng/L) approached those associated with accumulation of this toxin in shellfish (Perry et al., 2023).

Along with domoic acid and PSP toxins we often detect DSP and other toxins in B.C. coastal waters (Shartau et al., 2023). These include dinophysistoxin 1 and pectenotoxin 2, which are produced by algae of the genus *Dinophysis*, and *yessotoxin*, produced by *Protoceratium*, which was particularly abundant in 2022 (Ross et al., 2023). More recently, we have started to detect toxins called azaspiracids in some samples. To help determine the extent to which fish and marine mammals are exposed to these toxins we are adapting our analytical methods to measure them in biological samples such as gill, liver, and fecal material.

Comparing biotoxin measurements with environmental data collected by aquaculture industry partners, citizen scientists and DFO colleagues suggests that the production of certain biotoxins may be related to water temperature

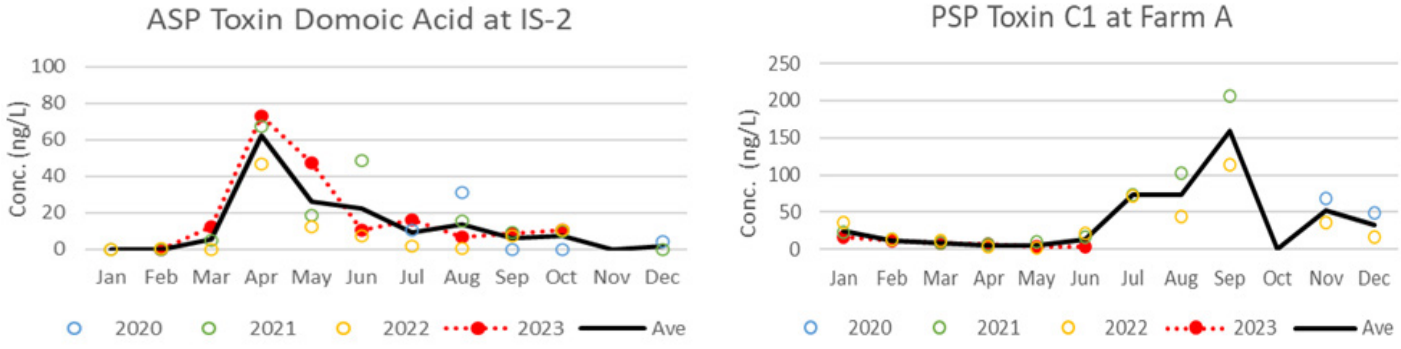


Figure 3: Examples of seasonal trends in ASP (left) and PSP toxin (right) concentrations observed at long-term monitoring sites in Malaspina Strait (IS-2) and Clayoquot Sound (Farm A: see Figure 1).

Figure 4: Algal bioreactor at the Fisheries and Oceans Canada Institute of Ocean Sciences in Sidney, B.C.

and the availability of major nutrients like nitrate and phosphate. We are using a unique, five-chambered algal bioreactor supplied by Industrial Plankton of Victoria, B.C. (Figure 4) to perform parallel culture experiments in order to investigate the effects of ocean conditions like nutrient concentrations and pH on growth and biotoxin production in harmful algae.

In conclusion, DFO's Marine Biotoxin Monitoring Program provides information on the status and trends of biotoxins produced by harmful algae in B.C. coastal waters. Long-term monitoring sites established in partnership with B.C. salmon farmers and citizen scientists provide information to help predict the occurrence of biotoxins at locations in the Salish Sea and on the west coast of Vancouver Island. Samples collected during regular DFO surveys provide information on biotoxin levels in critical habitat for at-risk salmon populations and resident killer whales. This information supports the assessment of risks posed by toxic HABs to marine life and how they might be affected by future climate-related changes in ocean conditions on Canada's west coast.

Acknowledgments

We thank Cermaq Canada, Snuneymuxw First Nation and Pacific Salmon Foundation citizen scientists as well as the Chief Scientists, Canadian Coastguard crews and DFO Science Staff involved in Salish Sea and La Perouse surveys for their ongoing contributions to the monitoring of harmful algal biotoxins in B.C. coastal waters.

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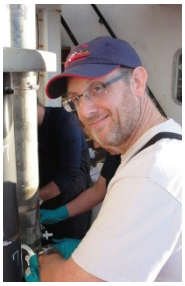


Dr. Andrew Ross (Andrew.Ross@dfo-mpo.gc.ca) is a Research Scientist at the Fisheries and Oceans Canada (DFO) Institute of Ocean Sciences (IOS) in Sidney, British Columbia and a Canadian member of the PICES Marine Environmental Quality (MEQ) Committee and Section on the Ecology of Harmful Algal Blooms (S-HAB). His research interests include the dynamics and drivers of toxic algal blooms in British Columbia coastal waters and the speciation, distribution and bioavailability of trace metals in the ocean. Dr. Ross is an Adjunct Professor in Biochemistry and Microbiology at the University of Victoria, Canada where he lectures in proteomics.

Mackenzie Mueller (Mackenzie.Mueller@dfo-mpo.gc.ca) is a Biology Technician at the Fisheries and Oceans Canada (DFO) Institute of Ocean Sciences (IOS) in Sidney, British Columbia where she acts as coordinator for the Marine Biotoxin Monitoring Program. Mackenzie is a graduate of the University of Victoria with a degree in Marine Biology and is currently working with Dr. Andrew Ross on research to better understand the causes and impacts of toxic algal blooms. She works closely with internal and external partners including aquaculturists, citizen scientists, Indigenous communities, and those involved in the conservation of wild salmon and marine mammals.

PICES 2023 Workshop Report - W07

Integrating biological research, fisheries science and management of flatfish species in the North Pacific Ocean in the face of climate and environmental variability

Josep Planas, Mackenzie Mazur, Naoki Toj, and Roman Novikov

Convenors

Josep Planas (corresponding; USA)

Mackenzie Mazur (Canada)

Naoki Tojo (Japan)

Roman Novikov (Russia)

Invited Speakers

Dr. Philina English (DFO, Canada)

Dr. Allan Hicks (International Pacific Halibut Commission, USA)

Dr. Noelle Yochum (Trident Seafoods, USA)

Background

The North Pacific Ocean is a large and productive ecosystem that is characterized by strong interdecadal climate variability. This Ocean basin supports a number of fish species of great ecological, as well as economical, importance. A successful PICES FIS-Workshop, that was co-sponsored by the International Pacific Halibut Commission (IPHC) at the 2019 PICES Annual Meeting (W2), addressed important current topics related to the biology and fishery of Pacific halibut and interacting species in the North Pacific Ocean. Two FIS Workshops have taken place in previous PICES Annual Meetings (in 2019 and 2022) to bring together researchers, scientists and managers from countries that are invested in this resource. An important outcome of these workshops was the need to increase the application of integrative approaches to improve our understanding of the biology and management of widely-distributed species, such as Pacific halibut, in the North Pacific Ocean, requiring a high level of cooperation at the international level. Therefore, to achieve these goals and as a step forward in addressing key areas of cooperation between PICES and IPHC as described in the current MoU between the two organizations, a third Workshop took place at the 2023 PICES Annual Meeting (W7) to address emerging issues in key flatfish species with broad distribution across the entire North Pacific Ocean. The theme of this Workshop was aimed at 1) devising strategies for data sharing on fishing efforts and management of flatfish species across the North Pacific Ocean, and 2) promoting international collaborative studies to improve our knowledge on movement of flatfish populations and potential distribution changes of flatfish and other interacting species in the face of climate variability.

Summary

This one-day Workshop (W7) was held on October 22, 2023, and the session was opened by Dr. Josep Planas who welcomed the participants and provided a brief introduction to the Workshop. The session featured 3 invited presentations and 9 regular oral presentations. The various presentations covered specific topics related to a) assessing the effects of environmental variability on the Pacific halibut fishery (English, Hicks, Webster, Young), b) food webs and productivity (Surma, Wolf), c) population genomics (Jasonowicz), d) parasitic infections (Kroska), e) bycatch and depredation (Yochum, Christie, Dykstra), and f) reproductive biology (TenBrink, Jones).

After the presentations, a discussion session took place among participants. The discussed topics including next steps for methods to understand the impact of climate change on flatfish species, improved understanding of the impacts of climate change on flatfish and implications for fisheries management, the inclusion of impacts of climate change in to flatfish stock assessments, heightened information sharing on biology and ecology of key flatfish species and on stock assessment and management strategies for flatfish among countries of the North Pacific rim, and the need for establishing working international collaborations among North Pacific rim countries to improve available information on connectivity and distribution changes of flatfish species in the face of climate change. The discussion session ended with support from participants for the submitted proposal of a fourth Workshop to be held at the 2024 PICES Annual Meeting in Honolulu.

Agenda for Workshop 7

09:00-9:10 Welcome and Introduction to the Workshop

9:10-9:40 Invited Speaker: Identifying the impacts of warming waters on British Columbia's groundfish productivity. – Dr. Philina English, Fisheries and Oceans Canada

9:40–10:10 Invited Speaker: Managing the Pacific halibut (*Hippoglosssus stenolepis*) fishery while considering historical and future changes in the environment. – Dr. Allan Hicks, International Pacific Halibut Commission

10:10-10:30 Oral Communication: Environmental conditions on the Pacific halibut fishing grounds obtained from a decade of coastwide oceanographic monitoring, and the potential application of these data in stock analyses. – Dr. Raymond Webster, International Pacific Halibut Commission, USA

10:30-10:50 Coffee Break

10:50–11:10 Oral Communication: Investigating food web and groundfish community structure in the eastern Gulf of Alaska. – Dr. Szymon Surma, University of British Columbia, Canada

11:10-11:30 Oral Communication: Exploring the relationship between diet and size-at-age in Pacific halibut. – Dr. Nathan Wolf, Alaska Pacific University, USA

11:30-11:50 Oral Communication: Will a warming subarctic Bering Sea favor yellowfin sole production?– Dr. Cynthia Yeung, NOAA Fisheries, USA

11:50-12:10 Oral Communication: Whole-genome sequencing to investigate population structure and dynamics of Pacific halibut in the northeast Pacific Ocean. – Mr. Andrew Jasonowicz, International Pacific Halibut Commission, USA

12:10–12:30 Oral Communication: Exploring the relationship of Ichthyophonus exposure to infection prevalence and severity in wild-caught Pacific halibut. – Ms. Anita Kroska, Alaska Pacific University, USA

12:30-14:00 Lunch

14:00-14:30 Invited Speaker: Conservation engineering approaches for mitigating Pacific halibut (Hippoglossus stenolepis) bycatch: biology, behaviour, and technology. – Dr. Noelle Yochum, Trident Seafoods

14:30-14:50 Oral Communication: Testing of a semi-demersal longline to reduce yelloweye rockfish bycatch in a U.S. West Coast Pacific halibut longline fishery. – Mr. Gregory C. Christie, Pacific States Marine Fisheries Commission, USA

14:50-15:10 Oral Communication: Gear-based approaches to protecting Pacific halibut captured on longline gear from removal by marine mammal depredation. – Mr. Claude Dykstra, International Pacific Halibut Commission, USA

15:20-15:40 Coffee Break

15:40-16:00 Oral Communication: Delineating yellowfin sole (Limanda aspera) reproduction in the northern Bering Sea provides information across the eastern Bering Sea continental shelf. – Mr. Todd TenBrink, NOAA Fisheries, USA

16:00–16:20 Oral Communication: Update of maturity-at-size and -age for Pacific halibut (Hippoglossus stenolepis) using histological analysis. – Mr. Colin Jones, International Pacific Halibut Commission, USA

16:20–16:50 Discussion

PICES Annual Meeting 2024 - Honolulu, USA

PICES Secretariat

The Secretariat is looking forward to welcoming the PICES Community to our Annual Meeting in Honolulu, USA at the Honolulu Convention Center!

For this year's theme"The FUTURE of PICES: Science for Sustainability in 2030" we will bring together research, ideas, and discussions exploring progress made to understand the combined effects of climate change and anthropogenic pressures on marine ecosystems, ecosystem services, and marine dependent social systems. Further, we will discuss how to steer our research for "the science we need for the ocean we want" and continue providing leadership to the United Nations Decade of Ocean Science for Sustainable Development.

The scientific program includes 10 workshops, 12 Topic Sessions, and an evening poster session. This year, we will begin sessions with a special Symposium for FUTURE (Forecasting and Understanding Trends, Uncertainty, and Responses of North Pacific Marine Ecosystems) and end sessions with a special panel on PICES next directions.

While the PICES Community is 'serious' about science, PICES Annual Meetings are a friendly, inclusive, and collaborative environment to discuss and share ideas. We welcome and celebrate diversity in our community, from Early Career Ocean Professionals (ECOPs) to Senior Scientists, breaking barriers for interdisciplinary research, and representation from numerous countries and cultures. Our annual meetings are a perfect opportunity for members to build relationships, get new perspectives, and develop collaborations in their work.

For more information, visit the PICES 2024 meeting website at: https://meetings.pices.int/meetings/annual/2024/pices/scope

Scientific Program and Schedule

Date	Sessions and Workshops	Business Meetings
Oct 26 - Saturday	Parallel Workshops	Day: EG meetings; Evening: Committee meetings
Oct 27 - Sunday	Parallel Workshops	Day: EG meetings; Evening: Committee meetings
Oct 28 - Monday	Opening Ceremony; FUTURE Symposium	
Oct 29 - Tuesday	Parallel Topic Sessions	EG meetings; F&A meeting
Oct 30 - Wednesday	Parallel Topic Sessions	EG meetings; F&A meetings
Oct 31 - Thursday	Parallel Topic Sessions; Evening Poster Session	EG meetings
Nov 1 - Friday	AM: Special Panel on PICES in the next decade & Noon: Closing Session	PM: Science Board Day 1
Nov 2 - Saturday		Science Board meeting Day 2; Governing Council Day 1
Nov 3 - Sunday		Governing Council meeting Day 2

Workshops

W1: North Pacific plankton time series data analyses and synthesis

W2: Applying social-ecological frameworks to explore actionable solutions for climate extreme events across the North Pacific

W3: Exploring human networks to power sustainability in North Pacific Ocean S1: Climate Extremes and Coastal Impacts in the Pacific

W4: Contrasting the occurrence of toxic Alexandrium blooms in the eastern and western North Pacific

W5: Exploring international knowledge co-production: Lessons learned from international marine science organizations at the science-policy interface

W6: Co-creating a shared framework for ocean data management: Finding common ground on terminology

W7: Integrating biological research, fisheries science and management of flatfish species in the North Pacific Ocean in the face of climate and environmental variability

W8: "Science Jam" - Bridging the gap between science and social media to communicate PICES accomplishments with the world

W9: Puffin diet samples as indicators of forage nekton availability and community structure in the North Pacific

BECI Special Workshop: Bringing together models for fisheries management under climate change – model ensembles and inference to guide decision-making

Sessions

Symposium: FUTURE

S1: Climate Extremes and Coastal Impacts in the Pacific

S2: S-CCME/SICCME session on innovation in using integrated approaches to detect and manage for the effects of climate change tipping points and critical thresholds in marine ecosystems

S3: Advanced tools to monitor, observe, and assess small pelagic fish populations in support of ecosystem based fisheries management and maintaining ecosystem services

S4: Observational frontier and new studies for understanding of ocean and ecosystem

S5 CANCELLED: Ocean negative carbon emissions: Blue technology innovation for promoting global sustainable development

S6: Past, Present and Future of CREAMS program: 30 years of international research in North East Asian Marginal Seas

S7: Social, economic and ecological implications of recoveries, range expansions and shifting distributions of marine birds, mammals and fish

S8: Changing ocean carbon cycle and its consequences for the ocean environment: Detection, prediction and mitigation

S9: Recent advances in plastic pollution research in the North Pacific

S10: East meets West and West meets East: Past, current and future implications of Non-Indigenous Species (NIS) in the North Pacific

S11: Impacts of warming-induced changes in body sizes on marine fish ecology and their consequences for ecosystems and associated fisheries

S12: The Changes in Distribution of Harmful Algal Blooms (HABs) in the North Pacific Region

S13: Rapid plankton assessment for ecosystem assessment

Special Panel: PICES in the next decade

Diver in Kaloko-Honokōhau National Park, Hawaii Credit: Shaun Wolfe / Ocean Image Bank

Regional Reports
The Western North Pacific: Current Status and Developments
Yoshikazu Fukuda and Tetsuya Nakamura

Sea surface temperatures and the Sea of Okhotsk sea ice in the 2023/2024 cold season
Yoshikazu Fukuda (Japan Meteorological Agency)

The western North Pacific exhibited positive sea surface temperature (SST) anomalies over a wide area from 30 to 45°N throughout the winter 2023/2024 (Figure 1), with values exceeding +6°C off the Sanriku coast of eastern Japan, where the Kuroshio Extension was shifted northward to around 40°N. Notable +2°C anomalies were also recorded in waters west of Japan in association with the presence of a polar front north of its normal position. In the area south of 30°N, negative anomalies were observed in March.

The winter maximum sea ice extent in the Sea of Okhotsk was 1.21 million km^2 in late February, which was around 108% of the 30-year average of 1.12 million km^2. The seasonal maximum exhibits a long-term decreasing trend of 0.051 million km^2 per decade, which corresponds to 3.2% of the sea's total area (Figure 2).

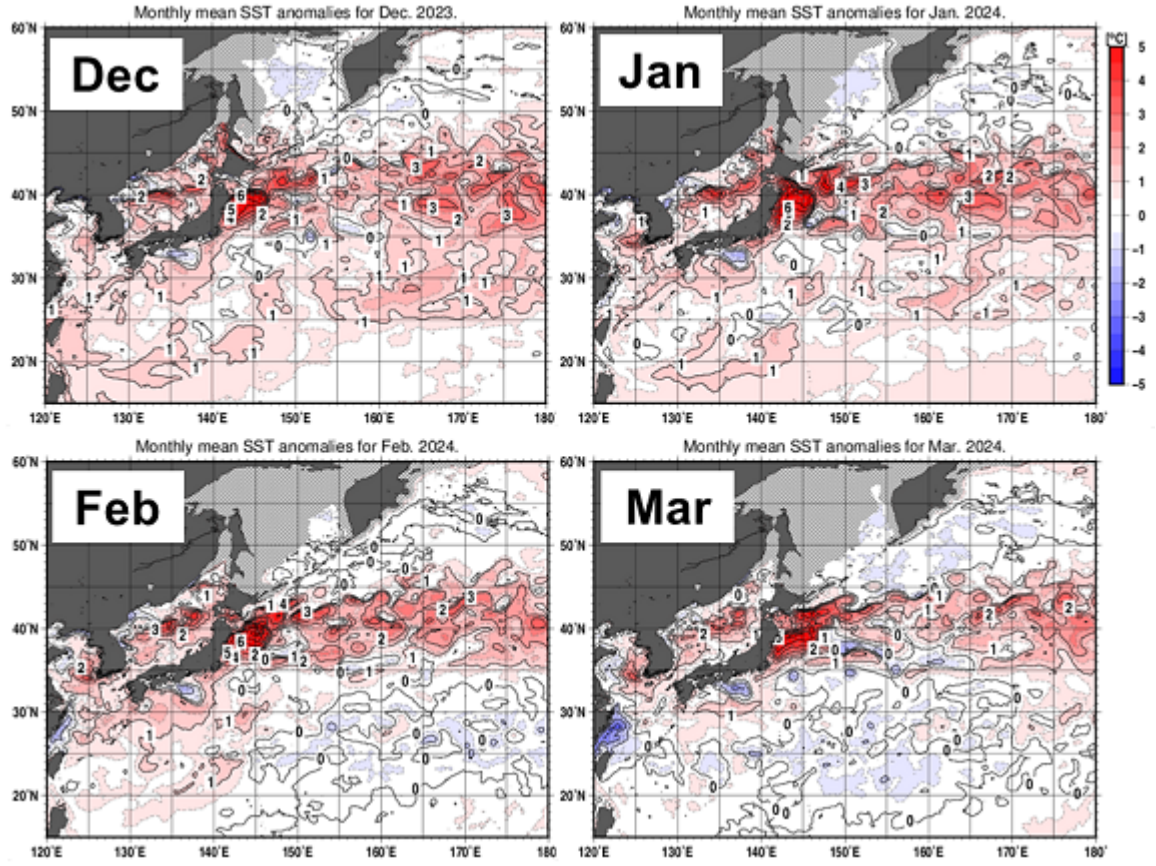


Figure 1: Monthly mean SST anomalies from December 2023 to March 2024 based on JMA HIMSST (High-resolution Merged Satellite and In-situ Data on Sea Surface Temperature). Anomalies are deviations from the 1991–2020 climatology.

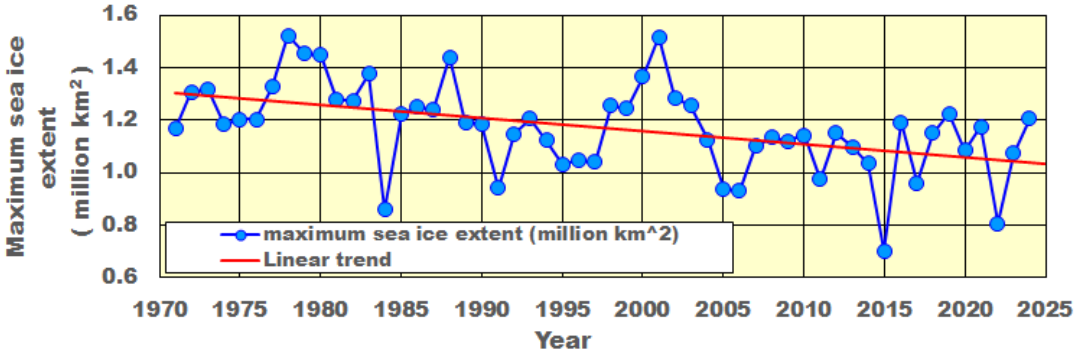


Figure 2: Time-series representation of winter maximum sea ice extents in the Sea of Okhotsk for 1971 – 2024. The red line denotes the long-term linear trend.

Japan Meteorological Agency's Research Vessel Ryofu Maru

Tetsuya Nakamura (Japan Meteorological Agency)

1. Introduction

The Ryofu Maru (Japan's first large-scale meteorological observation ship) was called the Meteorological Observatory sailing on the Sea, and was commissioned in 1937 to play a key role in typhoon observation for the western North Pacific. The name literally means "wind-defying ship" after a vessel used for scholarly exploration of unknown parts of northern Japan in the early 19th century. In 1966 the vessel was replaced by a second-generation ship, the Ryofu Maru II, with enhanced oceanographic and marine meteorological observation capacity from updates including weather radar and other meteorological observation equipment. The year after its completion, winter oceanographic observation along the 137th parallel east began and continues to this day. In 1995, the vessel was again replaced by a third-generation ship, the Ryofu Maru III, capable of continuous CO_2 observation for climate change monitoring and more extensive and accurate oceanographic observation in the western North Pacific. This generation featured further enhanced meteorological observation facilities, including an aerological observation system involving the use of GPS sondes. In March 2024, this maritime history continued with the Ryofu Maru IV, featuring even more advanced observation equipment and environmentally friendly design (Figure 1).

Figure 1: Ryofu Maru I (top) and Ryofu Maru IV (bottom).

The Japan Meteorological Agency (JMA) is the only organization in Japan capable of conducting long-term continuous oceanographic and marine meteorological observation in the western North Pacific. Today's Ryofu Maru, together with its sister vessel the Keifu Maru, continues to produce highly accurate observation data on fundamental oceanographic conditions in the western North Pacific. It plays a major role in monitoring elements of climate change such as global warming and marine environments, which are influenced by the movement of the western Kuroshio boundary current.

This paper outlines observations conducted using JMA's oceanographic and marine meteorological observation vessels, with focus on the latest generation of the Ryofu Maru.

2. Observations by JMA research vessels

JMA uses research vessels for regular monitoring along oceanographic observation lines in the western North Pacific (Figure 2) to determine oceanic carbon dioxide concentrations for optimal global warming prediction accuracy, and to elucidate the effects of long-term oceanic changes on the climate.

This observation provides information[1] on carbon dioxide column inventory, acidification, and changes in sea surface temperature/ocean heat content. The data contribute to decision-making on climate change countermeasures.

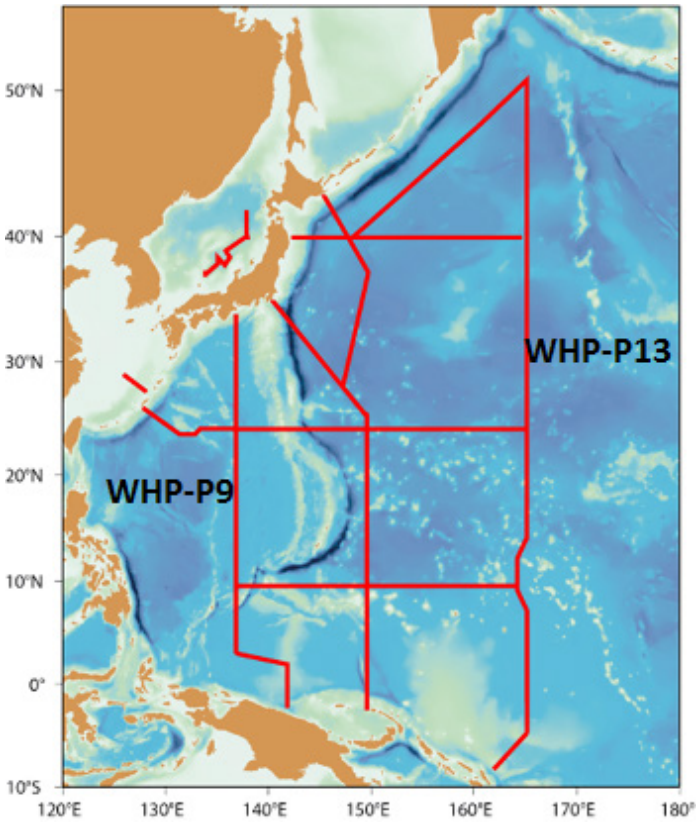


Figure 2: Japan Meteorological Agency oceanographic observation lines.

In particular, observation along the 137th parallel east (the 137°E Line) – a typical JMA fixed line – began in winter 1967 the year after the Ryofu Maru II entered service, and has been conducted twice a year since 1972, including summer observations (Figure 3).

Figure 3: 50th winter observation along the 137°E line.

The results have been used extensively in research papers and cited in IPCC (Intergovernmental Panel on Climate Change) assessment reports. At the 2016 PICES Annual Meeting, JMA was announced as the winner of the 9th PICES Ocean Monitoring Award (POMA)[2] for its JMA 137°E Repeat Hydrographic Section.

JMA's oceanographic observation line is defined in the western North Pacific, mainly in waters around Japan. For routine observation, the vessel stops at approximately every 1 degree of latitude (around 110 km) and lowers monitoring equipment into the ocean, repeating the process day and night. Stations generally observe down to a depth of 2,000 m, where there is hardly any current, but some go as deep as 6,000 m to detect minute fluctuations in lower layers.

Observation variables include water temperature, salinity, current, dissolved oxygen (O_2), nutrients (phosphate, nitrate, nitrite, silicate), total inorganic carbon, total alkalinity, hydrogen ion concentration index (pH), CFCs, chlorophyll, and phaeo-pigments. The results are published at data centers such as the CLIVAR and Carbon Hydrographic Data Office and on the JMA website[3].

3. Ryofu Maru IV equipment

3.1 Hull outline and maneuvering equipment

Built by Japan Marine United Inc. and commissioned in March 2024 as a JMA research vessel, the Ryofu Maru IV has a gross tonnage of 2,373, an overall length of approximately 85 meters, and a breadth of 14 meters.

The ship is powered by a tandem counter-rotating propeller system with an azimuth thruster device behind the normal controllable pitch propeller to serve as a rudder. Each propeller is reversed for counter-rotation to improve propulsive performance and fuel efficiency. This system enables short-range low-speed navigation using only the azimuth pod propeller and can generate 360° propulsive force, allowing stable and efficient maneuvering during stationary observation.

To protect marine environments (e.g., preventing organisms in ballast water from migrating through the vessel into alien waters), the ship has a ballast water treatment system compliant with the International Maritime Organization Ballast Water Management Convention D-2 standards and the United States Coast Guard regulations.

3.2 Observation equipment

The Ryofu Maru IV's meteorological observation equipment includes temperature and humidity meters, aerovanes, wave gauges, a precipitable water vapor measurement system (leveraging positioning signal delay from satellites for calculation), and an aerological observation system (to support forecasting of short-term heavy rainfall caused by water vapor from the ocean; Figure 4), as well as a depth recorder and a current profiler that transmits sound waves from the underside of the ship and converts the time difference between reflected waves into water depth and ocean current values (Figure 5).

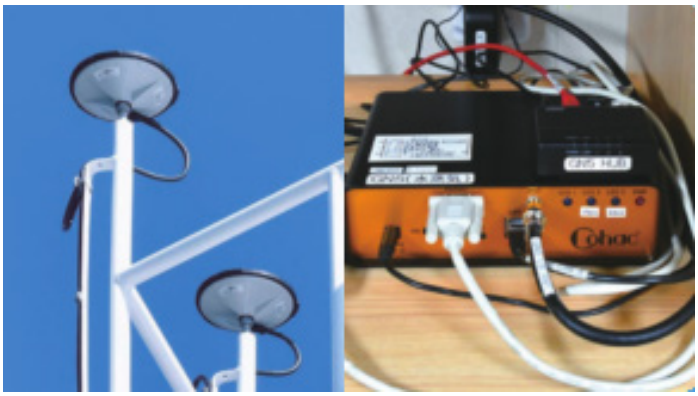


Figure 4: Precipitable Water Vapor measurement system.

Observation is conducted in Laboratory No. 1 (for continuous monitoring of greenhouse gas-related concentrations while the ship is sailing and analysis of seawater samples collected during stationary observation), Laboratory No. 2 (generally for analysis of oceanic chemical compositions), and Laboratory No. 3 (for monitoring and recording of data related to marine meteorological elements and ocean physics).

Observation is generally conducted using a conductivity-temperature-depth profiler (CTD), a 36-position water sampler (Sea-Bird Scientific, USA) and a winch/crane system (FET-Dynacon Inc., USA) (Figure 6).

Figure 5: Precision Depth Recorder and Acoustic Doppler Current Profiler (ship's underside).

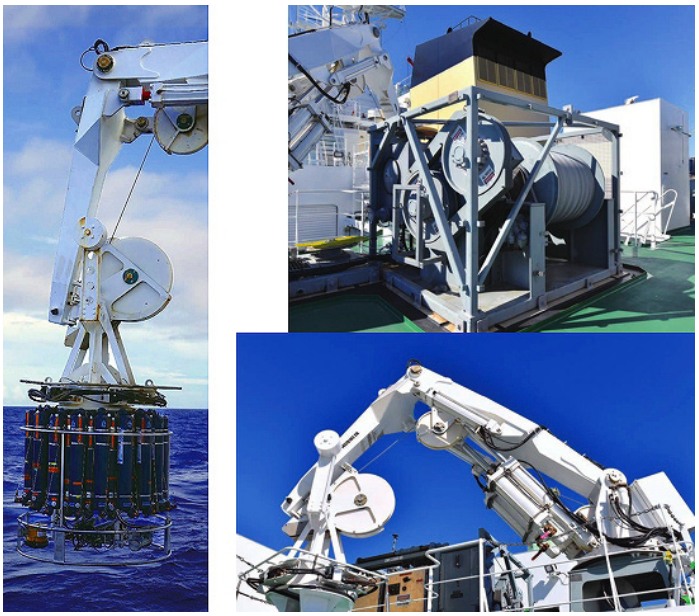


Figure 6: CTD winch and crane system.

The CTD system uses a special armored cable to acquire 24 data points per second on pressure, water temperature and conductivity (converted to salinity) from sensors, which are monitored in real time by an on-board computer. During water collection, samples can be taken at any depth among 36 layers using 10 L Niskin bottles, and chemical compositions are determined on board.

This CTD system also obtains data on other elements from external sensors, and an optical dissolved oxygen sensor (JFE Advantech Co., Ltd., Japan) is used to simultaneously record data.

4. Conclusion

Following the start of the COVID-19 pandemic in 2020, restrictions on ship operations and international port calls forced JMA to reduce the scale of its oceanographic and marine meteorological observations in the western North Pacific. Now, however, flexible voyage plans are again possible, and wide-area oceanographic observation was re-introduced in February 2024.

During the 2024 flood season (June to October), several Ryofu Maru observation cruises are planned (including water vapor observation around Japan) for the purpose of contribution to monitoring and forecasting of heavy rainfall on land. Current scheduling includes the 53rd boreal-summer oceanographic observation (July – August 2024) and the 59th boreal-winter oceanographic observation (February – March 2025) along JMA's 137°E line.

Together, with information from its sister ship, the Keifu Maru, the data produced will help to improve disaster prevention information based on oceanographic and marine meteorological observations. The vessel will continue to play key roles in monitoring of the climate and environmental change in the western North Pacific region.

Notes

[1] https://www.data.jma.go.jp/kaiyou/english/state_of_ocean_climate_index.html

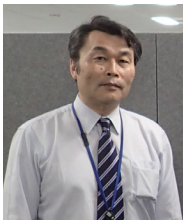
https://www.data.jma.go.jp/kaiyou/english/oceanic_carbon_cycle_index.html

[2] https://meetings.pices.int/awards/POMA_Award/POMA-recipients/2016-POMA

[3] https://cchdo.ucsd.edu/

https://www.data.jma.go.jp/kaiyou/db/vessel_obs/data-report/html/ship/ship_e.php

Yoshikazu Fukuda is a senior engineer in the Office of Marine Prediction within the Atmosphere and Ocean Department of JMA in Tokyo, Japan



Tetsuya Nakamura is the Head of the Atmospheric and Marine Environment Analysis Center in the Atmosphere and Ocean Department of JMA in Tokyo, Japan

Regional Reports

The Northeast Pacific: Update on Marine Heatwave Status and Trends

Andrea Hilborn, Charles Hannah, Lu Guan, Moira Galbraith, Tetjana Ross, and Akash Sastri

As we near the summer solstice of 2024, it's time to reflect on Northeast Pacific (NEP) temperatures from winter and spring thus far, and make a prediction for the summer ahead.

Globally, sea-surface temperature (SST) anomalies have remained in record-breaking territory since last year (e.g., Climate Reanalyzer, n.d.; Goreau and Hayes, 2024). Approximately 40% of the global ocean has remained in Marine Heatwave (MHW) status since August 2023, after a steady climb beginning in February 2023 (NOAA PSL, 2024). However, the impact of the El Niño on the NEP over the winter was mixed. Surface ocean temperatures remained warmer than normal for late autumn and winter (example in Figure 1A), but through early 2024 large areas further offshore of California (approximately 33°N to 45°N) had cool anomalies, with MHW conditions hugging the coastline (Figure 1B). This pattern lasted into April. Within the Canadian Exclusive Economic Zone (EEZ), MHW conditions were present throughout the autumn of 2023, winter and spring of 2024 (Figure 1D), but with a large amount of spatial and temporal variability. This is in contrast to 2023, which did not see MHWs in the Canadian EEZ until mid-May. Since April, a large MHW has been brewing in the western NEP. In recent weeks the MHW area has developed and expanded, with current SST anomalies averaging ~3°C. This offshore spring MHW development is consistent with the previous five years, as discussed further on the National Oceanic and Atmospheric Administration (NOAA) California Current MHW Blobtracker website (CCIEA, 2024). Coinciding with this MHW development, cold anomalies along the coast and north of 50°N have been present (Figure 1C).

For this update, we also have preliminary zooplankton data from Canadian surveys to compare with these SST observations. Zooplankton collected in the early autumn of last year had a large contingent of southern copepod (e.g., Mackas et al., 2007) and chaetognath species. A positive southern copepod anomaly was similarly observed in late 2023 during California Current ecosystem monitoring (see: https://www.integratedecosystemassessment.noaa.gov/regions/california-current/california-current-

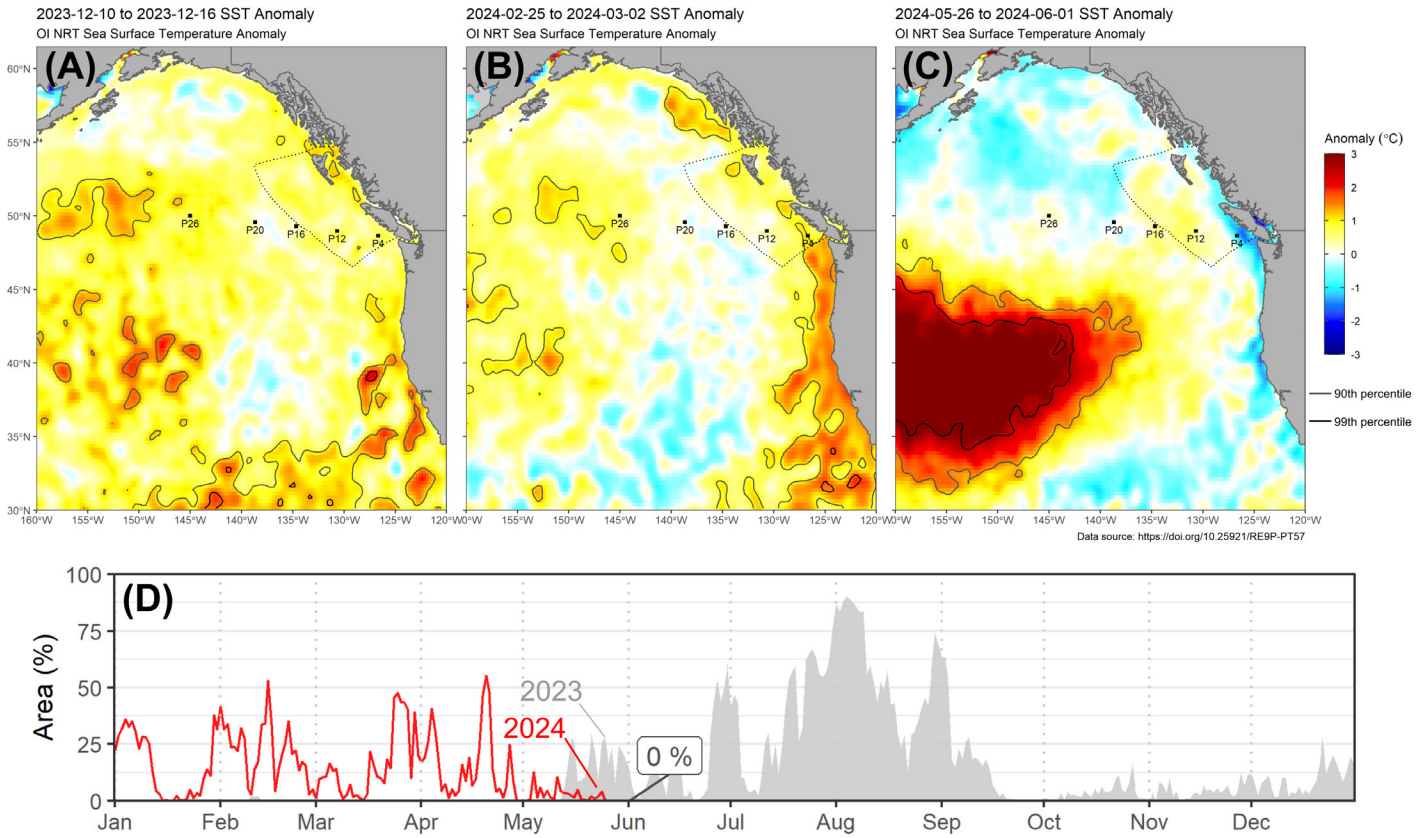


Figure 1: NOAA Daily Optimum Interpolation Sea Surface Temperature (OISST) anomaly from the week of December 10th, 2023 (A), February 25th, 2024 (B), and May 26th, 2024 (C), with approximate 90th and 99th percentiles from the 1991-2020 climatology (black contours). Selected stations along Line P are labelled as black dots, and the BC Exclusive Economic Zone (BCEEZ) is indicated with a dashed line. The percent of area within the BCEEZ dotted line in MHW status (D) is shown for 2024 (red) and 2023 (grey). Data sourced from https://doi.org/10.25921/RE9P-PT57 and analyzed by the authors.

iea-indicators). Along the shelf break of British Columbia (BC) there was also an abundance of salps and doliolids in autumn, another indicator of warm water influxes. Winter sampling on the west coast of BC was more spatially limited compared to autumn, but a single line crossing the shelf (Line P program, Jan. 23 to Feb. 9, 2024) captured low numbers of southern species on the shelf and shelf break area. The recent survey with multiple lines across the Vancouver Island shelf (May 14-27, 2024) had very few, if any, southern zooplankton. There were some *Mesocalanus tenuicornis* on the southern shelf and *Clausocalanus parapergens* along the shelf break. The sub-arctic and boreal shelf copepods were well represented with large numbers of *Neocalanus flemingeri* along the shelf break and offshore, which is a species that has not been seen since the start of the heat wave events beginning with the "Blob" in late 2013. During the May survey there were also very low numbers of doliolids observed along the outer shelf near the northern tip of Vancouver Island, and no salps captured at any of the stations. These surveys echo the SST and MHW time series, with the disappearance of warm-water species (i.e., jellies and southern copepods) indicating the diminishment of the El Niño.

At present, El Niño-Southern Oscillation (ENSO) conditions are rapidly transitioning to neutral, then likely La Niña. Recent probabilities estimate La Niña conditions developing during the next three months (June to August) at 50%, but 70% during August to November 2024 (NOAA ENSO blog, WMO 2024a). Similarly, though the global area in MHW status has been consistent over the last 10 months, projections show it generally declining into 2025 (NOAA PSL, 2024). However, La Niña conditions, which typically have a cooling effect, don't necessarily indicate a cease in warming temperatures under the conditions of climate change (WMO, 2024a; 2024b). The last nine years have been the warmest ever recorded, even during La Niña periods.

The current operational forecast from NOAA anticipates minimal warming offshore, and low probabilities of MHWs along the coast in the coming months (NOAA PSL, 2024). However, based on patterns from previous years, the California Current Integrated Ecosystem Assessment (CCIEA, 2024) anticipate that anomalously warm temperatures may reach USA and Canadian EEZ waters in the summer, and coastal waters potentially in autumn. If the offshore MHW waters shift north as a result of northward movement of the jet stream during summer, we expect there may be more warm anomalies in the Canadian EEZ that follow. Further, we suspect that MHW conditions may impact waters north of Vancouver Island earlier compared to surface waters further south.

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Regional Reports
The Bering Sea: Current Status and Recent Trends
Edited by Emily Lemagie and Elizabeth Siddon

Climate and sea surface temperature

During the period of October 2023 through March 2024, negative sea level pressure (SLP) anomalies (<3 millibars, mb) extended over much of the Bering Sea and Gulf of Alaska, with the lowest SLP anomalies centered north of the Bering Strait (Figure 1). Low pressure anomalies over the Arctic are associated with strengthening the polar vortex and reducing outbreaks of Arctic air to the middle latitudes, while a stronger Aleutian low is associated with increased wind variability. These conditions are typical of El Niño. The El Niño winter was a departure from the last three La Niña winters which had high SLP anomalies over the western Gulf of Alaska, associated with a weak Aleutian Low. A transition from the current ESNO-neutral (El Niño-Southern Oscillation) state to La Niña conditions over the tropical North Pacific are predicted over the summer.

The SLP anomaly pattern shown in Figure 1 was accompanied by weakly negative wind speed anomalies of 0 to 1.5 m s^{-1} across much of the Bering Sea and increased high-frequency variability. The details of this variability are discussed in the next section. Small mean wind anomalies were associated with small 2-m air temperature anomalies (within 1°C of the climatology) over the Bering Sea.

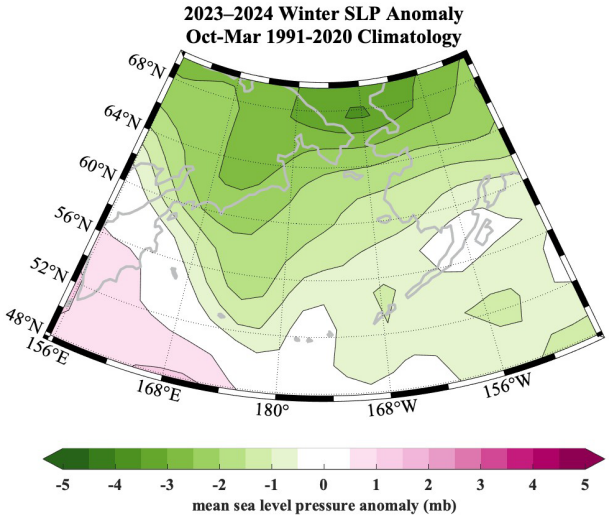

Figure 1: Mean sea level pressure (SLP) anomalies (mb) from the NCEP/NCAR Reanalysis for October 2023 – March 2024.

Sea surface temperatures (SST) were anomalously warm (0.5-1.5°C) over the southern Bering Sea averaged from October 2023 through March 2024 (Figure 2). The SST anomaly tendency was negative through the winter and spring, with SST approaching the climatological mean SST in April. Near-climatological SST over the Bering Sea shelf in September 2023 and near-climatological mean wind patterns through the winter set conditions for seasonal sea-ice advance over the Bering Sea shelf. In 2024, maximum spring sea-ice conditions over the Eastern Bering Sea shelf were fairly typical for the past decade (except 2018 and 2019 extreme years), and hence the development of a bottom cold pool almost as far south as NOAA EcoFOCI mooring M2 on the southeastern Bering Sea shelf. In April, weaker than usual winds over the southeast Bering Sea shelf and enhanced cloudiness contributed to cool conditions. Anomalously strong southward winds in May driven by relatively low SLP over the Eastern Bering Sea and mainland Alaska (Figure 3) contributed to a late sea ice retreat.

The distributions shown in Figures 1-3 are relative to norms over the period of 1991-2020.

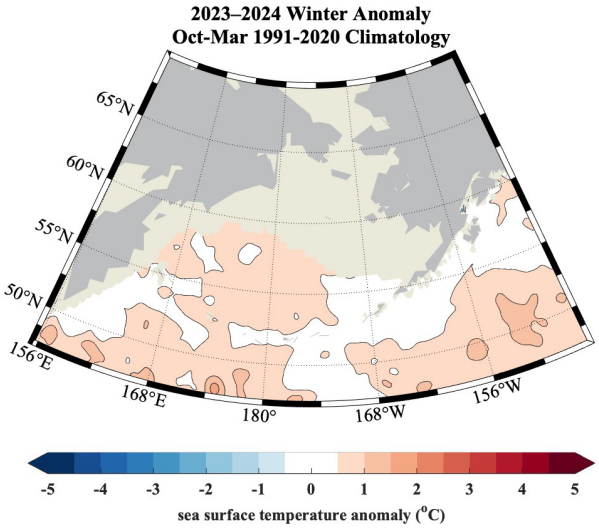

Figure 2: Mean sea surface temperature (SST) anomalies (°C) from the NOAA OI SST for October 2023 – March 2024, masked by regions with maximum sea ice concentration greater than 15%.

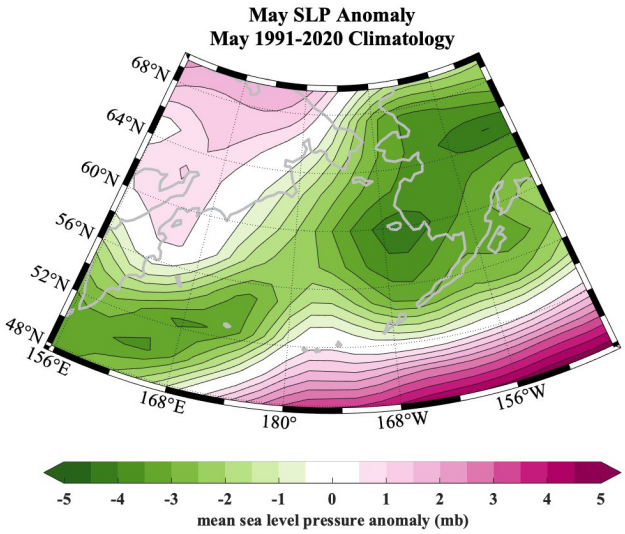

Figure 3: Mean sea level pressure (SLP) anomalies (mb) from the NCEP/NCAR Reanalysis for May 2024.

Winter Winds and Sea Ice over the Bering Sea Shelf

In the winter of 2023/2024, the advance of sea ice in the Bering Sea was delayed until mid-December (Figure 4) due to a moderately stormy November and residual warmth in the system and late freezing of the Chukchi Sea. Once sea-ice formation started, it advanced quickly over the shelf. During February and March 2024, frequent changes in wind direction (from the north or from the south) created a 'wiggly' pattern of small scale advance and retreat. Cool spring conditions maintained sea ice at its highest extent in early May since 2013.

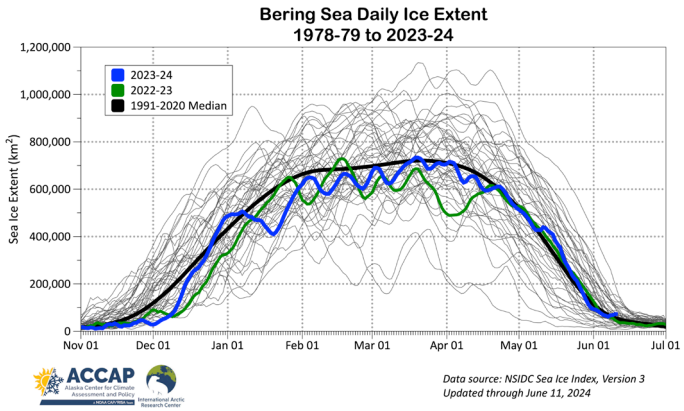

Figure 4: Daily estimates of sea-ice extent in the Bering Sea. Winter 2023/2024 is shown in blue. Figure courtesy of Rick Thoman, University of Alaska Fairbanks/Alaska Center for Climate Assessment and Policy.

In the Bering Sea, wind patterns typically correlate with sea-ice extent. Ice generally advances with northerly (from the north) winds and retreats with southerly winds. Figure 5a shows a typical pattern of negative correlation between northerly ice advance and wind velocity. Figure 5b shows that ice extent and wind anomalies were weakly correlated in 2024. Compared to prior years, there was relatively little energy in the wind signal at >10 day periods (a reflection of the frequent changes in storm tracks and resulting wind directions), which contributed to the lowest correlation between Bering Sea wind and sea ice extent since at least the year 2000.

Estimates of bottom temperature from the Bering 10K Regional Ocean Modeling System (ROMS)

The Bering 10K Regional Ocean Modeling System (ROMS; Kearney et al. 2020, Kearney et al. 2021) captured the sea-ice advance and maximum ice extent patterns well for 2023/2024. Despite the delayed timing in sea ice formation and 'wiggly' winter sea ice patterns, the ROMS is forecasting an average year for summer bottom temperatures in 2024 (Figure 6, top panel). The ROMS forecast shows the southeastern Bering Sea mean bottom temperatures to be slightly below average with a slightly larger-than-average cold pool based on bottom waters <2°C (Figure 6, middle panel) and a slightly smaller-than-average cold pool based on bottom temperatures <0°C (Figure 6, bottom panel). These patterns are most similar to previous summer conditions in 1995, 1997, 2020, and 2023.

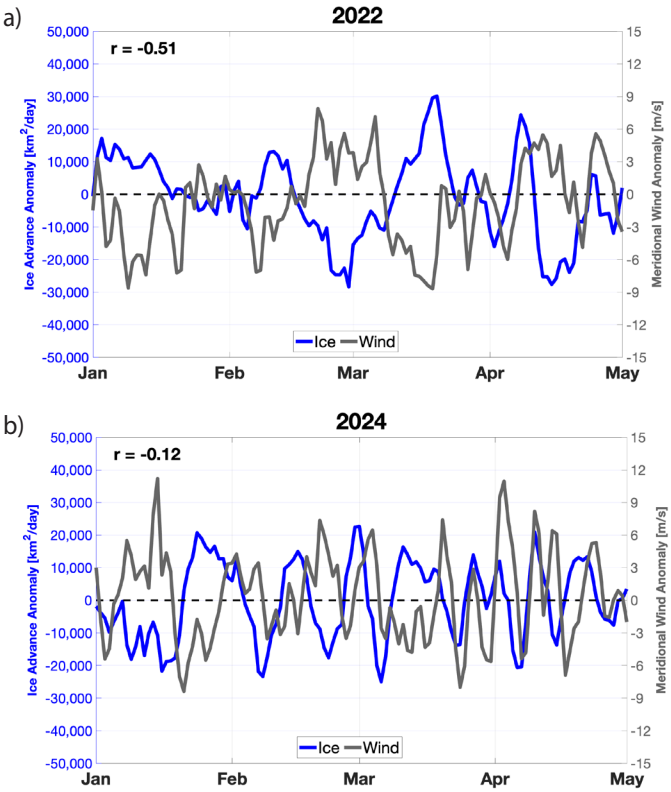

Figure 5: Correlation between ice extent and wind anomalies for (a) January-May 2023 and (b) January-May 2024. Figures courtesy of Tyler Hennon, University of Alaska Fairbanks.

Figure 7 shows the progression of forecasted bottom temperatures over the eastern Bering Sea shelf for June - August 2024. While the bottom temperatures over the middle shelf are forecast to remain fairly consistently <2°C, the bottom waters of the shallow inner domain are forecast to warm considerably throughout the summer.

Bristol Bay sockeye salmon

The 2024 Bristol Bay preliminary total run estimate of 44.9 million sockeye salmon is 25% lower than the recent 10-year average of 60.2 million sockeye, 10% below the 20-year average of 49.6 million sockeye salmon, and similar to the 1980 to present average of 43.3 million sockeye salmon. The record-setting 2021 and 2022 runs were the result of a strong 2017 brood year that experienced high survival at ocean entry in 2019.

The temporal trend in Bristol Bay sockeye salmon indicates a large increase beginning in 2015 and continuing for 9 years, with inshore run sizes in 2015-2023 all exceeding 50 million salmon and above long-term average (Figure 8). The forecast for 2024 represents a return to average conditions.

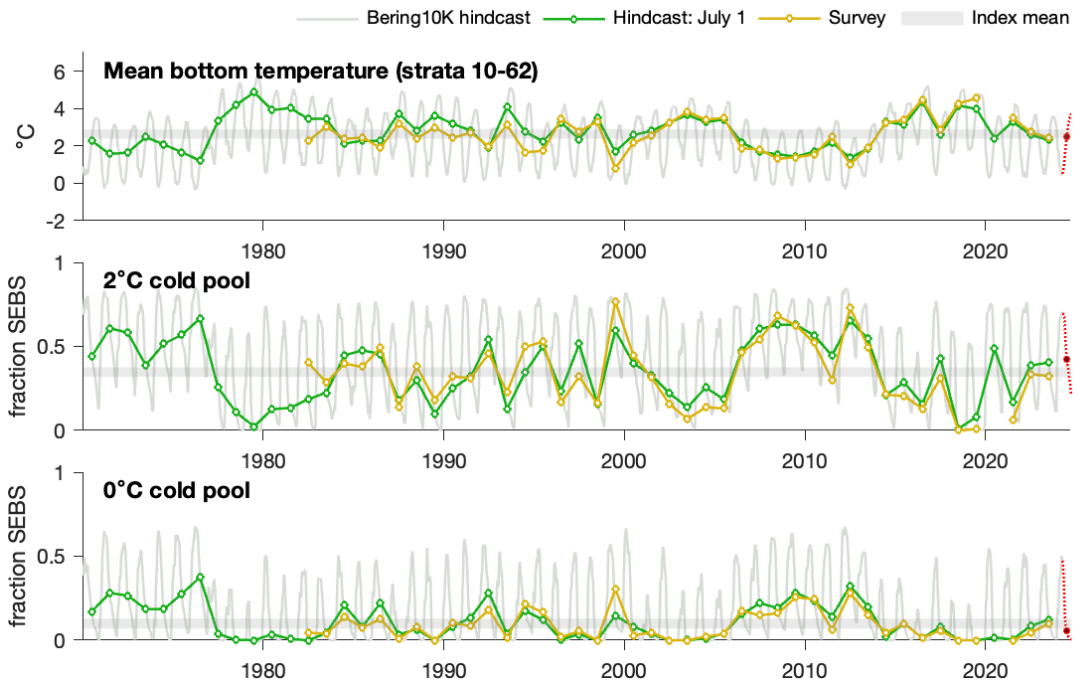

Figure 6: Regional Ocean Modeling System (ROMS) forecast of mean bottom temperatures over the eastern Bering Sea shelf (top panel), the fraction of the southeastern Bering Sea shelf with bottom water temperatures <2°C (middle panel), and the fraction of the shelf with bottom water temperatures <0°C for July 1, 2024. Figure courtesy of Kelly Kearney, Univeristy of Washington/Cooperative Institute for Climate, Ocean and Ecosystem Studies and NOAA-Alaska Fisheries Science Center.

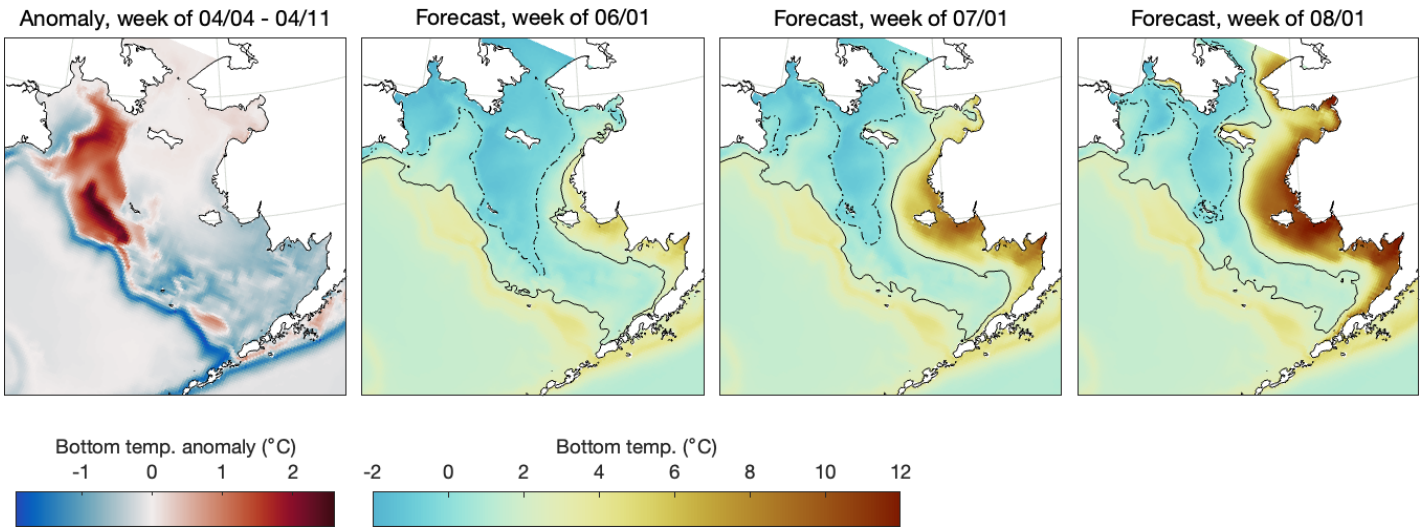

Figure 7: Regional Ocean Modeling System (ROMS) forecast of bottom temperatures in the eastern Bering Sea for summer 2024. Figure courtesy of Kelly Kearney, UW/CICOES and NOAA-Alaska Fisheries Science Center.

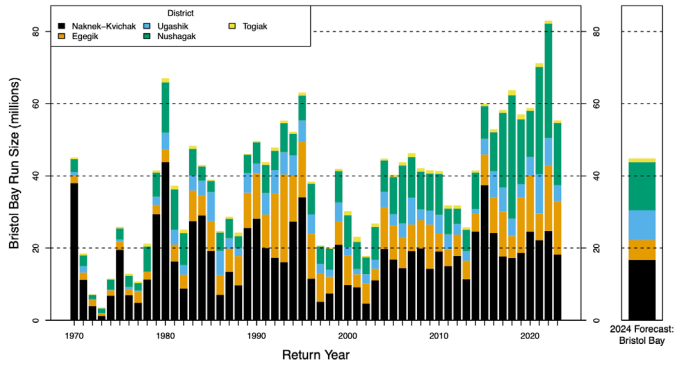

Figure 8: Annual Bristol Bay sockeye salmon total reconstructed run size 1963–2023. The 2024 forecast is shown to the right. Figure courtesy of Curry Cunningham, University of Alaska Fairbanks.

Bering Sea Snow Crab

The Bering Sea snow crab population experienced a dramatic decline of approximately 10 billion crab between 2018 and 2021 (Figure 9). In the immediate aftermath of the decline, several hypotheses were explored to explain the collapse including disease, predation, and fishing mortality. Ultimately, multiple studies have now linked the snow crab population collapse to a 2018-2019 Bering Sea marine heatwave event. Increased metabolic demands, decreased spatial extent, and declines in body condition suggest starvation may have played a role (e.g., Mullowney et al., 2023; Szuwalski et al., 2023). The marine heatwave affected all sizes of crab and the collapse resulted in the first ever fishery closures for snow crab. These closures will likely remain in place until the small crab in the system (left column of Figure 9) grow to the size harvested in the fishery (right column of Figure 9).

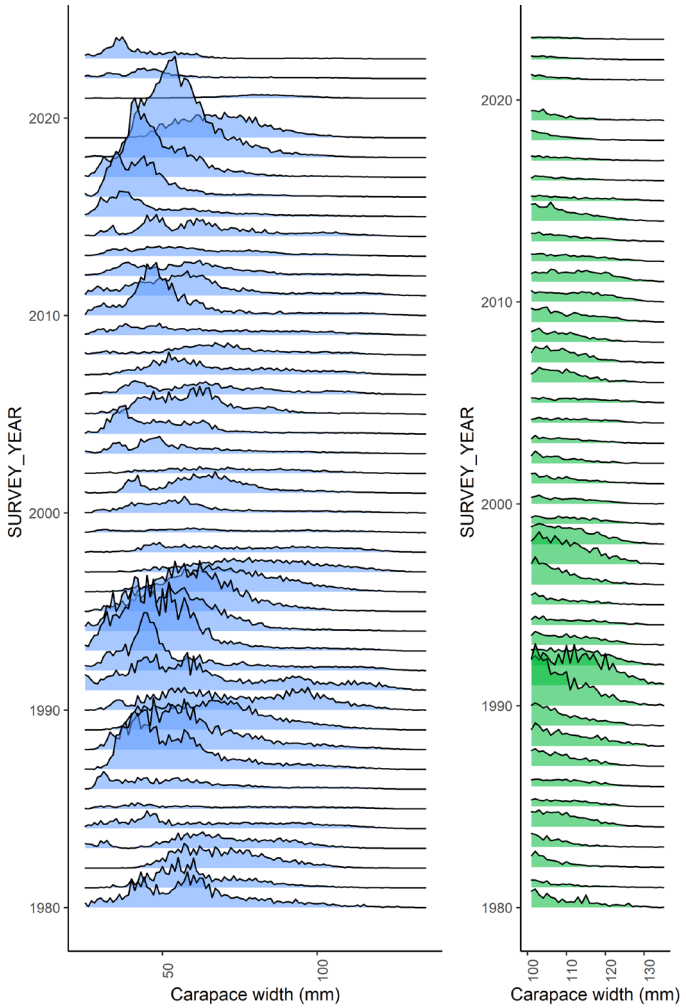

Figure 9: Numbers at size of male Bering Sea snow crab from the NOAA-Alaska Fisheries Science Center bottom trawl survey, 1980–2023. All sizes of male snow crab at carapace width (mm) are shown in blue; snow crab of commercially marketable size are magnified in green. Figure courtesy of Cody Szuwalski, NOAA-Alaska Fisheries Science Center.

Select 2024 surveys in the Bering Sea

- Alaska industry cooperative pot survey, chartered vessel, 16 March - 8 April 2024. Completed
- NOAA Pacific Marine Environmental Lab (PMEL) and AFSC EcoFOCI spring ichthyoplankton survey in the eastern Bering Sea on the R/V Oscar Dyson, 17 - 31 May 2024. Partially Completed
- NOAA Marine Mammal Lab ice seal aerial surveys using NOAA aircraft (king air), 1 April - 4 May 2024. Completed
- NOAA Marine Mammal Lab ice seal ecology, chartered vessel, 21 April - 1 June 2024. Completed
- NOAA Marine Mammal Lab Northern Fur Seal abundance trend monitoring, land-based surveys, 8 - 29 August 2024. Planned
- NOAA-AFSC Arctic ecosystem Distributed Biological Observatory, chartered vessel, 24 August - 21 September 2024. Planned
- NOAA-AFSC Eastern Bering Sea juvenile fish surface trawl survey, R/V Oscar Dyson, 24 August - 7 September 2024. Planned
- NOAA-Alaska Fisheries Science Center Northern Bering Sea juvenile fish surface trawl survey, chartered vessel, 25 August - 22 September 2024. Planned
- NOAA Marine Mammal Lab eastern Bering Sea beluga whale abundance survey, chartered aircraft, 21 June - 5 July 2024. Planned
- NOAA PMEL and AFSC EcoFOCI Fall mooring survey, R/V Oscar Dyson, 3 - 26 September 2024. Planned
- NOAA-AFSC eastern Bering Sea summer groundfish and crab bottom trawl survey, chartered vessel, 25 May - 3 August 2024. Planned
- US Arctic Ecosystem and Climate Cruise, R/V Sikuliaq, 05 August - 26 August 2024. Planned
- NOAA-AFSC northern Bering Sea summer groundfish and crab bottom trawl survey, chartered vessel, 4 - 27 August 2024. Planned

- NOAA Marine Mammal Lab Northern Fur Seal vital rates study at the Pribilof Islands, land-based survey, 22 August - 10 October 2024. Planned

Acknowledgments

Many thanks to the scientists who helped create this report: Dr. Emily Lemagie at NOAA-PMEL and Dr. Nicholas Bond at UW/CICOES provided information on climate and sea surface temperature; Mr. Rick Thoman and Dr. Tyler Hennon at University of Alaska Fairbanks provided information on winter winds and sea ice extent in the Bering Sea; Dr. Kelly Kearney at UW/CICOES and NOAA-AFSC provided information on estimates of bottom temperature from the Bering 10K Regional Ocean Modeling System (ROMS); Dr. Curry Cunningham provided information on Bristol Bay sockeye salmon; Drs. Cody Szuwalski and Erin Fedewa provided information on Bering Sea snow crab.

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Elizabeth (Ebett) Siddon (elizabeth.siddon@noaa.gov) is a fisheries research biologist at NOAA Fisheries, Alaska Fisheries Science Center, in Juneau, Alaska. Elizabeth is the Ecosystem-Based Fisheries Management lead and connects ecosystem science to management. She leads the Ecosystem Status Report for the Eastern Bering Sea. This report is used by regional fisheries managers at the North Pacific Fishery Management Council to inform fishing quotas each year.

In Memoriam: Dr. Susumu (Sus) Tabata

Dec 9, 1925 – February 5, 2024

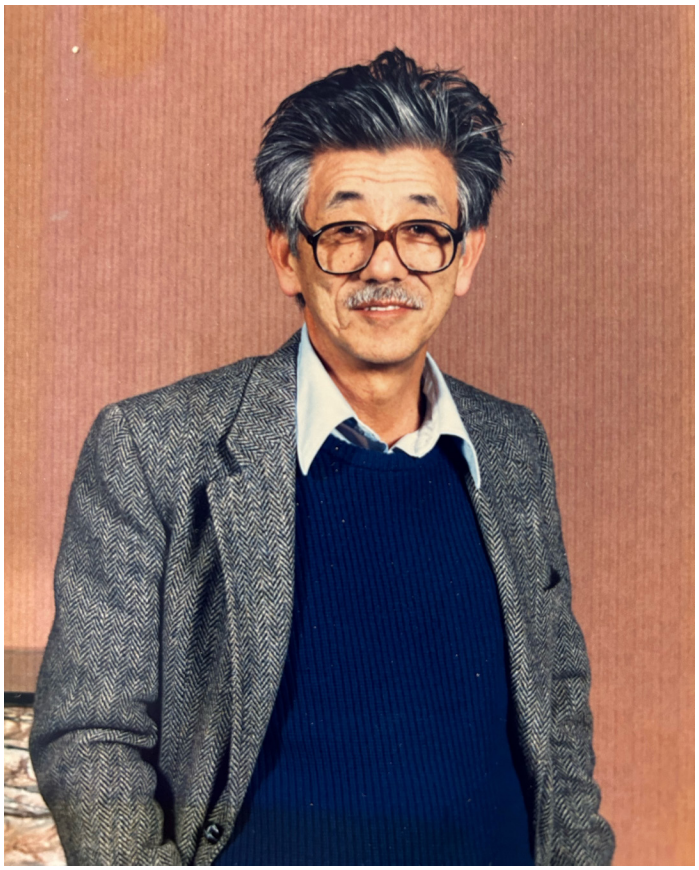
Dr. Susumu (Sus) Tabata passed away on February 5, 2024 at the age of 99 in the home he built on the ocean he studied his entire life. Sus was a preeminent Canadian physical oceanographer in the post-war period when the field of oceanography was in its developmental stages.

Sus was born in the small Canadian fishing town of Steveston near the mouth of the Fraser River. During World War II Susumu Tabata, then a teenager, was moved with his family and other Canadians of Japanese ancestry from the coast of British Columbia to be interned in the interior of British Columbia. His family, together with uncles, aunts and cousins, lost their property. Despite this hardship, Susumu Tabata continued his schooling and graduated from the University of British Columbia with a Masters Degree in physical oceanography in 1954. Upon graduation, he was hired to work at the Pacific Biological Station in Nanaimo, British Columbia, then managed by the Fisheries Research Board of Canada and later by Fisheries and Oceans Canada. He continued his academic studies, moving with his wife and young daughter to Japan and graduating with a Ph.D. from the University of Tokyo in 1964. He moved to the Institute of Ocean Sciences in Sidney, British Columbia in the early 1970s and remained there until his retirement in the early 1990s. After retiring, Sus continued to work part-time as a Research Scientist Emeritus.

Sus is best known for his role in initiating and maintaining the long Station P/ Line P oceanographic observations. The Line P time series was awarded the PICES Ocean Monitoring Award (POMA) in 2010 (https://meetings.pices.int/awards/POMA_Award/POMA-recipients/2010-POMA). His careful and painstaking approach to the collection, quality control, and evaluation of open-ocean data collected over a long time period was underappreciated during much of his career, but it now provides scientists with a very high quality, long time series for climate change and numerical model evaluation. For example, his observations at Ocean Station P and along Line P gave birth to the standard "test data set" for numerical models and scientific hypotheses. The importance of such high-quality long data series is now much more appreciated as part of the growing focus on global change and the role of the oceans in that change. In addition to his direct contributions, he inspired multiple generations of researchers to continue this work.

His1958 paper on the heat budget in northern BC waters marked the beginning of his long investigations into North Pacific ocean processes and their heat and salt fluxes. His Ph.D. Thesis presents analytical studies of Line P. Most of his papers are needed by present scientists to place their own measurements in context.

He was one of the first oceanographers to focus on changes in the ocean with time, as opposed to the mapping of average properties and currents that was the focus of oceanography up to the 1950s. For example, the Tully, Dodimead and Tabata (1960) paper documented the nature of a massive warming in the eastern Gulf of Alaska in 1957-58. They determined it was advected from the south over a considerable depth range and they noted its impact on the separation latitude of the North Pacific Current. They proposed this warming pushed sockeye salmon farther north in the Pacific Ocean and led to most Fraser River sockeye salmon returning home through Johnstone Strait rather than Juan de Fuca Strait. Sockeye salmon of



Dr. Sus Tabata in 1970s.

the Fraser River dominated all Canadian salmon stocks and this is the first paper, to our knowledge, that links this salmon migration path to ocean temperatures. The next forty years proved their hypothesis to be correct, and the link of ocean temperatures to salmon migration routing has been applied by the BC fishing industry to plan their sockeye catches, and more importantly, by Canadian and US governments to negotiate fishing treaties. Few other scientists have impacted multi-disciplinary research and fisheries management to this extent.

Dr. Tabata began the difficult task of computing heat and salt fluxes through the North Pacific and their changes in time. Tabata (1965) presents heat and salt budgets for the central Gulf of Alaska, based on early Station P measurements, noting that strong horizontal advection is required to balance the heat budget of the surface mixed layer in autumn. His analysis inspired Ken Denman and many others to develop mixed layer budgets for this region. The MILE (1975), STREX (1980), and Ocean Storms (1987) multi-investigator experiments at and near Ocean Station P all were inspired by this analysis.

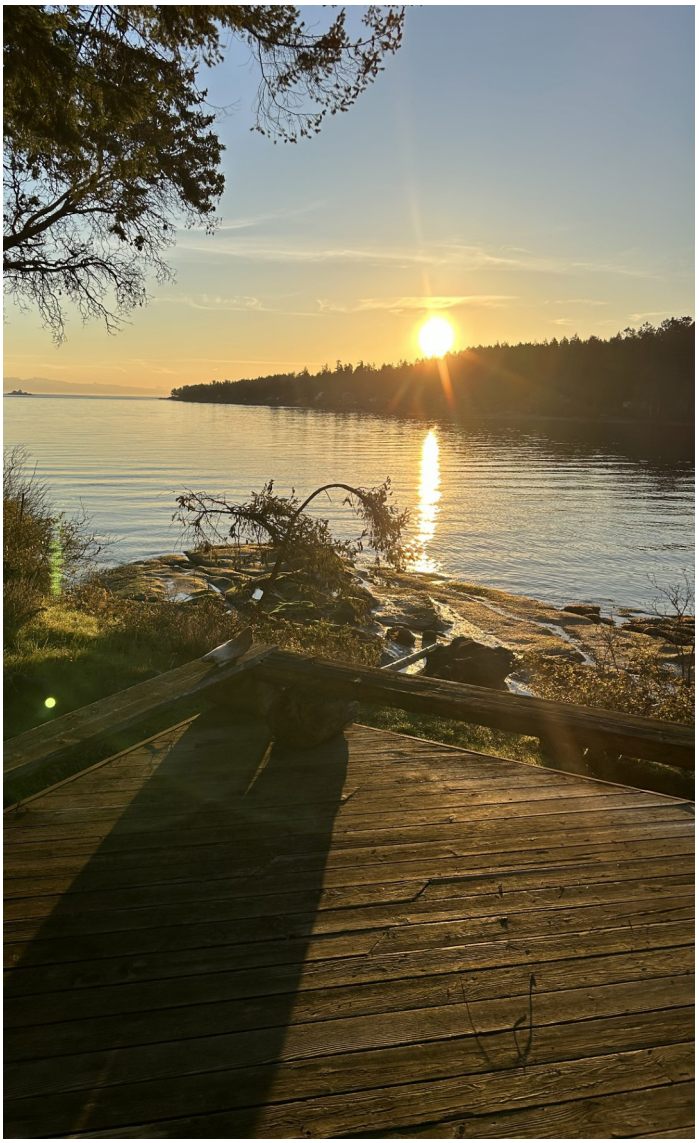
His three review papers in 1975 and 1976 provide a thorough overview of physical features and processes of the North Pacific Ocean. The Tabata (1975) description of the prevailing surface currents in the North Pacific remains the standard for most oceanographers within the Pacific Rim.

Tabata (1982) describes the discovery and features of the Sitka Eddy in the Gulf of Alaska. Through careful analyses of all available hydrographic observations, he defined all features of these eddies except their westward propagation. Their anticyclonic rotation, suppression of subsurface isopycnals, extreme depth penetration, formation regions, and immense size are all noted. Gower and Tabata (1993) describe their westward propagation in detail, based on Geosat satellite altimeter observations. This paper also observed, possibly for the first time, the significant change in propagation speed of mesoscale eddies with latitude and its general agreement with Rossby wave theory. To date, more than 25 papers have been published on these eddies, showing how they dominate oceanographic processes and biological productivity of the northern Gulf of Alaska.

Many of his insights were derived from his development of new technology. Dr. Tabata oversaw and managed quality control during the transition of ocean measurements of temperature and salinity profiles from BT to XBT to CTD. It is his name on data reports of the first CTD profiles, and even on the reports of the first current meter measurements from ocean moorings. He and Nick Fofonoff published reports in 1957 and 1958 on the use of digital computers to calculate salinities and densities. Sus has recounted how they tied up half the computer time of the University of British Columbia to develop these programs, and that upon completion they astounded their international colleagues with quick maps of ocean dynamic heights following ocean cruises. Several decades later, he published reports of measurements of ocean temperature from space, and in the 1990s he and Jim Gower applied sea level measurements from GEOSAT satellite to track the movement of Sitka Eddies, as noted above.

Sus Tabata helped establish the John P. Tully Medal in Oceanography, awarded annually by the Canadian Meteorological and Oceanographic Society for outstanding contributions to ocean research, and was himself awarded this medal in 2008.

The Nikkei National Museum and Cultural Centre prepared a video interview of Sus and his life at https://www.youtube.com/watch?v=In5PCQoQiEc. Barbara Tabata – Sus's wife of 61 years – predeceased him in December, 2020 and they are survived by their 2 daughters, their son, and three grandchildren.



Sunrise at Gabriola Island.

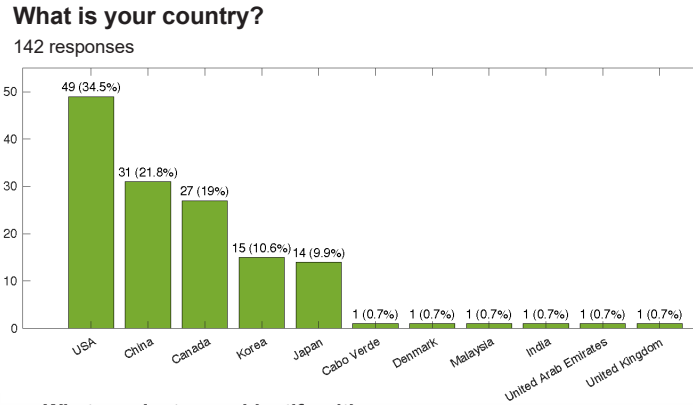
PICES by the Numbers:
Survey on Reducing PICES Impacts on Climate Warming and Environment Restoration Activities (SG-GREEN)

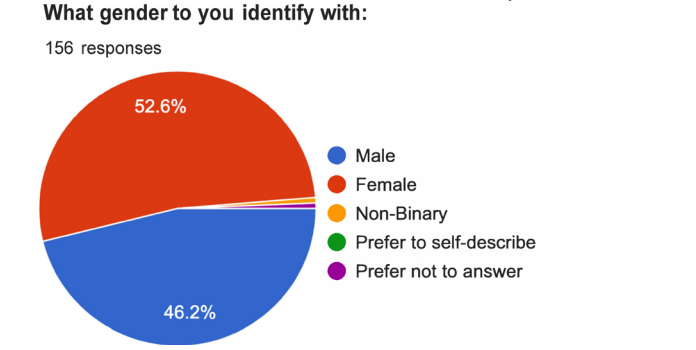
Vera Trainer, Hiroya Sugisaki, Robin Brown, Sung Yong Kim, and Jae-Hyoung Park

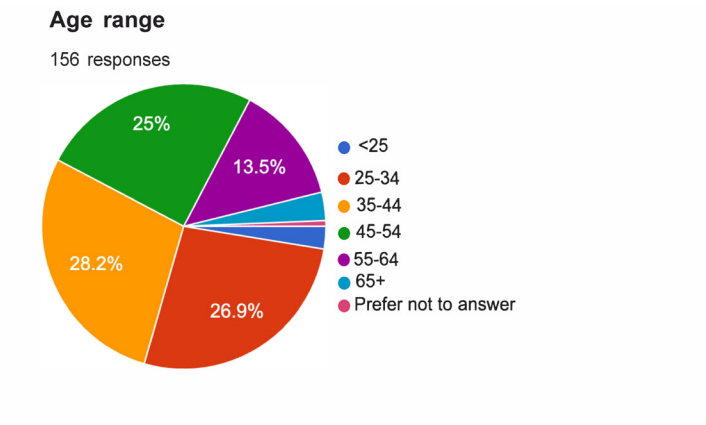
Climate scientists need to meet in a responsible manner. Our plan to reduce the impact of PICES on climate warming is part of the integrity of the organization. At PICES-2023 and over the months that followed, the SG-GREEN (Study Group on Generating Recommendations to Encourage Environmentally-Responsible Networking), with the help of the Human Dimensions Committee, conducted an online survey to query the PICES membership about their interest in changing how we meet, purchasing carbon credits to offset the cost of meeting in person, participating in beach clean-up, and other environmental activities. Given that many of us are climate scientists and care about the future of our planet, the responses to surveys show an overwhelming interest in changing the way that we do business. The survey was divided into questions about 1. Demographics, 2. Annual meetings, 3. Carbon offsets, and 4. Ocean preservation activities, and the results are summarized below.

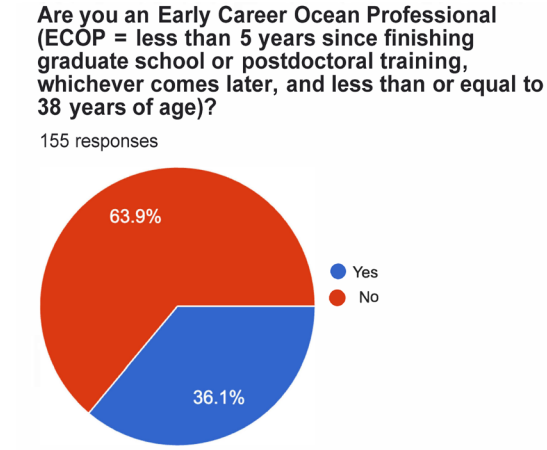
Demographics

Summarizing the demographic section, approximately 158 members completed the survey, with 53% identifying as female and 46% identifying as male. The age ranged from <25 to >65, with 36% identifying as Early Career Ocean Professionals (ECOPs). Most respondents were in the ecology, biology or fishery area of study (n=109) with others specializing in various areas of oceanography, including physical (12), chemical oceanography (8), general oceanography (8), polar oceanography or social science/management (7).









What is your area of scientific study?
148 responses

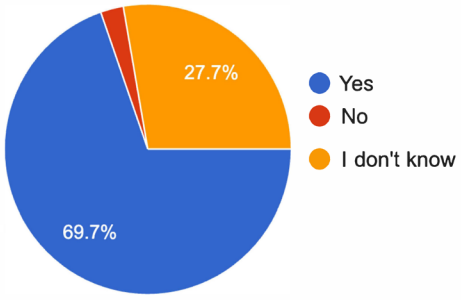
Ecology/Biology/Fishery: 109
Physical Oceanography: 12
Chemical Oceanograph: 8
Oceanography(broad): 8
Polar ocean: 2
Social science/management: 7

Annual Meetings

Most respondents felt that they would be allowed to attend the Annual Meeting in person (70%), even if there was a virtual option. However, for in person attendance, most people felt that their employer would require them to have a role, such as oral presenter, committee, or expert group chair. Approximately 60% of respondents stated that they would pay a registration fee to attend the PICES Annual Meeting virtually and would be willing to attend virtually (50%) if the meeting was outside their normal working hours.

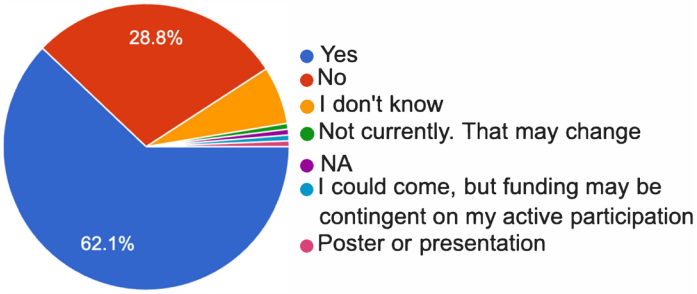
1. If there is a virtual option for a PICES Annual Meeting, will you be allowed to travel to attend the in-person meeting?

155 responses



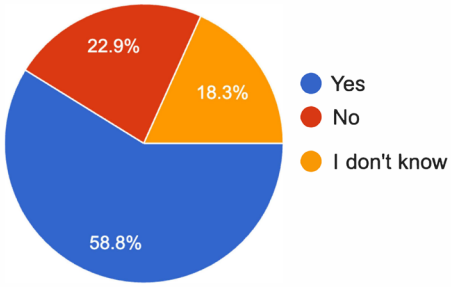
2. For in-person attendance, would your employer require you to have a role at the PICES annual meeting, such as oral presenter, chair of expert group, committee chair?

153 responses



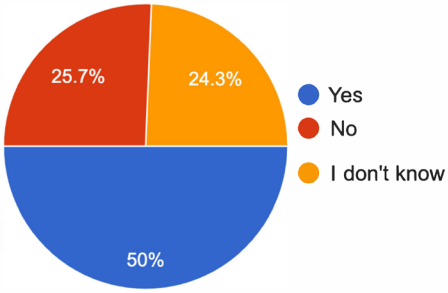
3. Will you pay a registration fee (less than the in-person registration fee) for virtual participation at a PICES Annual Meeting?

153 responses



5. Will you attend the Annual Meeting virtually if the meeting schedule is outside of your normal working hour, e.g. very early morning or at night?

152 responses



6. What approximate hours are you willing to attend the meeting?

Most participants prefer: 9:00-20:00 (local time)

4. What parts of the PICES Annual Meetings should be held in person?

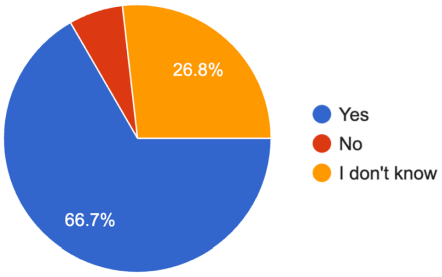
149 responses

Carbon Offset

There were strong feelings about carbon offsets, including 67% stating that PICES should provide recommendations on purchase of reliable carbon credits. Some respondents felt that a carbon offset fee should be included in the PICES registration fee (47%) while others felt that this fee should be paid by PICES as part of their annual operating costs (38%). Over 71% stated that they would like carbon offset recommendations to be a topic for a PICES expert group, which is why SG-GREEN members currently are writing a proposal for a new Study Group on this topic.

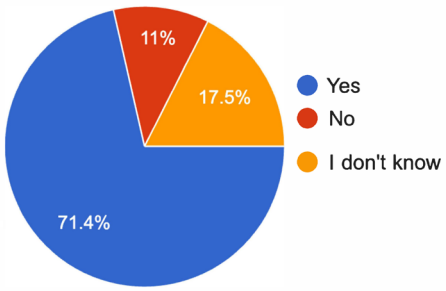
8. Should PICES provide recommendations on purchase of reliable carbon credits to offset the greenhouse gas emissions associated with PICES meetings? (carbon credit = a reduction, avoidance or capture of greenhouse gas emissions achieved by a certified project. One carbon credit represents the reduction or removal of one tonne of carbon dioxide or its equivalent in other greenhouse gasses)

153 responses



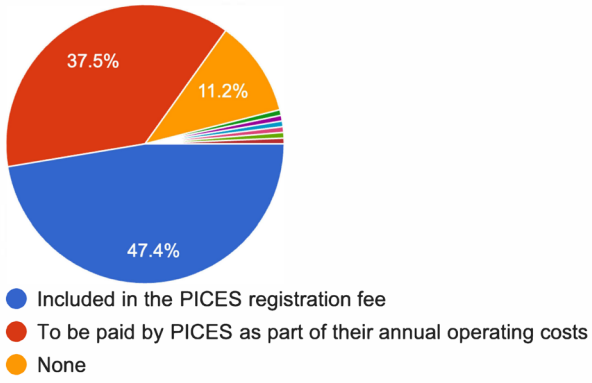
9. Would you like to see carbon offset recommendations (effectiveness, cost, etc.) a topic for a PICES Expert group to research?

154 responses



10. Would you be in favor of a carbon offset fee to be (select one option)

152 responses

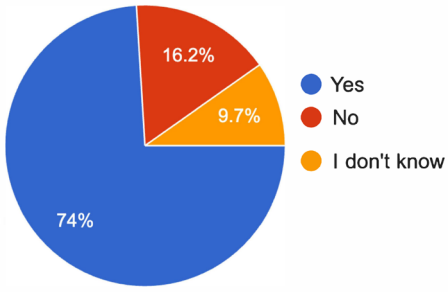


Ocean Preservation

A strong majority (74%) wanted to see a beach cleanup activity (and would participate in this activity) or other restoration activity as part of the PICES Annual Meeting, which is why SG-GREEN members currently are working with the PICES Secretariat to organize a beach clean-up activity in Honolulu during PICES-2024. 88% of the respondents are in favor of PICES eliminating plastic products (name tags, plastic bottles, cups etc.) at the annual meeting. Over 72% felt that PICES member nations should contribute an annual fee toward carbon offsets or another green project, such as habitat restoration.

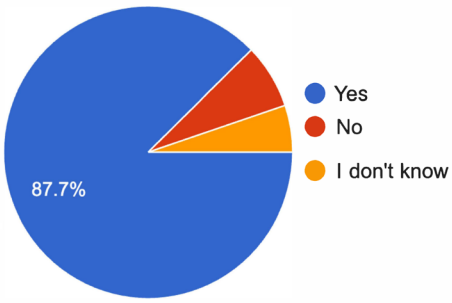
12. Would you participate in a PICES-sponsored beach cleanup or other restoration activity during the Annual Meeting?

154 responses



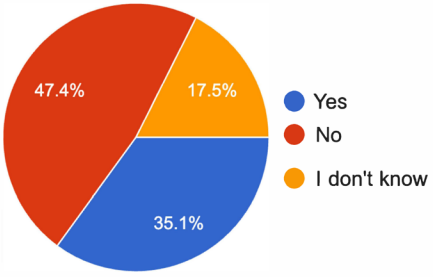
13. Are you in favor of PICES eliminating plastic products (name tags, plastic bottles, plastic coffee cups etc.) at its annual meetings?

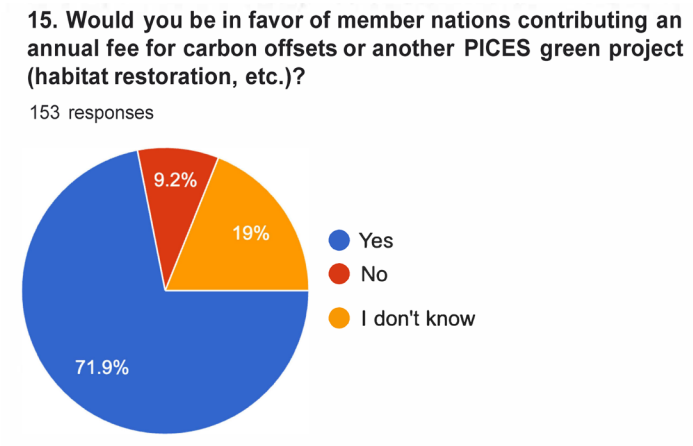
154 responses



14. Should PICES continue to provide meeting bags, stationery, and souvenirs, etc. at its annual meetings?

154 responses





In addition to the survey at PICES-2023, we have written to several of our partner organizations to ask how they are dealing with these questions. To date, we have heard:

- The Northwest Pacific Action Plan (NOWPAP) and the United Nations Environment Programme (UNEP) are compliant with the current UN carbon footprint reduction program relating to travel and plastic reduction. The travel policies include transitioning (where practical) to online/virtual meetings; travel by most direct routing, and other measures. UNEP collects and assesses all information in relation to the carbon footprint. UNEP purchases Certified Emission Reductions (CERs) from projects in Developing Countries as mandated by the United Nations Framework Convention on Climate Change (UNFCCC). UNEP has been climate neutral for the past 12 years. The UNEP greenhouse gas (GHG) management and reporting program can be found at https://www.unep.org/about-un-environment/sustainability/environmental-performance
- The Asia-Pacific Network for Global Change Research (APN) reports that they have moved to online/virtual meetings (where practical) and holding face-to-face meetings back-to-back to minimize the travel GHG footprint. APN has not yet introduced carbon offsets.

We are still awaiting responses from several other organizations (ICES, NPAFC, NPFC, ISC, SOLAS and SCOR).

Clearly, the PICES community has strong feelings about working toward climate mitigation activities as part of the PICES Annual Meetings. The SG-GREEN would like us all to continue the discussion to find ways to offset the cost of meeting in person to lead the way in collaboration with other international organizations.

Acknowledgments

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PICES Press welcomes your articles, especially during the UN Decade of Ocean Science for Sustainability, where we're seeking to increase partnerships, better our science communications, and improve our collective ability to create the "Ocean we Want." Please consider submitting articles on research, conference or event highlights, program news, and announcements.

Please see submission guidelines and previous issues on our website.
Deadlines are June 1st and December 1st for Summer and Winter volumes, respectively.

Thank you for your contributions!

School of fish - Yonaguni, Japan
Credit: Masayuki Agawa/Ocean Image Bank

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