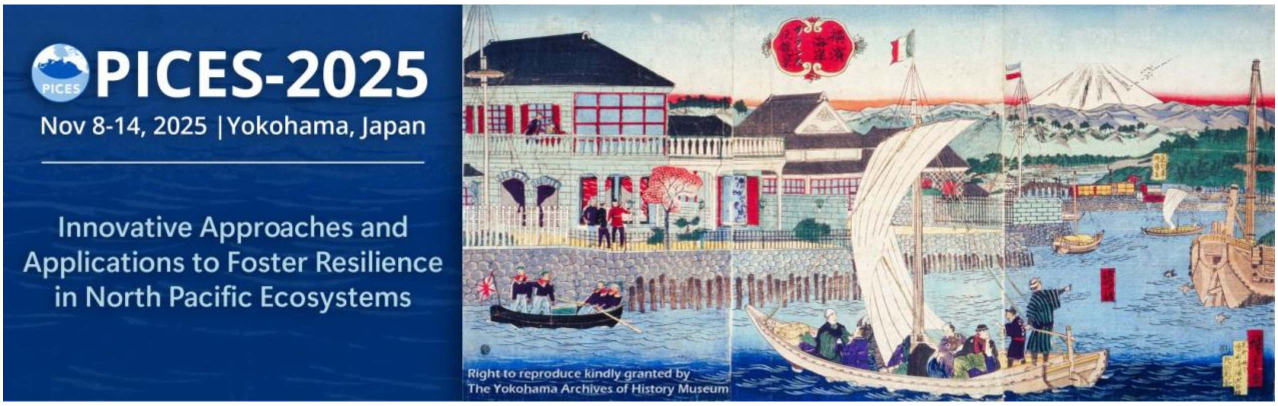

2025 Science Board Meeting

Report

(With Governing Council Decisions)

Held in a hybrid format at the Workpia, Yokohama, Japan, on November 14-15. 2025

Prepared by Science Board Chair, Dr. Sukyung Kang, and the PICES Secretariat

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Agenda item 1: Welcome, adoption of agenda (Kang, 10 mins)

Science Board Chair, Dr. Sukyung Kang, called the meeting to order, welcomed participants, and made introductions.

List of Participants

Science Board	
Sukyung Kang	Science Board Chair
Jennifer Boldt	Science Board Chair Elect
Akash Sastri (online)	Science Board Vice-Chair, BIO Chair
Steven Bograd	AP-UNDOS Co-Chair
Hanna Na	FUTURE SSC Co-Chair
Jackie King	FIS Chair
Mitsutaku Makino	HD Chair
Thomas Therriault	MEQ Chair
Lei Zhou	POC Chair
Sung Yong Kim	MONITOR Chair
FangFang Wan (online)	TCODE Vice Chair
Yury Zuenko	Russian representative
Guests from PICES Community	
Tetsuo Fujii	PICES Chair
Takashi Kamaishi	GC
Yutaka Hiroe	F&A
Hannah Lachance (online) cancelled	AP-ECOP
Lauren Miki Kashiwabara	AP-ECOP
Rachel Rody	AP-ECOP prospective
Talen Rimmer (online)	AP-ECOP
Kathryn Berry	BECI
Guests from Strategic Partners	
Alan Haynie	ICES
David Reid	ICES
Jo Foden	ICES
Toshiyuki Yamazaki	APN
Lian Peng (online) cancelled	IMBeR
Pavel Semkin	IMBeR
PICES Secretariat	
Sonia Batten	Executive Secretary
Sanae Chiba	Deputy Executive Secretary

Agenda Item 2: Updates from PICES Partner Organizations

Representatives of PICES partner organizations participated in the SB meeting in-person to update their recent activities and collaboration with PICES.

2.1. International Council for the Exploration of the Sea (ICES)

ICES Executive Secretary, Alan Haynie, SCICOM Chair. David Reid, and Head of Science Department, Jo Foden, updated ICES activities and collaboration with PICES. ICES is a major and one of the oldest strategic partners of PICES (see ICES-PICES MoU, 1998). We have shared multiple joint expert groups over the years, with the following currently active: Section on *Climate Change and Marine Ecosystems* (S-CCME), WG53 on *Sustainable Pelagic Forage Communities* (WGSPF), WG54 on *Best Practices for Using Deep Learning in Processing Plankton Images* (WGZE), the UNDOS-endorsed joint ICES/PICES UNDOS programme *SmartNet.* The Advisory Panel on the Arctic Ocean and Pacific Gateways (AP-ARC) explicitly continues liaison with the ICES WG Integrated Ecosystem Assessment for the Central Arctic Ocean (WGICA). AP-ARC and WGICA held a 3-day joint meeting at PICES-2025. PICES and ICES co-organized several Symposia series, including the Small Pelagic Symposium (SPF 2026) to be held in La Paz, Mexico, in May 2026.

2.2. Asian Pacific Network on Global Change (APN)

APN Director of Secretariat, Toshiyuki Yamazaki, updated APN's activities relevant to PICES. APN and PICES developed a Collaborative Framework for Scientific Cooperation that was signed in 2023. Both are intergovernmental organizations with overlapping geographic regions and a shared goal of supporting international cooperation in research. The focus over the past year has been on capacity development, supporting PICES ECOP through participation in proposal development training workshops hosted by APN. He encouraged PICES community to apply for eligible capacity development grant programs such as CAPaBLE. At PICES-2025, APN, together with ICES and Ocean Policy Research Institute (OPRI), co-convened Workshop 8: *Engaging with Local and Traditional Knowledge Holders to Co-Design Ocean Science in Pacific Small Island Developing States*, sponsored travel of participants from Pacific SIDS.

2.3. IMBeR: Integrated Marine Biosphere Research

IMBeR National Contact for Russia, Pavel Semkin, updated on recent IMBeR activities. IMBeR is one of the SCOR relevant large-scale ocean research projects. Through the collaboration with SCOR, PICES regularly co-sponsors IMBeR capacity development events and scientific conferences, by supporting travel of ECOPs from PICES member countries to attend those meetings, e.g. IMBeR IMBIZO conference series, and IMBeR ClimEco8 Summer School. The activities of many PICES expert groups, especially ones under the BIO Committee, are most relevant to IMBeR research focus.

2.4. Summary of collaboration with PICES partner organizations

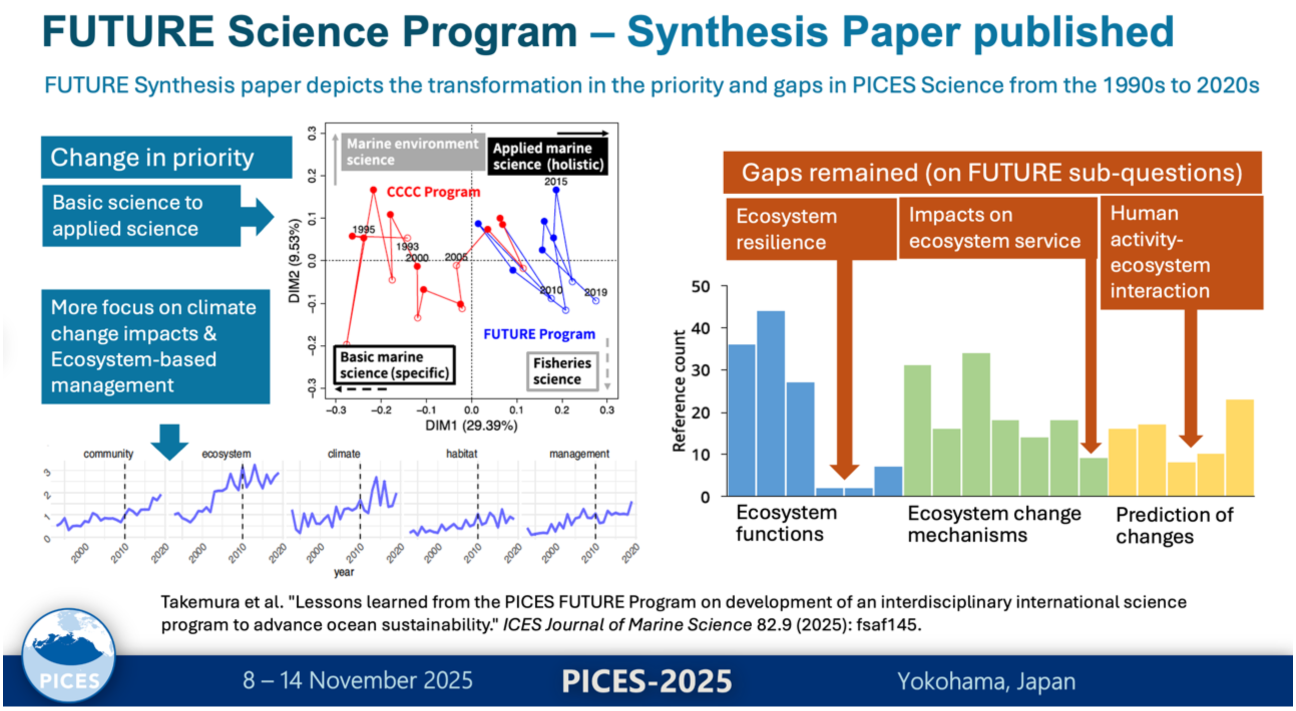
Responding to the request at ISB-2024, the PICES Executive Secretary reviewed the current collaborative frameworks with strategic partners or MoUs. See Appendix 1 for the lists of the existing 9 agreements and their status (also see the PICES website). At PICES-2024, a new MoU was signed with the Ocean Decade International Cooperation Center, China (ODCC), for collaboration on the UNDOS-related topics, including SmartNet support.

Besides the strategic partners with the official MOUs or Collaboration Frameworks, PICES has more than 50 partner organizations that mutually participate in each other's annual meetings and conduct collaborative research on respective EGs and Committees basis. PICES invited observers from more than 50 partner organizations, and 14 of them sent their representatives to PICES-2025, and seven partners co-sponsored sessions and/or workshops.

Agenda Item 3: FUTURE-SSC Report

FUTURE SSC co-chair, Hanna Na, updated their activities since the PICES-2024 and other emerging issues which require SB consideration. PICES Press article on the FUTURE Symposium held at PICES-2024 is found here. FUTURE plans to wrap up its 17 years of activities at PICES-2026. The update includes:

- Synthesis paper and other publications and deliverables
- Roadmap toward the completion of the FUTURE programme.



Agenda Item 4: SmartNet and AP-UNDOS Report

AP-UNDOS co-chair, Steven Bograd, updated SmartNet activities and planning for 2025~26. SmartNet: Sustainability of Marine Ecosystems through Global Knowledge Networks" is a joint ICES/PICES programme endorsed by UNDOS in 2021, aiming to establish a global knowledge network for ocean science by strengthening and expanding the collaboration of ICES, PICES, and partner organizations worldwide. SmartNet supports and leverages ICES and PICES member countries' activities related to the Ocean Decade. AP-UNDOS served as a PICES Steering Committee for SmartNet.

News:

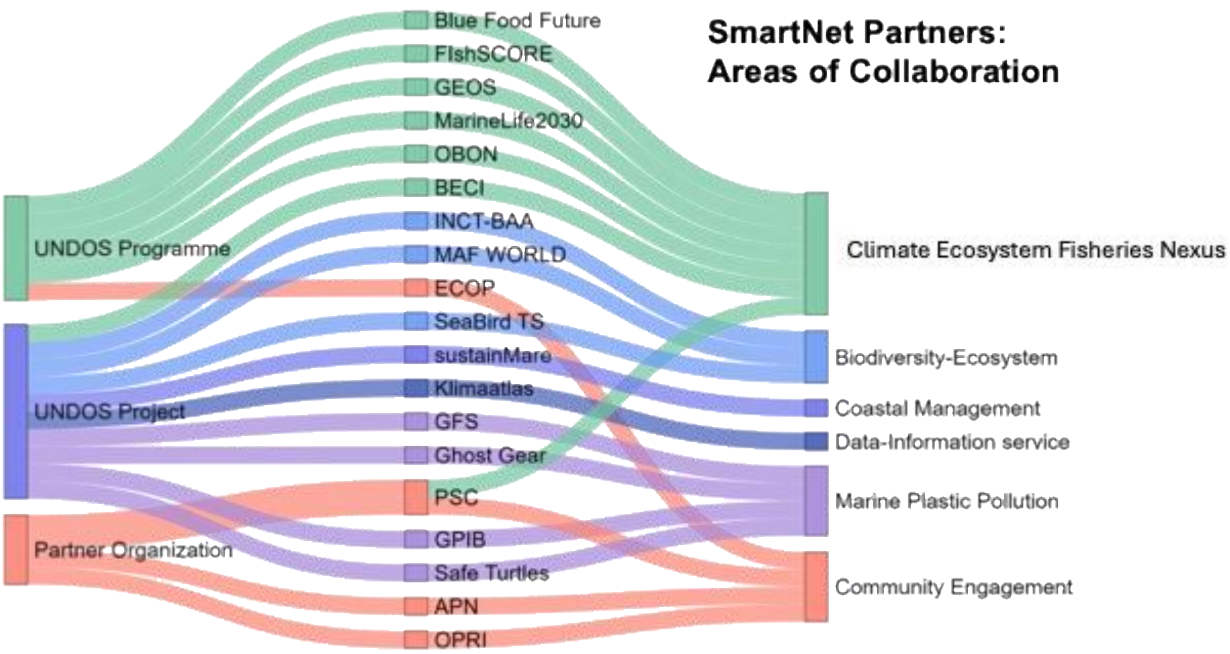
- GC approved AP-UNDOS representation on the Science Board at IGC-2025 (GC2025/S/2).
- Upon the agreement of the MoU between PICES and the Ocean Decade International Cooperation Center, China (ODCC), in November 2024, Ms Chen Yang was officially appointed in September 2025 as the UNDOS coordinator who assists UNDOS-related activities in PICES, including SmartNet. She works remotely from the ODCC office in China.
- The new SmartNet website design was developed to be posted on the PICES website after PICES-2025.

Phase II (2025-2028) Priority:

SmartNet has entered into Phase II in 2025 (see Phase II Implementation Plan for the details). SmartNet will enhance joint ICES-PICES collaborations through mutual annual science conferences, and upcoming co-organised international symposia, including SPF 2026, ESC 2027 (TBC), ECCWO6 2028 (TBC).
Three priority areas of Phase II are:

- Advance Climate-Ecosystem-Fisheries Nexus science and management through collaboration with multiple UNDOS programmes and projects (see Workshop 1 at PICES-2025)
- Expand capacity sharing opportunities beyond the ICES and PICES Convention Areas, with a particular focus on the Global South and Small Island Developing States (SIDS) (see Workshop 8 at PICES-2025)
- Inform new UNDOS activities through the global survey project "What is the Ocean We Want?"

SmartNet Partners and Areas of Collaboration:
SmartNet has been expanding its global knowledge network in its respective priority areas, such as Climate-Ecosystem-Fisheries Nexus, through the ICES and PICES frameworks and the efforts of the Decade Coordination Centre to align proposed UNDOS projects**.**



Agenda Item 5: Special Project Updates

5.1. Basin-scale Events to Coastal Impacts: An Ocean Intelligence System for Fish and People (BECI)

BECI Science Director, Kathryn Berry, updated BECI achievements, including the outcomes at PICES-2025.

Project Overview: BECI is the UNDOS-endorsed project, developing the North Pacific Ocean Knowledge Network, an interactive platform to help scientists and decision-makers better understand and respond to changing ocean conditions. The Knowledge Network organizes and synthesizes existing research, monitoring, and management efforts into a one-stop platform, enabling end users to easily access trusted information, identify trends, and co-develop solutions. The platform includes interactive dashboards and mapping tools for visualizing ocean conditions and species patterns across regions, searchable resource catalogues, and synthesis products including cross-regional analyses and standardized ecosystem assessments. The core focus areas are: the establishment of an extreme event intelligence hub through collaboration with WG49, AP-NPCOOS and S-HAB, and cross-regional ecosystem synthesis, which will be developed along with SG-NPSER4.

2024-2025 Strategic Engagement:

- Presented to most major North Pacific RFMOs: NPAFC Science Committee, NPFC Science Committee and Commission, PSC Committee for Scientific Cooperation, and WCPFC Northern Committee
- Engaged PICES Science Committee and multiple working groups, Advisory Panels and Committees
- Conducted targeted outreach to scientists, NGOs and fisheries stakeholders through conferences and meetings, including BC Salmon Recovery Conference, American Fisheries Society, and Wild Salmon Connections

Key Deliverables:

- Science Plan detailing seven strategic use cases for knowledge network implementation (https://beci.info/resources/)
- Indigenous Engagement Plan and Strategy (https://beci.info/resources/)
- A semi-function North Pacific Ocean Knowledge Network proof-of-concept, which platform was showcased throughout the PICES 2025

5.2. FishPhytO PICES/MAFF Project: Creating a phytoplankton-fishery observing program for sustaining local communities in Indonesian coastal waters

Project Science Team co-chair, Mitsutaku Makino updated FishPhytO activities. including a summary of the PST meeting on November 12 at PICES-2025. Agenda items included a budget report, management of the FishGIS app, activities in Indonesia and discussion on future activities. Dr. Makino reported that the team had identified funding sources to sustain project activities at a minimal level but would continue to seek additional support from various sectors, including academia and philanthropic organizations.

Background
In December 2022, the Ministry of Agriculture, Forestry and Fisheries (MAFF) of Japan offered to provide funding for a new 3-year PICES project for 2023-2026 following the Ciguatera project. The ideas of the proposal for the new project were discussed during the final Ciguatera PST meeting held in mid-March in Yokohama, Japan. Due to the unexpected termination of funding from MAFF in 2023, the team was seeking alternative funding sources to continue the project.

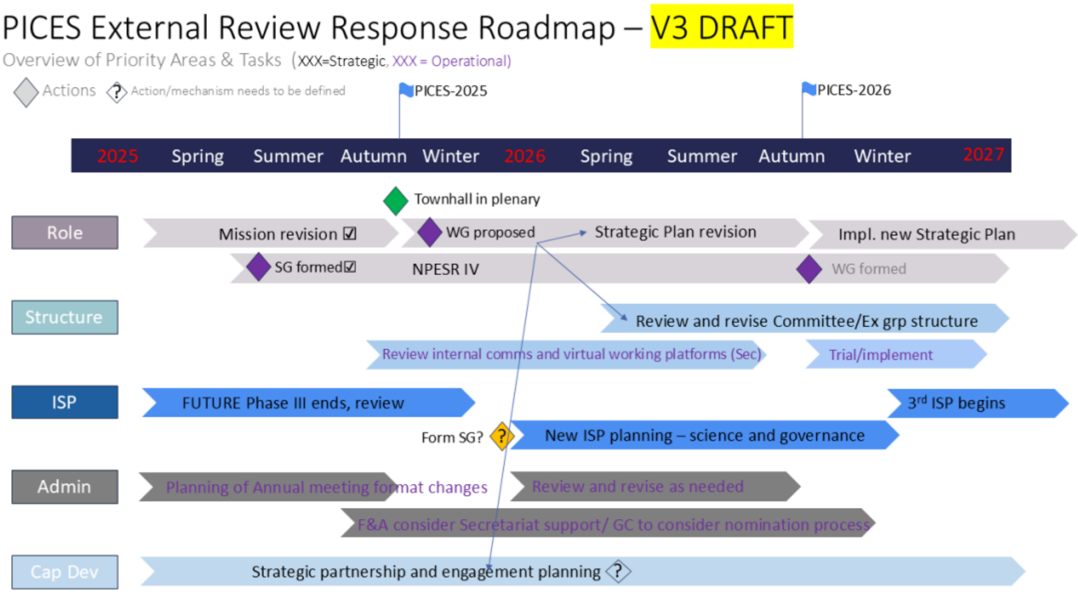
Objective of FishPhytO is to establish, in collaboration with local fishermen and research institutes and universities, a phytoplankton-fishery observing program in coastal Indonesia by integrating the FishGIS application, developed and refined during the previous two PICES/MAFF projects (2017–2023) with existing automated technologies for detection of toxic benthic Harmful Algal Bloom (HAB) species. The longer-term goal is to provide local communities with the capacity and knowledge to sustainably manage their fisheries resources and ensure seafood safety. The project also aims to identify potential research needs for deploying the FishGIS application in PICES member countries.

Agenda Item 6: Update of SG-External Review Report Response

PICES Executive Secretary Sonia Batten explained the progress of the Study Group on the External Review Report Recommendation, and the planning and roadmap for the evolution of PICES in the coming years (Review Panel Report). Responding to the SB requests to ensure co-designing of PICES's transformation process, three SB members, Kang, Bograd and Therriault, were invited to the SG-ERRR meeting in August 2025, to join the discussion on the new PICES Mission, establishment of the Strategic Plan working group and the External Review Response Roadmap. Taking into consideration the outcomes of the Town Hall on November 10, SB also discussed how the evolution of PICES will effectively be done through the input of member countries, partner organizations and various stakeholders, particularly in the development of the new

Integrated Science Program. Establishment of the new EG on Stakeholder engagement was suggested as one of the mechanisms.

Jo Foden, Head of the Science Department at ICES, presented proposed priority areas for ICES–PICES knowledge and experience exchange within the PICES transformation process. The suggested priority areas included: (1) structural revisions to scientific and technical committees, expert groups, steering groups, strategic initiatives, and communication and working platforms; and (2) administrative rules and procedures related to membership and nomination processes for expert groups.



Role	Structure	ISP	Admin	Cap Dev
Revise mission Mission statement drafted by SG-ERRR Communicate progress to PICES community via a town hall at PICES-2025	Review Committee and expert group structure Proposed to be done by Strategic Plan WG	FUTURE phase 3 ends. A review of FUTURE, successes, and lessons learned, is needed before Step 2.	Annual meeting format changes Meeting has been shortened, poster session moved, and session proposal timing changed in response to feedback. Will trial change to SB/GC meetings in 2026	Review strategic engagement and partnerships Strategic Plan WG will provide relevant input.
New strategic plan WG proposal drafted by SG-ERRR for approval at PICES-2025	Secretariat to review internal communications and working platforms On F&A agenda for Nov for input	Planning of new ISP	Review ways to support Secretariat (F&A) On F&A agenda for Nov	
Next edition of NPESR (4) Form SG (DONE, IGC-May) WG to be proposed at PICES-2026 (goal)			Review member nomination process (GC)	

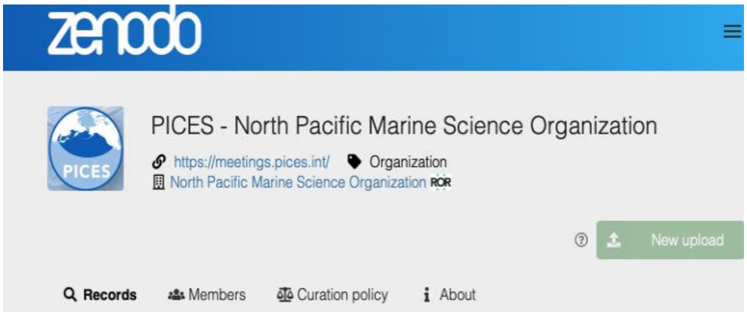
Agenda Item 7: Science and Technology Annual Report
Science Board

Science Board, FUTURE and Committees reported scientific achievements and progress of TORs of the respective Children Expert Groups since ISB-2025 (~5 min for each EG with a few more minutes for the EGs whose terms end at PICES-2025). Committees also updated their specific achievements if applicable. See the PICES-2025 Annual Report (EG reports to be added in winter 2026) for the details of each EG's activities.

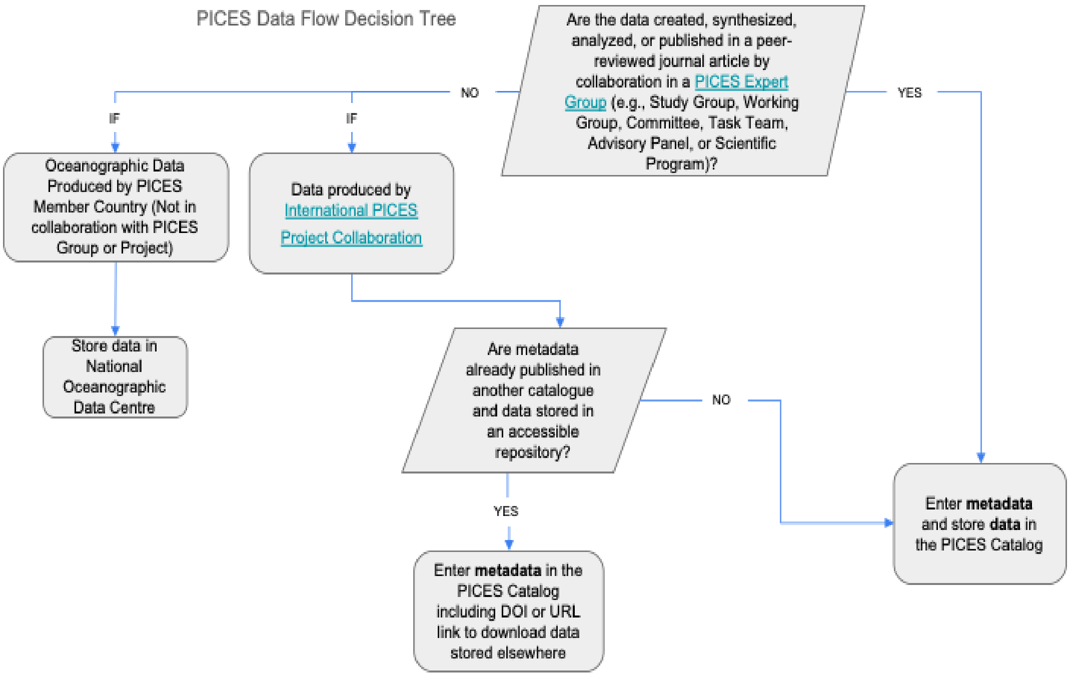
Agenda Item 8: PICES data reporting protocol

TCODE Vice Chair, Fangfang Wan, reported the progress of the PICE Data and Metadata Reporting and Publishing Protocol, which has been developed through discussion among WG52, TCODE and Secretariat, to support Expert Group and Special Project leads in publishing their data. Once approved, all data produced by EGs' activities will be required to be reported in a standardized manner. The protocol and Data Flow Decision Tree diagram will be finalized and submitted for SB recommendation at ISB-2026.

Background: Upon the cessation of old PICES metadata platform based on TINRO, WG52 established the new PICES Data Catalogue on the data repository Zenodo, and transferred the historical PICES data (>4000) from TINRO to the platform to be reviewed by PICES. Given that no clear guidance for data reporting has been provided for EGs and Special Projects in the past, WG52 drafted the protocol, including on data/metadata submission to Zenodo , to help PICES community adhere to the new PICES Data Management Policy (IGC-2024/S/8).



PICES Data Flow Decision Tree (draft)



Agenda Item 9: Election of SB Vice Chairs

A term of the SB Vice-chair is one year, and they shall be eligible for re-election for a successive term. Current Vice Chair Akash Sastri ends his 1st term at PICES-2025. As the new SB Chair, Jennifer Boldt is elected from Canada, SB shall nominate a suitably qualified member from the western North Pacific Side to be the new SB Vice-chair. The election took place according to the procedure defined in PICES Rules and Procedure 5 Election, and Dr. Hanna Na (Korea) was nominated and elected as the new SB Vice-Chair to serve for one year until PICES-2026. SB recommended GC approve his appointment. *=> GC approved (GC2025/S/6)*

Agenda Item 10: Committee Chair Election Results

The election took place during the business meetings of BIO, HD, POC, MONITOR and TCODE, according to the procedure defined in PICES Rules and Procedure 5 Election and 17: Scientific Readership. SB endorsed the election outcomes as listed in the table below and recommended GC approve the appointment of the new Chairs and Vice-chairs. *=> GC approved (GC2025/S/6)*

	Date of Election	New Chairs
BIO	Oct 20	Dr. Toru Kobari (Japan) was elected as the Chair of BIO Committee (1st term), and Dr. Julie Keister (USA) was elected as the Vice-Chair of BIO Committee (1st term)
HD	Nov 8	Dr. Karen Hunter (Canada) was elected as the Chair of HD Committee (1st term), and Dr. Shion Takemura (Japan) was elected as the Vice-Chair of HD Committee (1st term)
POC	Nov 9	Dr. Lei Zhou (China) was elected as the Chair of POC Committee (2nd term).
MONITOR	Nov 9	Dr. Kym Jacobson (USA) was elected as the Chair of MONITOR Committee (1st term), and Dr. Hiroto Abe (Japan) was elected as the Vice-Chair of MONITOR Committee (1st term)
TCODE	Oct 15	Prof. Fangfang Wan (China) was elected as the Chair of TCODE Committee (1st term), and Mr. Brett Johnson (Canada) was elected as the Vice-Chair of TCODE Committee (1st term).

Agenda Item 11: EG Proposals for SB Recommendation

11.1. Membership Needs/Change

SB acknowledged the membership requests of each EG and Committee as listed and urged national delegates to consider the appointment of new members at appropriate times. *=> GC acknowledged the membership requests as listed, and respective national delegates are urged to appoint them at a proper time.*

EG (rep. CMT)	Country	Name/Organizations if identified	email
Carry over requests from ISB-2025 or before			
AP-NIS (MEQ)	Russia	1 – 2 members	
AP-SciCom (SB)	Russia	1 – 2 members	
	USA	Matt Koller	
AP-UNDOS (SB)	Russia	Evgenia Kostianaia (IOC), ECOP leader in UNDOS	e.kostianaia@unesco.org
AP-ARC (SB)	Russia	Yury I. Zuenko	zuenko_yury@hotmail.com

	Russia	Kirill Kivva	kirill.kivva@gmail.com
AP-ECOP (FUTURE)	Japan	Nozomi Ihara (Hokkaido Uni)	ihara_n@lowtem.hokudai.ac.jp
S-CCME	Russia	1 – 2 members	
WG51 (HD)	Russia	Oleg N. Katugin (TINRO-Center)	oleg.katugin@tinro.vniro.ru
	Russia	Ekaterina Kurilova (VNIRO Khabarovsk)	katy_k07@mail.ru
WG52 (TCODE)	Russia	1 – 2 members	
WG54 (BIO)	USA	Mark Benfield	mbenfie@lsu.edu
	USA	Jeffrey Ellen	jeffrey.s.ellen.civ@us.navy.mil
	Canada	Akash Sastri	Akash.Sastri@dfo-mpo.gc.ca
	Canada	Paul Covert (co-chair)	pcovert@uvic.ca
	Japan	Satoshi Kitajima	kitaji@affrc.go.jp
	China	Fang Zhang	zhangfang@qdio.ac.cn
	China	Xumin Cheng(co-chair)	chengxm@sz.tsinghua.edu.cn
	China	Haiyong Zheng	zhenghaiyong@ouc.edu.cn
	Russia	1 – 2 members	
SG-NPESR4 (SB)	Canada	Thomas Therriault	thomas.therriault@dfo-mpo.gc.ca
SG-NPESR4 (SB)	China	1 – 2 members	
SG-NPESR4 (SB)	Russia	1 – 2 members	
TCODE	Russia	1 – 2 members	
FIS	Russia	1 – 2 members	
New requests at SB-2025 from here			
AP-ECOP (SB)	USA	Will Fennie. Has attended AP-ECOP meeting as an observer in 2025.	will.fennie@noaa.gov
AP-NIS (MEQ)	USA	2 members (TBD). 2 USA federal government members have had to resign and replacements are being sought.	
WG49 (FUTURE)	Canada	Mackenzie Mazur	mackenzie.mazur@dfo-mpo.gc.ca
WG54 (BIO)	China	Zesen Zhang (ECOP)	zhang-zs23@mails.tsinghua.edu.cn
	USA	Jeanette Gann	jeanette.gann@noaa.gov
	USA	Keiia Axler	kelia.axler@noaa.gov
	USA	Jennifer Fisher	Jennifer.Fisher@noaa.gov
SG-NPERS4 (SB)	USA	Jeanette Gann	jeanette.gann@noaa.gov
Members who step down			
S-CCME (FIS)	ex-officio	Viv Tulloch, BECI	Tulloch left BECI
AP-NIS (MEQ)	USA	John Darling (EPA) Joseph Krieger (GLERL NOAA)	USA federal government members have had to resign

11.2. Ex-officio membership request

SB reviewed ex-officio membership requests from EGs, and recommended GC approve the appointment of the ex-officio members as listed. *=> GC approved (GC2025/S/7)*

EG (Rpt. CMT)	Organization to represent	Ex-officio member name & contact	Note
WG53 (FIS)	NPAFC	Aleksei Somov, NPAFC Science Sub-Committee Chairperson	Proposed by Committee on Scientific Research and Statistics NPAFC
SG-NPSER4 (SB)	BECI	Kathryn Berry, Science Director of BECI, Kathryn.Berry@pices.int	

11.3. Change of EG Chairs

Selection and approval of EG Chairs took place according to PICES Rules and Procedures: Rule 17: Scientific Leadership. SB recommended GC approve the appointment of new chairs as listed. *=> GC approved (GC2025/S/6)*

EG (Rpt. CMT)	Current Chair to step down	New Chair Name/Country/Organization
AP-ECOP (FUTURE)	Hana Matsubara (Japan)	Toya Hirokawa, The University of Tokyo (Japan) toya910910@g.ecc.u-tokyo.ac.j
AP-ECOP (FUTURE)	Minkyoung Kim (Korea)	TBC
S-HAB (MEQ)	Mark Wells (USA)	Misty Peacock (USA)
S-CCME (FIS)	Kirsten Holsman (USA)?	TBC => 1 year extension till PICES-2026

11.4 Extension of the WG Term

SB recommended GC approve a one-year extension of the term of WG51. *=> GC approved (GC2025/S/8)*

EG (Rpt. CMT)	Duration	Rationale
WG51 (HD)	1 year to PICES-2026	One year extension of the term of WG51 is necessary to conduct a meta-analysis among PICES member countries using the developed methodology in this WG, and to organize the outcomes of PICES 2025 Session S15 as a Special Issue proposal for ICES-JMS.

11.5 Change of TOR

SB recommended the change of the TOR of AP-ARC as requested. *=> GC approved (GC2025/S/10)*

EG (Rpt. CMT.)	Description and rationale of changes
AP-ARC (SB)	TOR4 (current) Develop and support trans-disciplinary and collaborative approaches using co-production methods and inclusive of Indigenous knowledge systems to consider existing and future anthropogenically driven pressures, such as increased marine traffic, harmful algal blooms, non-indigenous species, noise, contamination, litter, and microplastics in the Pacific Arctic and its Gateways in alignment with PICES activities; (suggested revision) Review, collate and share trans-disciplinary and collaborative approaches using co-production methods and inclusive of Indigenous knowledge systems to consider existing and future anthropogenically driven pressures, such as increased marine traffic, harmful algal blooms, non-indigenous species, noise, contamination, litter, and microplastics in the Pacific Arctic and its Gateways in alignment with PICES activities; (rationale) Many transdisciplinary and collaborative approaches for Indigenous knowledge co-production already exist. Members consider that AP-ARC could be more useful in reviewing, collating and sharing those methods (rather than newly developing the methods).

11.6. Intersessional in-person meeting

SB reviewed the intersessional in-person business meeting requests from WG53 and S-CCME, which are planned in conjunction with the SPF Symposium to be held in La Paz in May 2026. SB confirmed the availability of the venue and recommended GC approve the proposals. *=> GC approved (GC2025/S/9). The Secretariat confirmed that meeting space will be available and will provide Meeting Owls to facilitate a hybrid meeting for all members.*

WG53 Request for Intersessional in-person business meeting

2-day business meeting on May 9-10, 2026 in La Paz, Mexico, following the SPF Symposium. The post-symposium WG meeting will be held at CICIMAR, and the rooms will be provided free of charge. WG53 requested partial travel support for a few WG members to attend the business meeting *(see Agenda 12.3 Travel support request).*

S-CCME Request for Intersessional in-person workshop

1-day workshop in La Paz, Mexico, in conjunction with the SPF Symposium (the meeting venue and date are TBC, but likely May 3 at CICIMAR, the same venue for the pre-symposium workshop). *(see Agenda 12.3 Travel support request).*

11.7 Revised EG Action Plan or Implementation Plan

EG (Rpt. CMT)	Description and Rationale of Changes	SB Action
11.7.1. AP-CREAMS (MONITOR)	New Action Plan (PICES-2025 – PICES-2029) including change in TORs.	*Defer to ISB-2026*

11.7.2. S-CCME (FIS)	Phase V Implementation Plan (PICES-2025 – PICES-2030)	SB recommended
11.7.3 TCODE	TCODE Action Plan (2025-) **PICES Rule: Guidelines for Chairs and Convenors: III. Scientific and Technical Committees** Chair of a Scientific/Technical Committee is responsible for; • maintaining an up-to-date Action Plan to indicate how the Committee's activities are, or will, achieve goals under the PICES Strategic Plan.	*Information only*

11.7.1. AP-CREAMS New Action Plan (2025-2029)

At **SB-2024**, AP-CREAMS proposed the revision of its ToRs to expand its target area toward the wider western North Pacific. SB recognised the importance of understanding the interaction of physical, chemical and biological processes between the East Asian marginal seas, AP's core study area, and the wider western North Pacific regions, and recommended their proposals. However, GC requested a clearer rationale for the region the AP intends to expand in the revised AP Action Plan, and deferred the decision to ISB/IGC-2025 or later. GC agreed that the fixed term of AP will be removed when the new Action Plan has been reviewed and approved.

GC Decision 2024/S/21. AP-CREAMS revision. GC requested more detailed information on the rationale behind the proposed change, therefore it was determined that their term (with current ToRs) be extended for half a year, to enable them to submit a revised proposal to include: A rationale for the changes suggested including necessary revisions to the Action Plan, suggested membership needs (they may require additional USA members in an expanded area, for example) and a map using PICES eco-regions. This is to be presented at the next Intersessional Science Board meeting. It is expected that the fixed term will be removed when the proposal has been reviewed.

In response to the GC decision noted above, AP-CREAMS submitted a revised Action Plan to ISB-2025 in May. SB reviewed the Action Plan and agreed that it required further editing by SB members and its reporting parent committee, MONITOR, before submission to the GC. AP-CREAMS has been revising the Action Plan in response to SB members' comments, with guidance from MONITOR, but was unable to complete the revision by SB-2025. The SB advised AP-CREAMS to ensure submission of the revised Action Plan to **ISB-2026.**

11.7.2. S-CCME Phase V Implementation Plan (PICES-2025 - PICES-2030)

FIS Chair, Jackie King, reported With the Phase IV Implementation Plan ending at PICES-2025, S-CCME developed the Phase V plan with the guidance of its parent Committees (FIS, BIO, POC). SB reviewed and recommended GC approve the new Implementation Plan. *=> GC approved but recommends that the newly adopted PICES Mission Statement (see below), and language reflecting PICES move towards actionable science, are reflected in the Plan table (GC2025/S/10)*

GC Decision 2025/A/13. New PICES Mission Statement.
PICES conducts and coordinates marine research and the exchange of knowledge across the North Pacific Ocean to provide member states with actionable information on the current and future conditions of the ocean environment and its resources, including the interactions among the atmosphere, ocean, marine ecosystems and human dimensions. PICES brings together academic researchers, government scientists and managers, and organizations responsible for the protection and sustainability of the North Pacific Ocean to inform decisions and actions.

DRAFT, Nov 2025
Implementation Plan for Phase 5 (2025-2030) PICES-ICES Section on Climate Change Effects on Marine Ecosystems

S-CCME/SICCME Vision

PICES and ICES will become the leading international organizations providing science and advice related to the effects of climate change and variability on marine resources and ecosystems.

PICES and ICES will develop the scientific basis for evaluating the vulnerability, status and sustainability of marine systems under changing climate conditions. Collaborative research within PICES and ICES will facilitate the development, maintenance and evolution of a network of regional interdisciplinary research teams that will share research approaches on a global scale to foster laboratory, field and modelling activities that will provide data and understanding at the spatial and temporal scales needed to monitor, assess and project climate change impacts on marine ecosystems.

S-CCME's (updated) Goals:

1. **Identify, coordinate, and integrate the research activities** needed to understand, assess and project climate change impacts on marine ecosystems.
2. **Review various strategies for sustaining the delivery of ecosystem goods and services** based on predictions that quantify estimates of uncertainty;
3. **Advance efforts to define and quantify the vulnerability and sustainability of marine ecosystems to climate change,** including the cumulative impacts and synergetic effects of climate and marine resource use;
4. **Support global ocean prediction frameworks**, through international collaborations and research, building on ICES and PICES monitoring programs.

UNDOS Alignment

PICES and ICES continue to be well positioned to be leading organizations participating in the UN Decade of Ocean Science for Sustainable Development ("Decade" 2021-2030). The Decade is intended to provide a common framework for international collaboration on ocean scientific research and innovative technologies in support of ocean sustainability. The Decade will contribute to the UN 2030 Agenda for Sustainable Development by fostering international cooperation aligned with 7 main societal goals:

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

The goals of S-CCME align well with all the Decade objectives, particularly a predictable ocean. PICES and ICES intend to participate in the Decade through actions, and S-CCME can support these through coordination and collaboration (e.g., through SmartNet).

5 Year Implementation Plan Activities & Milestones

Since the inception of S-CCME in 2011, there have been significant advancements in the tools and methods used to understand and respond to climate-driven changes to marine ecosystems and fisheries. Increasingly, these tools and information form the basis for implementing climate-informed fisheries and ecosystem management. Integration of EBM tools and ocean forecast and prediction models forms the foundation of expert advice and decision making that helps support vibrant coastal communities, ecosystems and economies. S-CCME/SICCME are well positioned to coordinate and streamline advice and tools towards operational implementation and help advance scenario planning and decision making with the best available science and information.

Support an interdisciplinary community of practice for exchange of information

S-CCME will collaborate with ICES and PICES working groups and advisory bodies to define the future direction of the joint Section/Initiative, emphasizing sustained coordination of climate change research, integration of climate information into advice products, participation in the UN Decade of Ocean Science for Sustainable Development (UNDOS), and empowerment of early-career scientists within the community of practice. In particular, S-CCME will identify focal sub-areas and points of contact for integration across sub-groups within ICES and PICES. These focal areas may include themes such as climate-informed Ecosystem Based Management, climate-linked spatial modeling, scenario and adaptation planning, tipping point analyses, risk assessments, and ensemble approaches.

Communicate and advance understanding

Through information-sharing networks, regular meetings, and interdisciplinary workshops, S-CCME will advance understanding of climate impacts and adaptation in marine ecosystems. Joint ICES–PICES theme sessions and workshops will provide a forum for scientific exchange and dissemination to the broader research and policy communities. In Phase V we aim to hold annual business meetings as well as 10-12 (roughly monthly) meetings of the chairs and sub-group leads and a semi-annual Spring working meeting to identify and advance products, tools, and frameworks to support actionable climate-informed EBM advice. At each annual business meeting, S-CCME members participating in UNDOS activities will share relevant projects and discuss ways in which S-CCME does or can support UNDOS efforts.

Synthesize and share knowledge with relevant bodies

S-CCME will co-develop open-science resources, including code packages and data templates, to enable transparent and reproducible synthesis of climate-related information. Regional summaries and synthesis products will be coordinated with ICES and PICES communities and submitted to regional, national and international assessments (e.g., IPCC AR7, IPBES) and advisory processes.

Recurring Annual Activities (All Goals)

Annual Cycle	Purpose	Outputs
Monthly S-CCME Leads Meetings	Coordination, monitoring, and communication among S-CCME/ SICCME and deliverable leads.	Quarterly updates and shared action logs.
Spring Working Meeting	Planning, training, and synthesis around annual deliverable themes.	Workshop report, refined deliverable plans, “State of Progress” summary.
Business Meeting (Sept/Oct)	Annual review, alignment with ICES/PICES committees, and approval of next-year priorities.	S-CCME Annual Report, coordination and communication across

		regions, updated implementation schedule.
Final Year (2030)	Phase V Symposium replaces Spring Meeting or is in coordination with the fall Business Meeting.	S-CCME Legacy Report, synthesis outputs, and Phase VI plan.

Cross-Cutting Metrics (All Goals)

- **Governance:** Regular meetings, participation rates, and timely reporting.
- **Science Outputs:** Deliverables, publications, and synthesis contributions.
- **Advice Outputs:** Uptake of products in ICES/PICES and member nation processes.
- **Capacity Building:** Number and diversity of early-career scientists engaged.
- **International Alignment:** Documented contributions to UNDOS, IPCC, and related initiatives.
- **Open Science and Communication:** Shared data, code, and communication products.

Milestones and Progress Metrics (2026–2030)

Goal	Key Activities	Milestones	Progress indicators
Goal 1: Identify, coordinate, and integrate the research activities needed to understand, assess and project climate change impacts on marine ecosystems.	Coordinate interdisciplinary research on marine ecosystem responses to climate change. Facilitate information exchange across ICES and PICES expert groups and regional initiatives. Support early-career scientist engagement in integrated climate–ecosystem research.	**Monthly Theme Leads Meetings:** Maintain monthly coordination between S-CCME co-chairs, ICES SICCME leads, and theme group leads to track progress and emerging science priorities. **Annual Spring Workshop:** Focus on defining and refining interdisciplinary research priorities and deliverable themes (e.g., EBM, stock assessments, oceanographic projections). **Annual Business Meeting (Sept/Oct):** Review coordination outcomes, finalize annual report, and align next year's priorities with PICES and ICES committees.	10–12 coordination meetings held annually with bi-annual summaries. Annual workshop report and progress statement included in S-CCME annual report. Increased cross-membership and collaboration across ICES and PICES expert groups.
Goal 2: Review various strategies for sustaining the delivery of ecosystem goods and services based on predictions that quantify estimates of uncertainty.	Review state of the art tools and methods that integrate climate projections into ecosystem-based management (EBM). Lead deliverable theme groups producing operational templates and guidance for management uptake. Collaborate with ICES and PICES advisory bodies and working groups to align outputs with management and regional priorities.	**Deliverable Themes Established (2026):** Launch working groups for climate-informed EBM, Ecosystem Overview templates, and climate-ready stock assessments. **Annual Spring Workshop:** Review and refine deliverable progress and ensure connection to management applications. **Annual Business Meeting:** Evaluate EBM implementation outcomes and integration into advice frameworks.	At least three active deliverable theme groups by 2026. At least one guidance document, template, or synthesis paper per theme by 2030. Documented use of S-CCME deliverables in ICES and PICES advice processes.

Goal 3: Advance efforts to define and quantify the vulnerability and sustainability of marine ecosystems to climate change, including the cumulative impacts and synergetic effects of climate and marine resource use.	Advance regional and thematic synthesis to identify vulnerabilities under climate scenarios. Facilitate integration of physical, biological, and human dimensions through coordination among scenario and risk modeling. Engage in regional international assessments (UNDOS, IPCC AR7, IPBES) to communicate findings around ecosystem impacts and changes as well as effective adaptation and mitigation approaches.	**Annual Spring Workshop:** Feature focused sessions on vulnerability assessment methods and applications. **Annual Business Meeting:** Synthesize progress toward IPCC AR7 inputs and regional synthesis products. **Deliverable Themes:** Develop standardized “Climate Assessment Framework” for ICES/PICES regions.	Contributions submitted to IPCC AR7 and UNDOS projects. Regional climate assessment frameworks (and where applicable, climate summaries) completed and shared with PICES/ICES committees. Published synthesis products (e.g., fact sheets, special issues) highlighting regional vulnerability trends.
Goal 4: Support global ocean prediction frameworks, through international collaborations and research, building on ICES and PICES monitoring programs.	Advance coupled physical– biological modeling, AI-based forecasting, and open-science tool development. Promote international collaborations linking PICES/ICES to UNDOS networks and SmartNet initiatives. Support the creation of reproducible code and data-sharing frameworks.	**Deliverable Themes:** Launch theme groups focused on coordination among ICES and PICES groups working on oceanographic and AI modeling and marine CDR (carbon dioxide removal). **Annual Spring Workshop:** Report progress on predictive modeling deliverables and cross-regional synthesis. **Final Symposium (2030):** Present S-CCME Phase V outcomes, including predictive framework prototypes and global stocktake contributions.	Open-access modeling and synthesis tool inventory released by 2028. At least one PICES/ICES-endorsed synthesis of predictive frameworks completed. S-CCME 2025–2030 Report or special volume published and endorsed by both organizations.

Appendix A: Background

In the spring of 2011, PICES and ICES agreed to move forward on the Science Plan for a PICES-ICES Section on Climate Change effects on Marine Ecosystems (S-CCME IP). This project is known within ICES as the Strategic Initiative on Climate Change Impacts on Marine Ecosystems (SICCME). As stated in the Science Plan the goal of S-CCME was to:

1. Define the research activities needed to understand, assess and project climate change impacts on marine ecosystems with sufficient spatial and temporal resolution to plan strategies for sustaining the delivery of ecosystem goods and services and the preservation of biodiversity. When possible projections should quantify estimations of uncertainty.

2. Define and quantify the vulnerability of marine ecosystems to climate change, including the cumulative impacts and synergetic effects of climate and marine resource use.

3. Build global ocean prediction frameworks, through international collaborations and research, building on ICES and PICES monitoring programs.

The PICES and ICES co-chairs published an initial Science Plan and a 2012-2014 Implementation Plan (IP) for this initiative (Hollowed et al, 2013: Appendix 4, S-CCME IP). A phased implementation approach was proposed, and at the PICES Annual Meeting in 2019, S-CMME requested that IP Phase durations be extended to 5 years; this request was approved by the Governing Council. Within the IP, both organizations recognized that while the specific activities of S-CCME may change overtime three activities of the S-CCME IP were expected to be continuous:

1. Synthesis of existing knowledge,
2. Advancement of new science and methodology, and
3. Communication of research findings.

Phase 2 (2015-2017) IP included:
- Continue to advance new science focused on climate change effects on marine ecosystems through theme/topic sessions and workshops;
- Update and improve forecasts with IPCC AR5 scenarios;
- Convene an international symposium in 2016;
- Develop regional synthesis reports;
- Initiate inter-sessional training for projecting climate change impacts on marine ecosystems;
- Continue collaboration with global climate change research community.

Phase 3 (2018-2020) IP included:
- Continue to advance new science focused on climate change effects on marine ecosystems through theme/topic Sessions and workshops;
- Update and improve predictions with IPCC AR6 scenarios;
- Develop regional synthesis reports;
- Convene an international symposium in 2018.

Phase 4 (2021-2025) IP included those of phases 1-3 as well as :
- Provide forums for communication and coordination between national climate research nodes modeling teams. A key element of this process will be to propose investigator meetings during the PICES and ICES annual meetings.
- Evaluate and compare ecosystem projections and outcomes based on CMIP6 projections and IPCC AR6 results released in 2021.
- Continue to expand core research activities, including laboratory and field activities, needed to advance the global synthesis of climate change impacts on marine ecosystems for sustaining the delivery of ecosystem goods and services, and define and quantify the vulnerability of marine ecosystems and key living marine resources to climate change. [Decade relevant]

- Convene dedicated S-CCME topic sessions for PICES and ICES Annual meetings. [Decade relevant]
- Provide a forum for the assessment and synthesis of existing projections of climate change impacts on marine ecosystems through joint theme or topic sessions and workshops at international symposia including the 5th Effects of Climate Change on the World's Oceans Symposium (tentatively scheduled for June 2023 in Bergen, Norway). [Decade relevant]
- Encourage integration with the PICES Human Dimensions Committee and the ICES Strategic Initiative on Human Dimensions through joint theme or topic sessions and workshops.
- Publish regional summaries in a timely manner to allow their consideration by the relevant IPCC Assessment Reports. This effort will facilitate international collaboration and will provide a vehicle to communicate our current knowledge to stakeholders and the broader scientific community.

11.7.3. TCODE New Action Plan (ISB-2026 -)

TCODE Vice-chair, Fangfang Wan, reported the progress of the TCODE New Action Plan. The current Action Plan was revised in 2022. Given that SG-DATA, WG-52 and TCODE have revised the PICES Data Management Policy and have been modifying the PICES data reporting strategies and protocols since 2022, TCODE members agreed that updates of its Action Plan were necessary. TCODE submitted the draft Action Plan (2025-) for SB review at SB-2025. They plan to seek SB endorsement on the Plan at ISB-2026.

DRAFT, Nov 2025

Technical Committee on Data Exchange Action Plan (2025---)

Mission

The mission of the PICES Technical Committee on Data Exchange (TCODE) includes the following:

- Identify the data sharing and management needs of PICES and PICES members;
- Develop strategic plans to meet these requirements;
- Review PICES Zenodo entries and ensure they are consistent with PICES activities;
- Recommend to Science Board, the establishment of expert groups to deal with specific functions of TCODE;
- Review the progress of tasks assigned within TCODE, and provide Annual Reports to Science Board on the work of TCODE;
- Review and rank annual nominations for PODA and POMA awards;
- Advise the PICES Secretariat on its data exchange activities; and
- Review and update PICES data management policy.

Strategy of TCODE

To implement its mission, the TCODE will address each of the five specific goals to advance and apply scientific knowledge of PICES strategy. Specific actions and tasks within each of these goals are as follows:

Goal 1: Foster collaboration among scientists within PICES and with other multinational organizations

Action1 Establish dialogue with the various bodies of the international, national and local organizations, commissions and programmes involved in Marine Data and Information Management issues

Task 1.1 Maintain dialogue with PICES-ICES UN Decade working group and SmartNet , activities.

Task 1.2 Maintain dialogue with relevant programmes, sub-commissions, sub-projects in the IOC of UNESCO, such as IODE (ODIS, OTGA), NOWPAP, NEAR- GOOS, IOOS, ODIN, WESTPAC and CIOOS.

Task 1.3 Establish dialogue with organizations such as UNESCO/IOC and ICES to support the UN Decade of Ocean Science, in particular, its societal outcome of “Transparent and accessible ocean”

Task 1.4 Review and evaluate proposals submitted to SCOR and ICES to establish new working groups

Task 1.5 Keep in contact with other Committees, Programs and WGs of PICES

Goal 2: Understand the status and trends of international marine data centers and information sites

Action 2 Propose topic sessions and workshops at upcoming annual meetings, and intersessional meetings and symposia

Task 1 Support topic sessions and workshops at upcoming annual meetings, and intersessional meetings and symposia

Task 2 Advise the Secretariat and expert groups on data exchange activities.

Goal3: Advance methods and tools

Action 3 Provide support for the use of shared information technologies

Task 3.1 Review and update PICES data management policy

Task 3.2 Work with PICES expert groups and PICES Secretariat to update and maintain PICES data inventory and PICES Zenodo catalogue

Task 3.3 Provide guidance to each PICES expert groups regarding PICES data management policy, data inventory, and Zenodo submission protocols

Goal4:Provide relevant scientific information pertinent to North Pacific ecosystems that is timely and broadly accessible

Action 4 Support preparation of the North Pacific Ecosystem Status Report (NPESR)

Task 4 Assisting development of PICES north pacific database activities via BECI group

Goal5:Engage with early career scientists to sustain a vibrant and cutting edge PICES scientific community

Action 5 Promote training and education activities with local, regional and international organizations.

Task 5 Support training and education activities of regional and international organizations, programmes, projects such as IOC/OTGA.

Agenda Item 12: Request for Funding

12.1 Report on Past Travel and Other Funding Support

During the 2024 Intersessional Science Board meeting, under Agenda item 12 "Travel Support Requests", SB requested information on historic amounts of travel and other funding support, to facilitate the discussion and prioritization of amounts to recommend. A subsequent request was made concerning the funds spent when implementing the Governing Council Decisions that resulted from Science Board recommendations. The Executive Secretary agreed to provide a summary of such spending (see Appendix 2 for the 2025 version of full report)

12.2 Summer School Proposal

MONITOR Chair, Sung Yong Kim, reported the AP-NPCOOS proposal for the Summer School planned to be held in Hokkaido, Japan, in 2026. Sanae Chiba, PICES Deputy Secretary, confirmed that the organizer team had communicated with Secretariat in advance of the SB meeting regarding the structure and budgetary breakdown of the proposal, and that the proposed plan was logistically feasible. SB highly evaluated the proposal and recommended GC approve the Summer School to be held as proposed. *=> GC approved the plan and budget as proposed (GC2025/S/11)*

Score criteria **3**: highly recommended, **2**: recommended, **1**: recommended only if budget is available, **0**: not recommended.

EG (RPT CMT)	Title, Date, Location	Amount and rational of fund request	SB Priority
AP-NPCOOS (MONITOR)	2026 PICES Summer School on "*Ocean Biologging*" September 14-18, 2026 Hokkaido University, Hakodate, Japan Local Host: Hokkaido University	CA$ 15,000 for travel support of 15 students. CA$ 6,000 for operational costs Additional cost: CA$ 12,000 will be funded by co-sponsors (FRA, Nagasaki University Organizer consulted Secretariat on the rational of the request prior to proposal submission	High (2.9)

See the full proposal for the detailed plan and detailed cost breakdown on the next page.

2026 PICES Summer School on "*Ocean Biologging*": Proposal
Hosted by Hokkaido University Fisheries Sciences, Hakodate, Hokkaido, Japan
October 22, 2025

Dates (Tentative): September 14-18, 2026 (Students arrive September 13th)

PICES URL: TBD

Location: Hokkaido University, Hakodate, Hokkaido, Japan

Co-Principal Organizers: Takahiro Tanaka (Nagasaki University, AP-NPCOOS, Japan), Yanhui Zhu (Hokkaido University)

School Coordinators: Kazushi Miyashita (Hokkaido University), Yanhui Zhu (Hokkaido University), Kenji Minami (Hokkaido University)

Steering/Selection Committee: Takahiro Tanaka (Nagasaki University, AP-NPCOOS, Japan), Kazushi Miyashita (Hokkaido University), Hikaru Homma (FRA, AP-NPCOOS, Japan), Akira Yamaguchi (FRA, AP-NPCOOS, Japan), Jack A. Birth (AP-NPCOOS, MONITOR, USA), Sung Yong Kim (AP-NPCOOS, MONITOR, Korea)

Proposed Instructors: Kazushi Miyashita (Hokkaido University, Principal Lecturer); Yanhui Zhu (Hokkaido University); Kenji Minami (Hokkaido University); Kazuhiro Nakaya (Hokkaido University); Ippei Suzuki (Hokkaido University); Yuta Sakuragi (Kyoto University)

Teaching Assistants: TBD

Synopsis: The 5-day summer school on "Ocean Biologging" will focus on techniques for monitoring both the behavior of marine organisms and the environmental conditions they experience using biologging technology. The program will begin with introductory lectures on biologging, covering fundamental concepts, equipment, and parameters measured by biologging devices.

Following the lectures, participants will engage in laboratory demonstrations and hands-on exercises using live fish in a large experimental aquarium at the Hakodate Research Center for Fisheries and Oceans. Various fish species will be used, allowing participants to directly compare data across species and gain insights into species-specific behaviors. The practical sessions will teach students how to attach sensors to marine organisms, collect time-series data such as depth, acceleration, and body orientation, and analyze the data using the tags they have deployed themselves.

In addition to tracking animal behavior, students will also learn methods to collect and analyze environmental data, such as seawater temperature, using biologging devices. Through these integrated exercises, participants will develop a comprehensive understanding of how biologging can be applied to study both marine organisms and their surrounding environments, bridging the gap between animal behavior and oceanographic processes.

Topics to be covered include: biologging; marine biology; data logger attachment; collecting and processing of timeseries data; Analysis of marine organisms' behavior; GPS positioning; marine environmental monitoring.

The goal of this summer school is to provide students with a comprehensive understanding of modern biologging techniques used to monitor both the behavior of marine organisms and the environmental conditions they experience, across a wide range of temporal and spatial scales. To achieve this, the program combines detailed lectures by local and invited experts with laboratory demonstrations and hands-on exercises. Participants will learn how to install biologging sensors, collect time-series data such as depth, acceleration, and temperature from tagged organisms, and analyze these data to gain insights into the interactions between marine life and their surrounding environment.

Proposed Summer School Schedule:

HU: Hokkaido University
HRC: Hakodate Research Center for Fisheries and Oceans
KU: Kyoto University

The detail of the lectures is TBD.

Sunday (Sep. 13) Students Arrival and Check-in

Monday (Sep. 14) Attaching biologging equipment to marine organisms
(AM) Introduction to Biologging: Principles, Technologies, and Applications (Dr. Miyashita, Dr. Suzuki, HU)
(PM) Hands-on Training in Biologging Equipment at HRC (Dr. Suzuki, Dr. Zhu, HU)

Tuesday (Sep. 15) Hands-on Field Training in GPS and Oceanographic Observation
(AM) Move to Onuma Park and Lecture on the nature of Onuma (Dr. Zhu, Dr. Minami, HU)
(PM) Field Practice in GPS Positioning and Environmental Measurements at Onuma Park (Dr. Zhu, Dr. Minami, HU)

Wednesday (Sep. 16) Practical Training on Retrieval and Analysis of Biologging Data
(AM) Lecture on Biologging Data Analysis (Dr. Sakuragi, KU)
(PM) Data analysis at HRC (Dr. Sakuragi, KU; Dr. Zhu, HU)

Thursday (Sep. 17) Practical Training on Retrieval and Analysis of Biologging Data
(AM) Lecture on Behavioral Ecology of Sharks (Dr. Nakaya, HU)
(PM) Data analysis and Presentation/Report preparations at HRC (Dr. Zhu, HU)

Friday (Sep. 18) Data analysis and Presentations
(AM) Data analysis and Presentation/Report preparations at HRC (Dr. Miyashita, Dr. Minami, HU)
(PM) Presentations and Wrap-up

Logistics
- Lunch to be provided by the summer school
- Arrival Sunday Sep 13; Depart Saturday Sep 19.
- Participants will stay at a local hotel in Hakodate

Draft Schedule

10 October 2025	Draft proposal for PICES Science Board completed
12 November 2025	Steering/Selection Committee meet at PICES Annual Meeting 2025, Yokohama, Japan
Jan–Feb 2026	Design workshop announcement
March 2026	Announce Workshop on PICES web site (SC members circulate)
15 May 2026	Applications due
1 June 2026	Selection decisions made
15 June 2026	Invitees confirm participation Invitation letters for visa applications issued; decide from whom:

Application and Acceptance Guidelines

- 10–15 participants. Brief CV, statement of interest, one letter of reference (for example, from advisor/supervisor).
- Preference to PICES member nations, but open to others, especially North Pacific rim.
- Graduate school students and early career scientists (Ph.D. < 5 years before) encouraged.
- Targeting students whose research is related to or will benefit from the summer school curriculum content.

Costs

- On-site costs for lab and experimental aquarium use, ground transport, and lecture room will be provided to participants at no expense.
- Participants to support their own travel to Hakodate and housing and food during the stay.
- Limited funding for travel may be available.

Potential Funding sources:

- The total estimated summer school cost for 15 students is $18,000.
- Japan Fisheries Research and Education Agency (FRA) and Nagasaki University will support $12,000. We anticipate funding from PICES for the remaining cost ($6,000) and students travel support (for instance, $15,000 in total for 15 students).

Resources Requested from PICES

- PICES support identifying partial funding contributions from international organizations (e.g. ICES, NPRB, SOLAS, SCOR, NOWPAP, IMBeR, etc.).
- PICES hosting of web page for summer school information and updates and applications.
- PICES staff support for administration of web page and application processing

Breakdonw of the estmated costs except student Travel support						
Items	Content	JPN¥	QTY	JPY¥(Total)	CAD$(Total)	(1 CAD$ = 100 JPN¥)
Travel Expences	Invited instructor	110000	2	220000	2200	
Travel Expences	On-site support staff	110000	1	110000	1100	Japanese AP-NPCOOS member
Direct personnel costs	Teaching Assistants	39000	5	195000	1950	5 Grad school students
Direct personnel costs	Administrative staffs	48000	3	144000	1440	3 Persons
Material Cost	Data logger	70000	10	700000	7000	TD sensor (Temperature and Depth)
Material Cost	Experimental Consumable	40000	1	40000	400	cable ties, tapes, feed for live fish etc
Material Cost	Live Fish	50000	1	50000	500	catch fish using recreational fishing boat
Facility fees	Seawater for aquarium	100000	1	100000	1000	
Facility fees	Lab use	1000	5	5000	50	¥1000*5days
Leasing fees	rental car	150000	1	150000	1500	
Misc	Lunch	25000	5	125000	1250	¥1000*25persons*5adys
				Total Costs	18390	CAD$
				Costs supported by local co-sponsors	12250	CAD$
				Funds request to PICES	6140	CAD$

Instructors

Kazushi Miyashita (Hokkaido University), miyashi@fish.hokudai.ac.jp
Kenji Minami (Hokkaido University), k.minami@fsc.hokudai.ac.jp
Yanhui Zhu (Hokkaido University), zhuyanhui920817@fsc.hokudai.ac.jp
*Kazuhiro Nakaya (Hokkaido University), nakayakk@gmail.com

*Ippei Suzuki (Hokkaido University), is7@fsc.hokudai.ac.jp
*Yuta Sakuragi (Kyoto University), sakuragi.yuta.8z@kyoto-u.ac.jp

*to be invited/confirmed.

Steering/Selection Committee

Takahiro Tanaka (AP-NPCOOS, Japan), takahirot@nagasaki-u.ac.jp
Kazushi Miyashita (Hokkaido University), email
Hikaru Homma (AP-NPCOOS, Japan), homma_hikaru93@fra.go.jp
Akira Yamaguchi (AP-NPCOOS, Japan), yamaguchi_akira35@fra.go.jp
Jack A. Birth (AP-NPCOOS, MONITOR, USA), jack.barth@oregonstate.edu
Sung Yong Kim (AP-NPCOOS, MONITOR, Korea), syongkim@kaist.ac.kr

12.3 Travel Support Proposal from PICES EGs

SB reviewed the proposals and ranked their priority using the following scoring criteria: 3 = highly recommended (High); 2 = recommended (Middle); 1 = recommended if budget is available (Low); 0 = not recommended. *=> GC determined that funding requests will be supported according to the available budget that applies for 2026 (known on January 1) and will take into account the priorities from Science Board (GC2025/S/12)*

Request from PICES Expert Groups: Request for travel funding support for PICES scientist(s) who convene or are invited to the Sessions/Workshops relevant to EG's activities at the international meeting(s) etc.			
AP-ECOP (FUTURE)			
Conference title / Date / Location	Recipient name (if identified)	Amount and rational of fund request	SB Priority
ICES Annual Science Conference 2026 15-18 September 2026 in Brest, France	AP-ECOP co-chairs/members (1-2 ECOP(s), at least one) Recipient(s) will be identified by the Intersessional Science Board Meeting in May 2026.	6,100 CAD (for two people) (Airfare: 2,000 CAD; Accommodation: 150 CAD × 5 nights = 750 CAD; Per diem: 50 CAD × 6 days = 300 CAD) ICES is one of the most important partner organizations of PICES, and there is still room to strengthen collaboration between our respective ECOP networks (i.e., AP-ECOP & SIIECS). By attending the ICES Annual Science Conference, the PICES ECOP representative(s) will enhance networking between PICES and ICES, collect information, co-organize events, and engage in discussions on future synergies.	Middle (2.2) (SB comment) Recipients must be the members of EGs (e.g. Joint ICES/PICES EGs, AP-ECOP, S-CCME). SB to give guidance on selection of ECOPs to travel.
AP-NIS (MEQ)			
Conference title / Date / Location	Recipient name (if identified)	Amount and rational of fund request	SB Priority
International Conference on Aquatic Invasive Species (ICAIS) Aug 23-27, 2026, in Belfast, Northern Ireland	2-3 ECOPs (TBD)	Partial travel support and/or registration fee waivers for PICES ECOPs ICAIS is a globally recognized forum to exchange information on aquatic invasive species research, management, and policy. A goal of AP-NIS is to increase information sharing and contribute to capacity building. Having PICES ECOPs participate in this conference will give them long lasting benefits. Dr. Therriault will work with the local organizing committee to ensure PICES support is fully recognized -- Castle Ward level.	Middle (2.0)
WG53 (FIS)			
Conference title/ Date / Location	Recipient name (if identified)	Amount and rational of fund request	SB Priority

Post SPF2026 Business meeting May 8-10, 2026, in La Paz, Mexico	2 WG53 members	4,800 CAD (for two people) (Airfare: 1,500 CAD; Accommodation: 150 CAD × 4 nights = 600 CAD; Per diem: 75 CAD × 4 days = 300 CAD) This WG will hold a 2 day business meeting following the 2026 ICES/PICES/FAO small pelagic forage communities symposium in La Paz, Mexico (see Agenda 11). We are requesting travel for two WG53 members to attend this meeting. We anticipate the WG members will also attend the Symposium, but paid through their institution (so the request here will constitute partial funding for the entirety of the Symposium)	High (2.6)
S-CCME (FIS)			
Conference title/ Date / Location	Recipient name (if identified)	Amount and rational of fund request	SB Priority
Intersessional Workshop at SPF2026 May 3, 2026, in La Paz, Mexico	2 S-CCME members at least 1 ECOP	$5,000 total (e.g., 3K for one non-North American member and 2K for 1 North American member)	Middle-High (2.4)

Requests From Partner Organizations (See Agenda item 15 or 16 for the event details)			
Conference title / Date / Location	Recipient name / contact	Amount and rational of fund request	SB Priority
10th SOLAS Summer School: Introducing SOLAS new science plan which emphasizes "SOLAS science towards Solutions". 9-27 March, 2026, Tamandare, Brazil	A few ECOPs from PICES countries (TBD)	Participation cost (incl. travel support) for 2 ECOPs PICES regularly co-sponsored SOLAS Summer School, by supporting travel of a few ECOPs from the PICES countries to attend the summer school. Also see Agenda 15: Capacity development event.	Middle (2.0)
NPAFC Workshop "Interactions between salmon, ecosystems, and climate: from mechanisms to predictive models" 16-17 May 2026, Vancouver, Canada	(TBD)	CA$ 7500 to support Workshop organization (PICES hope to use the funds for travel support of PICES scientists to attend the workshop). NPAFC co-sponsors SPF2026 with same amount of support. Workshop objectives align with major scientific topics of joint interest defined in the NPAFC-PICES MOU.	Middle (2.1)

Agenda Item 13: New Expert Group Proposals

The proposals of five new Expert Groups were submitted, four of which were to seek SB recommendation at PICES-2025.

SB supports the proposal of WG-SPLAN. However, SB feels that the current proposal is very ambitious—ranging from strategic planning to implementation support—and that the proposed TORs may not be achievable within a three-year timeframe. SB would like to revisit this proposal at the next SB meeting in December and submit the suggested revisions to GC.

=> GC approved the creation of WG-58 (WG-SPLAN) (GC2025/S/13). There was discussion on this WG, which SB had not recommended at this time. Council appreciated SB's thoughts but were concerned that awaiting further suggestions from SB and the required back and forth between GC and SB would add a significant delay for its establishment. Council determined that it was most efficient to approve the WG now but the members (who will come from both SB and GC and can therefore very effectively represent both groups) are charged with modifying the ToR as their first action.

Name	Proposed Parent CMT	Note
13.1. WG: Strategic Plan Update and Implementation – WG-SPLAN To be WG58 (Full Proposal)	GC, SB	In accordance with the External Review Committee recommendation for PICES to revise its Role, and to undertake actionable science to better support member countries, the WG will revise the current Strategic Plan. The WG takes into consideration the priorities and needs of member countries, and once the new Plan is adopted, support its implementation. Implementation should consider how the PICES Committee Structure should be modified to deliver the new Strategic Plan, and how the products and knowledge generated by PICES activities can best be transferred to each country.

SB recommends GC approve the establishment of the new Expert Groups listed below. *=> GC approved the creation of the following new working groups with terms of Reference as provided (GC2025/S/13). BIO and POC will solely be the parent committees of WG56 (WGDSC), and WG57, respectively.*

Name	Proposed Parent CMT	Note
13.2. WG: Comprehensive understanding of ocean acidification in the North Pacific To be WG55 (Full Proposal)	POC, BIO	**Draft proposal reviewed at ISB-2025* Recommendation by S-CC: This new WG aims to gather ocean monitoring data related to OA, and further its scientific interpretation as well as the evaluation of its effects on the North Pacific ecosystem. These activities are beyond the current ToRs of S-CC, and hence they will become our complementary partner. For this reason, S-CC recommend to our parent committees (POC and BIO) that we should approve this new WG, and promote their cooperation with us. (clarification on difference from S-CC) S-CC is working on coordination of international research studies (S-CC ToR 1) for the wide range of ocean biogeochemical studies including ocean acidification, and sometimes carry out basin-scale synthesis of biogeochemical data (S-CC ToR 6). However, scientific interpretation of "synthesized dataset" is not included in the ToRs of S-CC: We only encourage such interpretation studies by outside groups (S-CC ToR 6). **SB comment: clarify the Data Plan*

13.3. WG: Deep-sea connectivity with focus on seamount ecosystems – WG-DSC To be WG56 (Full Proposal)	BIO	Bult upon the accomplishments of WG47: Ecology of Seamount, this WG aims to advance understanding of seamount ecosystem connectivity by integrating biological and physical data. It will compile information on seamount taxa relevant to propagule transport, assess circulation models around seamounts, and conduct biophysical connectivity modelling in the North Pacific to identify key source areas and inform global management.
13.4. WG: Ocean finescale processes: impacts and parameterizations To be WG57 (Full Proposal)	POC	This WG to advance understanding of dynamical ocean finescale (horizontal scale: 0.1–100 km) processes, including mesoscale and submesoscale processes. WG will integrate high-resolution observations and simulations, assess their roles in North Pacific ecosystems and climate, and evaluate and improve model parameterizations. Building on the achievements of WG 38: Mesoscale and submesoscale processes and WG 50: Sub-mesoscale processes and marine ecosystems, this WG will address remaining gaps, particularly regarding internal waves and parameterization, to strengthen modelling, projection, and international collaboration on ocean-climate interactions.
13.5. WG: Bridging zooplankton production and assessment and management fisheries resources in changing oceans – WG-BZF (Draft Proposal)	BIO, FIS	This WG aims to bridge gaps between zooplankton ecology and fisheries assessment by fostering communication among oceanographers, modelers, and managers. The group will review data and models, develop protocols for integrating zooplankton into stock assessments, evaluating model performance, building collaborative networks, and promoting international cooperation. **Information only, seek approval at ISB/IGC 2026*

Full Proposal 1: WG- Strategic Plan Update and Implementation

Title and Acronym of the Group

WG on Strategic Plan Update and Implementation – WG-SPLAN

Term (WG and SG only) **WG: 3 yrs and SG: 1 yrs (with exception)*	**Proposed Parent Committee(s)** **Recommended to have no more than 2 committees*
3 years, from PICES-2025 to PICES-2028	GC and SB

Co-Chairs (Name, Country, Affiliation, Email address)
**consider appointing a chair from both Western and Eastern North Pacific*

TBC

Motivation, Goals and Objectives (max. 300 words)
**clarify scientific justification, societal outcomes, etc.*

The Strategic Plan developed in 2016 needs to be reviewed and updated in accordance with the External Review Committee recommendation for PICES to revise its Role, and to undertake actionable science to better support member countries. The WG should contain one member (at least) from each country who is either a member of GC, or nominated by the GC member, and who has access to the policy priorities and needs of their country. The WG should also contain member scientists from each discipline who can provide input on practical, relevant, current and emerging information that PICES members can provide.

The WG will first revise the Strategic Plan, taking into consideration the priorities and needs of member countries, and once the new Plan is adopted, support its implementation. Implementation should consider how the PICES Committee Structure should be modified to deliver the new Strategic Plan, and how the products and knowledge generated by PICES activities can best be transferred to each country.

The group also needs to consider, at appropriate intervals, the list of External Review Report Recommendations, and identify where the WGs activities address and meet them, and where more work is needed.

Relevance to the PICES Strategic Plan (max. 150 words)

Revising the strategic plan is clearly highly relevant. Furthermore, it will determine the requirements of many other aspects of the Organization, including its infrastructure and resourcing. Revisions to PICES Committee structure, planning of the next Integrated Science Program and capacity development regarding strategic engagement all need to consider the Strategic Plan in their implementation.

Linkage(s) to Previous PICES Expert Groups Activities (if any)

study-groups WG-SG-RSP Disbanded - PICES - North Pacific Marine Science Organization

Linkage(s) to Other Organizations and Programs (if any)

N/A

Terms of References

1. Review the current PICES Strategic Plan;
2. Compile and consider the views of Contracting Parties on their priorities for actionable scientific information from the North Pacific Ocean (based on information solicited and provided by GC), and the preferred mechanism for its delivery, over the next 5-10 years;
3. Engage with PICES partners (Regional Fisheries Management Organizations, Regional Seas Bodies and other international organizations) on needs from PICES to support their activities;
4. Propose revisions to the current PICES Strategic Plan that incorporate ToR 1-3 in time for consideration by Council at PICES-2026; Incorporating any feedback, finalize the new Strategic Plan.
5. Review and propose revisions to the PICES Committee structure and their Action Plans to achieve the Strategic Plan goals.
6. Communicate with other expert groups working on PICES evolution in response to the External Review

Report Recommendations, for example those involved with the next NPESR and the next Integrated Science Program (ISP) to coordinate development across PICES activities and reduce duplication of effort. Secretariat to provide support for this.

7. After PICES-2026 and publication of the new SP the WG to continue to liaise with PICES expert groups and provide guidance on how to develop and transfer information products generated by emerging PICES activities, such as NPESR IV and the next Integrative Science Program, to member countries and partner organizations.

Time Line and Expected Deliverables

** **WG**: annual plan (year 1... Year 2...) ; **Section & AP**: 3-5 yr Action Plan*

** include information on the respective TOR(s) to be addressed.*

ToR 1-3. A summary will be prepared which describes the needs of member countries and partner organizations for actionable science based on activities in ToR 2 and 3. (Year 1)

ToR 4. Utilizing the summary from above and the review of the existing Strategic Plan a draft new Strategic Plan will be developed and presented at PICES-2026. Any suggested revisions will be made and the Strategic Plan published and circulated/communicated to member countries and partner organizations. (Year 1)

ToR 5-6. In collaboration with the Expert Group developing the next ISP propose revisions to the PICES Committee Structure to be considered by Science Board. (Year 2)

ToR 6-7. Active liaison with other expert groups and review of emerging information products. A report will be produced containing guidance for transfer of different information types. Recommendations on ongoing needs will be prepared. (Year 3)

SB Comments:

- Should be a 5 yr term, separating strategic and operational components. Current plan is too ambitious and the topics to deal is very wider, thus probably cannot achieve in 3 yrs.
- Should consider establishing some Task Teams (e.g. stakeholder engagement, Strategic plan, ISP, organization structure) or new SGs for them.
- Should consider more SB members (and CMT, and relevant EGs) engagement, e.g. in developing TOR and Time Line.

Data Management Plan (if applicable)

**see PICES Data Management Policy,*

ToR 7 will need to connect to the Data Management Plan to ensure consistency in language across PICES activities.

Suggested Members

The following people have volunteered so far:

Name	Country	ECOP? (Y or N)	Email Address
Sonia Batten	Secretariat	N	Sonia.batten@pices.int
Steven Bograd (SB)	USA	N	Steven.bograd@noaa.gov
Evan Howell (GC)	USA	N	Evan.howell@noaa.gov

Any other information

Full Proposal 2: WG- Comprehensive understanding of ocean acidification in the North Pacific

Title and Acronym of the Group

Comprehensive understanding of ocean acidification in the North Pacific

Term (WG and SG only) From .... To.... **WG: 3 yrs and SG: 1 yrs (with exception)*	**Proposed Parent Committee(s)** **Recommended to have no more than 2 committees*
3 yrs	BIO, POC

Co-Chairs (Name, Country, Affiliation, Email address)
**consider appointing a chair from both Western and Eastern North Pacific*

Masahiko Fujii (Japan, Atmosphere and Ocean Research Institute, the University of Tokyo, mfujii@aori.u-tokyo.ac.jp), Guang Gao (China, State Key Laboratory of Marine Environmental Science, Xiamen University, guang.gao@xmu.edu.cn), Claudine Hauri (USA, International Arctic Research Center, University of Alaska Fairbanks, chauri@alaska.edu), Kitack Lee (Korea, Division of Environmental Science and Technology, Pohang University of Science and Technology, ktl@postech.ac.kr)

Motivation, Goals and Objectives (approximately up to 300 words)
**clarify scientific justification, societal outcomes, etc.*

Ocean acidification (OA) and its biological effects are occurring on various spatial and temporal scales. Therefore, in order to accurately grasp the progress of OA and take effective measures, it is necessary for each country to conduct monitoring in various oceanic regions with different marine environments, analyze the data obtained, and share and mutually compare the results obtained. However, the methods used for monitoring and the degree of data sharing achieved have varied from country to country, and this has been a major challenge for the integrative analysis and assessment of the state and impacts of OA in the North Pacific region. This working group aims to contribute to the comprehensive scientific understanding of OA in the western and eastern North Pacific by 1) accelerating the acquisition of monitoring data, 2) compiling the data collected in different countries as inventory data and making the data available for mutual comparison between countries/regions, and based on the intercomparison, and 3) create scientific interpretation that can explain inter-national/regional difference of temporal OA variation. This working group also aim to 4) make recommendations to facilitate integration of the data sets and facilitating information exchange on the biological effects of OA, throughout the above activities 1)-3). This would be in collaboration with international research organizations, such as the Global Ocean Acidification Observation Network (GOA-ON), which has directly addressed these issues by establishing a data portal and other means.

Relevance to the PICES Strategic Plan (approximately 100-200 words)

The aim of this WG is relevant to the PICES Strategic Plan from the following perspectives:

1) Foster collaboration among scientists with other multinational organizations such as GOA-ON, Integrated Marine Biosphere Research (IMBeR), and International Council for the Exploration of the Sea (ICES).
2) Help understand the status and trends of OA, and possible impacts on marine ecosystems and society, due to the loss of marine biodiversity.
3) Advance monitoring methods and tools for assessing OA parameters.
4) Provide scientific insights about OA by compiling and synthesizing monitoring data in each country.

Linkage(s) to Previous PICES Expert Groups Activities (if any)
**See the link for the current and past PICES Expert Groups*

This WG builds on the previous work of WGs 13, 17 and 33, and will coordinate its activities closely with the Section on Carbon and Climate (S-CC). It is also expected that this WG will inform and be informed by the work of WGs 49, 52 and 53.

Linkage(s) to Other Organizations and Programs (if any)

This WG fills a gap in the current GOA-ON global observing network and will complement the work of its various regional hubs. It will also be useful to ICES scientists studying biological impacts of ocean acidification in the Atlantic and Arctic.

Terms of References

1. Assist member countries in establishing effective OA monitoring and the data sharing that is necessary for

evaluating current and projecting future OA and its impacts on marine ecosystems and society around the North Pacific.

2. Summarize on a basin scale the present status and changing rate of OA in North Pacific open ocean and marginal seas.
3. Understand the variability of coastal acidification existing along the North Pacific coastal areas, as well as their mechanisms.
4. Ensure effective mutual communication with other international scientific groups that have experience and responsibility for the coordination of OA studies, such as GOA-ON, IMBeR, and ICES.
5. Communicate the needs of biologists to chemical monitoring programs to infer species and ecosystem responses, evaluate the needs and requirements of a biological monitoring program, and develop a theoretical framework linking chemical changes to biological response, with the GOA-ON Biology Working Group.
6. Provide scientific interpretation and evaluation of OA impacts on marine ecosystems and society in the wand eastern North Pacific.
7. Organize webinars, symposia and workshops, and publish a scientific paper on monitoring and data syntheses of OA, as well as the compound impacts of OA with ocean warming, deoxygenation, and other local stressors in the North Pacific.

Time Line and Expected Deliverables

** include information on the respective TOR(s) to be addressed.*

Year 1 (2026)

- Acquire monitoring data in each country.
- Hold webinar and WG meeting (just before or after PICES annual meeting).

Year 2 (2027)

- Compile the data collected in different countries as inventory data.
- Make the data available for intercomparison between countries/regions in the western and eastern North Pacific.
- Analyze national/regional difference of OA patterns based on the compiled data set.
- Hold webinar and WG meeting (just before or after PICES annual meeting).

Year 3 (2028)

- Make recommendations to facilitate integration of the data sets and facilitating the sharing of relevant monitoring data and information exchange on the biological effects of OA.
- Draft and submit a scientific paper which explains the observed national/regional difference of OA patterns based on the analysis of the compiled dataset
- Hold webinar and WG meeting (just before or after PICES annual meeting).
- Draft and submit a final PICES scientific report.

Data Management Plan (if applicable)

**see PICES Data Management Policy*

Acquired data shall be managed by the national oceanographic data center in each country. Furthermore, data that becomes available for release shall be made publicly accessible through sequential uploads to the GOA-ON portal site, thereby facilitating cross-national data comparison and discussion.

SB comments: more clarify the plan.

Suggested Members

Name	Country	ECOP? (Y or N)	Email Address
Tsuneo Ono	Japan	N	ono_tsuneo65@fra.go.jp
Fei Chai	China	N	fchai@xmu.edu.cn
Jan Newton	USA	N	janewton@uw.edu
Anna Kurnosova	Russia	N	anna.kurnosova@tinro.vniro.ru
DongJoo Joung	Korea	N	dongjoo.joung@pusan.ac.kr
Lawrence Patrick C. Bernardo	Japan	N	lcbernardo@aori.u-tokyo.ac.jp
Charity Lee	Korea	N	cmlee@kiost.ac.kr
TBD	Canada		

Any other information

N/A

Full Proposal 3: WG- Deep-sea connectivity with focus on seamount ecosystems

Title and Acronym of the Group	
PICES WG: Deep Sea Connectivity with Focus on Seamount Ecosystems (WGDSC)	
Term (WG and SG only) From .... To.... **WG: 3 yrs and SG: 1 yrs (with exception)*	**Proposed Parent Committee(s)** **Recommended to have no more than 2 committees*
From 2026 to 2028	BIO (Biological Oceanography)
Co-Chairs (Name, Country, Affiliation, Email address) **consider appointing a chair from both Western and Eastern North Pacific*	
Donald Kobayashi (USA, NOAA, donald.kobayashi@noaa.gov), TBN	
Motivation, Goals and Objectives (max. 300 words) **clarify scientific justification, societal outcomes, etc.*	
Seamount ecosystems are patchily distributed communities associated with deep bathymetric features. Broad array of taxa inhabit these ecosystems. Adequate influx of new individuals is required for population maintenance or recovery of impacted ecosystems. Many marine taxa have dispersive propagules which temporarily inhabit the water column away from benthic adult habitat. Propagules from one location may potentially colonize the same location as well as other locations depending on ocean currents and larval ecology. This WG seeks to better understand this process by applying connectivity modelling to seamount ecosystems using best available scientific knowledge. Mapping sources, pathways, and destinations of propagules will characterize interconnectedness of seamount networks. Certain locations may be disproportionately larger sources of propagules over others, and this knowledge can improve management. Ecological knowledge for many seamount taxa is sparse. The WG's first work component will be to assimilate scientific data on seamount ecosystem taxa pertinent to propagule transport. This could include, but is not limited to, timing and location of spawning, type of propagule, pelagic larval duration, larval behavior, settlement cues, environmental dependencies. Physical oceanography around seamounts is difficult to resolve given fine scale processes around abrupt seafloor features. Review and synthesis of prior deep connectivity modelling will be accomplished. This information will help establish best practices for characterizing flow fields around seamounts and using such circulation data for particle transport modelling. Available circulation models will be explored and downscaling may be applied if deemed necessary. This will be the WG's second work component. The WG's final work component will be using the biological and physical data to run biophysical connectivity modelling for selected seamounts in the North Pacific as a proof of concept. It is anticipated that this new working group will lay the foundation for a global examination of seamount connectivity.	
Relevance to the PICES Strategic Plan (max. 150 words)	
This working group aligns with PICES' strategic goals by fostering international collaboration among experts in seamount ecosystems, physical oceanography, biophysical modeling (Goal 1). Leveraging this expertise to better understanding larval supply dynamics to seamount ecosystems will help characterize their vulnerability and resilience (Goal 2). A primary goal of this working group is to better understand how seamount ecosystems respond to environmental forcings at multiple temporal scales (Goal 3). The quantitative methodology utilized (deep sea Lagrangian particle tracking along isopycnals in ensemble framework) will provide new tools to better understand physical forcings on ecosystems (Goal 4). This working group will promote open data-sharing practices and ensure accessibility and circulation of scientific information (Goal 5). This working group will support early-career scientists by requiring ECOP membership as part of its structure (Goal 6). This working group will foster global scientific cooperation and contributes to sustainable marine ecosystems in the North Pacific.	
Linkage(s) to Previous PICES Expert Groups Activities (if any)	
This proposed working group builds upon the work of PICES WG 47 (Ecology of Seamounts), which focused broadly on seamount ecosystem science. By expanding into deep sea connectivity, a specific topic highlighted by the WG 47 final report, this working group will further efforts to better understand seamount ecosystem vulnerability and resilience.	
Linkage(s) to Other Organizations and Programs (if any)	

NPFC (North Pacific Fisheries Commission): The theme of this working group is recognized as critically important by the Scientific Committee (SC) of the NPFC as well as multiple NPFC SC subsidiary bodies such as the Small Scientific Committee on Bottom Fish and Marine Ecosystems (SSC-BFME), Small Working Group on Vulnerable Marine Ecosystems (SWG VME), and Small Working Group on North Pacific Armorhead and Splendid Alfonsino (SWG NPA-SA).

Terms of References

1. Review existing biological information of seamount taxa relevant to propagule transport modeling.
2. Review existing studies on deep sea connectivity, inventory ocean circulation models for suitability, and develop best practices for seamount connectivity modeling. This could include downscaling of existing circulation model output.
3. Apply connectivity modeling to selected seamounts in the North Pacific as a proof of concept.
4. Foster collaboration between ecosystem biologists and physical oceanographers, build scientific capacity via ECOP engagement in WG.
5. Organize workshops and symposia sessions to disseminate findings and enhance capacity building.
6. Produce a PICES final report summarizing the literature review, best practices for connectivity modeling, and results of the application to selected seamounts of the North Pacific. Peer-reviewed publication(s) will be part of this TOR with quantity and scope of such to be determined during the course of this WG.

Time Line and Expected Deliverables
** include information on the respective TOR(s) to be addressed.*

Year 1 (2026)

1. WG meeting (Zoom meeting in early 2026 after approval of WG)
    a. Discuss schedules, plans, and contributors for terms of reference and deliverables
    b. Discuss logistics of intersessional and asynchronous progress
    c. Discuss roster of WG, recruitment
    d. Discuss subgroups and subject matter expert teams, recruitment
2. WG hybrid meeting (mid 2026)
    a. Summarize progress
    b. Establish subgroups for biological, physical, connectivity
    c. Establish subject matter expert teams
    d. Develop work plan for subgroups
    e. Discuss schedules and plans of symposium sessions and presentations during the next PICES annual meeting and at other relevant venues
3. Contact information (continuous effort)
    a. Compile list of experts on deep sea life history
    b. Compile list of experts on deep sea circulation
    c. Compile list of experts on deep sea connectivity
4. PICES in-person workshop (during PICES annual meeting)
    a. Summarize subgroup work progress
    b. Next steps

Year 2 (2027)

1. WG hybrid meeting (mid 2027)
    a. Discuss schedules and plans of symposium sessions and presentations during the next PICES annual meeting and at other relevant venues
2. Study and preparation of reports (continuous effort)
    a. Subgroup Biological (life history review, table of connectivity-relevant parameters)
    b. Subgroup Physical (models/data review and recommendation)
    c. Subgroup Connectivity (work plan for connectivity modeling and sensitivity analyses)
3. PICES in-person workshop (during PICES annual meeting in Japan)
    a. Summarize subgroup work progress
    b. Presentation of subgroup reports

c. Next steps

Year 3 (2028)

1. WG hybrid meeting (mid 2028)
    a. Discuss progress of modeling and sensitivity
2. Conduct connectivity modelling and sensitivity analyses (continuous effort)
3. PICES in-person workshop (during PICES annual meeting in Japan)
    a. Summarize progress
    b. Presentation of connectivity and sensitivity analyses
    c. Wrap up

Data Management Plan (if applicable) **see PICES Data Management Policy,*

This working group is committed to adhering to the PICES Data Management Policy and ensuring the responsible collection, sharing, and dissemination of data, in alignment with the FAIR principles (Findable, Accessible, Interoperable, and Reusable).

Data Accessibility and Sharing

All best practices developed by this working group will be openly published in peer-reviewed journals and made publicly accessible to the scientific community. The coding libraries compiled during the working group's activities will be hosted on GitHub, ensuring open access, transparency, and reproducibility. These libraries will include annotated datasets with appropriate metadata following PICES data-sharing guidelines to facilitate interoperability and broad usage.

Compliance with PICES Data Policy

The working group will ensure that all collected and processed data adhere to the PICES data policy by:

- Utilizing recognized open-access repositories and platforms for data storage and dissemination.
- Providing comprehensive metadata and documentation for reproducibility.
- Complying with data licensing and citation best practices.
- Ensuring that the datasets meet FAIR data principles.

Data Repositories

The working group encourages the use of well-established repositories for datasets, including:

- GitHub for dataset hosting and model sharing.
- Public repositories such as IEEE in compliance with international data-sharing policies.

Through these efforts, the working group aims to enhance data transparency, support international research collaboration, and facilitate the wider implementation of deep sea connectivity modelling.

Suggested Members

Name	Country	ECOP (Y or N)	Email Address
Donald Kobayashi	USA	N	donald.kobayashi@noaa.gov
Amy Baco-Taylor	USA	N	abacotaylor@fsu.edu
Johanna Wren	USA	N	johanna.wren@noaa.gov
Christina Conrath	USA	N	christina.conrath@noaa.gov
Sung Yong Kim	Korea	N	syongkim@kaist.ac.kr
Alexei Orlov	Russia	N	orlov.am@ocean.ru
Kota Sawada	Japan	N	sawada_kota27@fra.go.jp
Satoi Arai	Japan	Y	arai_satoi36@fra.go.jp
Cherisse Du Preez	Canada	N	cherisse.dupreez@dfo-mpo.gc.ca
Tetjana Ross	Canada	N	tetjana.ross@dfo-mpo.gc.ca
Devon Warawa (invited)	Canada	Y	devon.warawa@pices.int
Lissette Victorero (DOSI ex officio)	Finland	N	lissette.victorero@gmail.com

Any other information

Recruitment of additional WG members is currently ongoing. The members listed above have confirmed their membership interest in this proposed WG (with exception of Devon Warawa, who was invited 10/28/2025).
[this document last updated 1700, 10/29/2025 HST]

Full Proposal 4: WG- Ocean finescale processes: impacts and parameterizations

Title and Acronym of the Group	
Oceanic Finescale Processes: Impacts and Parameterizations	
Term (WG and SG only) From .... To.... **WG: 3 yrs and SG: 1 yrs (with exception)*	**Proposed Parent Committee(s)** **Recommended to have no more than 2 committees*
From PICES-2025 to PICES-2028	POC

Co-Chairs (Name, Country, Affiliation, Email address)
**consider appointing a chair from both Western and Eastern North Pacific*

Dr. Zhiwei Zhang, China, Ocean University of China, zzw330@ouc.edu.cn
Dr. Bo Qiu, USA, University of Hawaii at Manoa, bo@soest.hawaii.edu

Motivation, Goals and Objectives (max 300words)
**clarify scientific justification, societal outcomes, etc.*

Oceanic finescale processes are loosely referred to as dynamical processes with horizontal scales of (0.01-100) km including mesoscale eddies, submesoscale processes, fronts, and internal waves, etc. These finescale processes play crucial roles in mediating oceanic energy cascade, biogeochemical and heat transport, and air-sea exchanges, and thus have significant impacts on the marine ecosystem and climate variations. For instance, the strong vertical motions induced by submesoscale processes can, on one hand, increase the primary productivity through upwelling and, one the other hand, facilitate the carbon export through downwelling, both of which having profound influences on biogeochemical cycles, ecosystems, and climate. However, the transient and small-size nature of finescale processes makes their observations and simulations challenging and critical gaps exist in understanding their mechanisms of energy cascade and tracer transport and their pathways in modulating the North Pacific ecosystems and climate. In particular, because the prevailing global models are still too coarse to resolve the finescale processes, their energy cascading and tracer transporting effects have to be parameterized in models. Improper parameterizations of finescale processes can lead to significant biases in projections of ocean warming, acidification, deoxygenation, and thus marine biodiversity and climate resilience.

The PICES Working Group 38 (WG 38) on "Mesoscale and Sub-mesoscale Processes" has ended in 2019, and the WG 50 on "Sub-mesoscale Processes and Marine Ecosystems" will be ended this year. While WG 38 and WG 50 have done a lot of work on meso- and submesoscale processes, additional finescale processes such as internal waves are not included. Furthermore, model parameterizations of finescale processes were not considered. It is timely and scientifically meaningful to transition from the tasks of the above two WGs to our proposed new WG: "*Oceanic Finescale Processes: Impacts and Parameterizations*".

The new WG aims to (1) collecting and integrating high-resolution observational datasets and simulation outputs and data analysis methods to better study finescale processes, (2) better understanding the physics of finescale processes and their impacts on the North Pacific climate variations, (3) enhancing the knowledge finescale processes' roles in biogeochemical processes (e.g., primary production and carbon export) and their impacts on the North Pacific ecosystems, (4) evaluating and developing parameterizations of finescale processes and (5) evaluating their influences on the models' performance in the North Pacific". The establishment of this WG helps to understand the status and changes of North Pacific ecosystems and climate and to improve the models' simulation and projection capabilities on these issues. It will also develop tight collaborations with international colleagues to promote studies on the relevant topics.

Relevance to the PICES Strategic Plan (max 150 words)

The proposed WG on Oceanic Finescale Processes and Model Parameterizations aligns closely with PICES' vision of fostering trans-disciplinary, multinational collaborations to advance understanding of North Pacific ecosystems and enhance resilience. By integrating high-resolution observations and simulations, the group directly supports PICES' mission to coordinate marine research through data exchange and methodological innovation. The PICES have 6 Goals in terms of "Advance Scientific Knowledge". The initiative fosters collaboration (Goal 1) by uniting observational oceanographers, ocean modelers, and ecosystem scientists across nations to address finescale dynamics. It advances understanding of ecosystem status, vulnerability, and resilience (Goal 2) by quantifying how finescale processes—such as mesoscale eddies, submesoscale processes, and internal waves—mediate responses to natural forcings and human activities (Goal 3). The usage and development of parameterizations enhance modeling tools (Goal 4), improving projections of climate variability and ecosystem shifts under anthropogenic pressures. By curating and disseminating datasets and analytical methods, the group ensures timely access to critical scientific information (Goal 5). Furthermore, engaging early-career scientists in cutting-edge data-model integration sustains a vibrant PICES community (Goal 6). Ultimately, this work bridges observational and modeling gaps, strengthening the scientific foundation needed to assess and mitigate ecological risks in a changing North Pacific—a core pillar of PICES' strategic priorities.

Linkage(s) to Previous PICES Expert Groups Activities (if any)

WG 38: Mesoscale and Submesoscale Processes
WG 50: Sub-mesoscale Processes and Marine Ecosystems

Linkage(s) to Other Organizations and Programs (if any)

N/A

Terms of References

1. Review recent advances in finescale processes and their parameterizations in North Pacific to identify key knowledge gaps and innovation opportunities.
2. Assess the availability, accessibility, and interoperability of observation and simulation datasets to study finescale processes in the North Pacific.
3. Integrate multi-platform observational data (e.g., satellites, moorings, gliders, and drifters) with high-resolution model outputs to depict spatiotemporal variability of finescale processes in the North Pacific.
4. Identify the mechanisms and pathways how finescale processes modulate the North Pacific biogeochemical cycles, ecosystem, and climate variations.
5. Evaluate the existing and develop new parameterization schemes for unresolved finescale processes in North Pacific models.
6. Evaluate the performance of numerical models with embedded finescale parameterizations under different climate scenarios.
7. Promote collaborations for data sharing, capacity-building workshops, and early-career mentorship to enhance research on finescale processes.

Time Line and Expected Deliverables
** include information on the respective TOR(s) to be addressed.*

Time Line (from PICES-2025 to PICES-2028)

Year 1

(1) Convene an inaugural workshop (virtual/hybrid) to introduce the members and discuss the Terms of Reference (TOR) of the new WG.
(2) Review research advances in finescale processes in North Pacific and the relevant parameterizations (TOR 1).
(3) Assess the finescale datasets to study finescale processes in the North Pacific (TOR 2).
(4) Integrate observational/model data to depict spatiotemporal variability of finescale processes in the North Pacific (TOR 3)

Year 2

(1) Convene a hybrid workshop focused on TOR 3–5.
(2) Identify mechanisms linking finescale processes to North Pacific biogeochemical cycles, ecosystem, and climate variations (TOR 4).
(3) Evaluate existing parameterization schemes for finescale processes (TOR 5)
(4) Develop new parameterization schemes for finescale processes (TOR 5)

Year 3

(1) Evaluate performance of numerical models with embedded finescale parameterizations (TOR 6).
(2) Final workshop (in-person) to review TOR 1–6.
(3) Finalize collaborative frameworks (TOR 7) and compile project outcomes.

Expected Deliverables

(1) Annual progress reports to PICES, highlighting advancements against TOR objectives.

(2) Mentorship partnerships linking early-career scientists with modeling/observational experts on finescale processes.
(3) A review paper synthesizing research advances, current knowledge gaps, and innovation priorities in North Pacific finescale processes and parameterizations.
(4) A peer-reviewed article on finescale modulation pathways for North Pacific ecosystem and climate variations.
(5) A report on best practices for finescale parameterization in North Pacific models with guidelines for integrating finescale processes into policy-relevant models.

Data Management Plan (if applicable)
**see PICES Data Management Policy,*

The new WG will collect the observational and model data used to study finescale processes in the first year. After these data are evaluated and quality control processed, they will be freely and openly shared with the PICES member countries and beyond in the second year. All of the data will meet the FAIR Guiding Principles (Findable, Accessible, Interoperable and Reusable, Wilkinson et al., 2016) to the greatest extent practicable.

Suggested Members

Name	Country	ECOP? (Y or N)	Email Address
Zhiwei Zhang Bo Qiu Takeyoshi Nagai Sung Yong Kim Takaya Uchida Lixin Qu Lia Siegelman	China USA Japan Republic of Korea Russian Federation China USA		zzw330@ouc.edu.cn bo@soest.hawaii.edu tnagai@kaiyodai.ac.jp syongkim@kaist.ac.kr takachanbo@gmail.com lixinqu@sjtu.edu.cn lsiegelman@ucsd.edu

Any other information

Draft Proposal 5: WG- Bridging zooplankton production and assessment, and management fisheries resources in changing oceans

<table>
<tr><td colspan="2">Title and Acronym of the Group</td></tr>
<tr><td colspan="2">Bridging zooplankton production and assessment and management fisheries resources in changing oceans, WGBZF</td></tr>
<tr><td>Term (WG and SG only) From .... To....
*WG: 3 yrs and SG: 1 yrs (with exception)</td><td>Proposed Parent Committee(s)
*Recommended to have no more than 2 committees</td></tr>
<tr><td>WG: 3 yrs</td><td>BIO and Fish</td></tr>
<tr><td colspan="2">Co-Chairs (Name, Country, Affiliation, Email address)
*consider appointing a chair from both Western and Eastern North Pacific</td></tr>
<tr><td colspan="2">Hui Liu, USA, Texas A&M University
Jennifer L. Boldt, Canada, Fisheries and Oceans Canada
Gen Kume, Japan, Kagoshima University</td></tr>
<tr><td colspan="2">Motivation, Goals and Objectives (max. 300 words)
*clarify scientific justification, societal outcomes, etc.</td></tr>
<tr><td colspan="2">While the importance of zooplankton in regulating fisheries population dynamics has been well recognized, limited effort has been taken to mechanistically link zooplankton dynamics with fish populations into assessment and management of fisheries resources. Lacking such a linkage yields a critical barrier to develop strategies for ecosystem-based management of marine living resources. Specifically, a large knowledge gap exists regarding how variations in zooplankton production may influence the dynamics of fish populations, through recruitment dynamics and spatial/temporal distributions of fish populations. A noticeable obstacle to enhancing our understanding of the processes connecting zooplankton with fisheries production is lacking sufficient communication among biological oceanographers (i.e., zooplankton ecologists), assessment modelers, and resources managers on the need, availability of zooplankton data, relevant assessment models, and the application into stock assessment across a management range of spatial and temporal levels.
The goal of WGBZF is to build up a communication platform through PICES for biological oceanographers (i.e., zooplankton ecologists), assessment modelers, and natural resources managers linking zooplankton to fisheries stock assessment and management in the PICES region. Objectives of WGBZF over a period of three years are:
1. Review assumptions, recent advances, and limitations of zooplankton data collection, data availability, and quantitative fisheries models.
2. Produce recommendations and protocols for biological oceanographers and fisheries modelers on practical application of incorporating zooplankton production into fisheries stock assessment and make these available broadly to users in PICES countries.
3. Develop practical approaches for evaluating assessment model efficiencies with/without including zooplankton in improving fisheries management regarding climate change.
4. Build up a network of scientists and laboratories on zooplankton and fisheries among PICES nations with early career scientists involved from the developing countries.
5. Promote international collaborations among zooplankton and fisheries researchers through international organizations such as PICES and ICES.
6. Publish a final report summarizing results.</td></tr>
<tr><td colspan="2">Relevance to the PICES Strategic Plan (max. 150 words)</td></tr>
<tr><td colspan="2">As stated clearly in Motivation, Goals and Objectives, the proposed WGZBF is closely relevant to four goals of the PICES strategy to advance and apply scientific knowledge.
Goal 1: Foster collaboration among scientists within PICES and with other multinational organizations
Goal 2: Understand the status and trends, vulnerability and resilience, of marine ecosystems
Goal 4: Advance methods and tools
Goal 6: Engage with early career scientists to sustain a vibrant and cutting edge PICES scientific community</td></tr>
<tr><td colspan="2">Linkage(s) to Previous PICES Expert Groups Activities (if any)</td></tr>
</table>

The proposed WGBZF is well compatible with recent completed PICES WGs (e.g., WG37 and WG43), and the ongoing WGs (i.e., WG48 and WG53), which will make the terms of reference and activities of WGBZF broadly impactful in the PICES regions. A PICES-BIO sponsored WGBZF would not only promote information exchange and collaboration across PICES WGs but also among ongoing ICES WGs (e.g., WGZE, WKTAF and IEASG). Also, the proposed WGBZF would provide a basis for training early-career scientists in developing countries in North Pacific Ocean. For this purpose, the proposed WG has assembled scientific expertise from PICES nations and supporting members from ICES nations as well as from several early-career scientists to fully represent the science community of zooplankton ecologists and fisheries modelers fostering a global exchange of scientific information and discussion.

Linkage(s) to Other Organizations and Programs (if any)

1. With supporting members from ICES nations the proposed WGBZF will build up a platform of information exchange and collaboration on zooplankton and fisheries research between PICES and ICES.
2. Contributing to the update of the Ecosystem Status Report produced by PICES.
3. Providing the additional options on zooplankton and fisheries research through the ongoing working groups of PICES and ICES.
4. Promote integrating zooplankton and fisheries research to science plans in international organizations such as PICES and ICES.

Terms of References

1. Build up a platform of communication for biological oceanographers (i.e., zooplankton ecologists), stock assessment modelers, and natural resources managers on zooplankton and fisheries through an interactive website
2. Review assumptions, recent advances, and limitations of zooplankton data collection, data availability, and quantitative fisheries models.
3. Produce recommendations and protocols for biological oceanographers and fisheries modelers on practical application of incorporating zooplankton production into fisheries stock assessment and make these available broadly to users in PICES countries.
4. Develop practical approaches for evaluating assessment model efficiencies with/without including zooplankton in improving fisheries management regarding climate change.
5. Build up a platform of communication for biological oceanographers (i.e., zooplankton ecologists), stock assessment modelers, and natural resources managers on zooplankton and fisheries through an interactive website.
6. Promote international collaborations among zooplankton and fisheries researchers through international organizations such as PICES and ICES.
7. Publish a final report summarizing results.

Time Line and Expected Deliverables
** include information on the respective TOR(s) to be addressed.*

Year 1 (2026)

1. WG meeting (before or during the PICES annual meeting: Canada)
   - ✓ Discuss schedules, plans, tasks, and contributors for terms of reference and deliverables.
   - ✓ Discuss schedules and plans of a workshop/session during the next PICES annual meeting in Canada.
2. PICES workshop (during PICES annual meeting: Canada)
   - ✓ Summarize practical disadvantages and limitations of methods and models for zooplankton data collection, data availability and quantitative fisheries models.
   - ✓ Develop the recommendations and applicable protocols for improving the methods and models.
   - ✓ Discuss the potential methods and practical approaches for incorporating zooplankton in fisheries stock assessment.
3. Contact information
   - ✓ Create a network on scientists and laboratories on zooplankton and quantitative fisheries research especially including the early career scientists on the PICES website.

4. Review articles
   - ✓ Prepare to draft a review article on the status, assumptions, advantages and limitations of methods and models for zooplankton data collection, data availability and quantitative fisheries models.

<u>Year 2 (2027)</u>

1. WG meeting (before or after PICES annual meeting: China)
   - ✓ Revise schedules, discuss newly emerged issues, and update plans for terms of reference and deliverables.
   - ✓ Exercise linking candidate models with zooplankton time-series data in prediction and assessment of stock status (i.e., indices), and compare the estimates and sensitivity of the model results.
   - ✓ Open recommendations and applicable protocols for the methods, approaches, and candidate models.
2. PICES symposium (during PICES annual meeting: China)
   - ✓ Overview zooplankton, fisheries and ecosystem status in PICES and ICES regions (Invited talks).
   - ✓ Discuss mechanisms and ocean processes related to recruitment to be formulated in assessment models.
   - ✓ Integrate latest information on zooplankton methods, fisheries models, and their applications in PICES and the other regions.
3. Contact information
   - ✓ Update the list of contact information on scientists and laboratories on zooplankton and quantitative fisheries research especially for the early career scientists on the PICES website.
4. Review articles
   - ✓ Submit, revise and publish the review articles on methods and models for zooplankton data collection, data availability and fisheries models.
5. PICES scientific report
   - ✓ A draft of PICES scientific report, including the following information on zooplankton data availability and quantitative fisheries models.
     - ➢ Review of the assumptions, advantages and limitations applying zooplankton into stock assessment.
     - ➢ Recommendations and applicable protocols.
     - ➢ Application of practical model to some zooplankton time-series and comparison of the production estimates.

<u>Year 3 (2028)</u>

1. WG meeting (before or after PICES annual meeting: Korea)
   - ✓ Discuss and revise the drafted PICES scientific report.
   - ✓ Discuss future activities through the WG generated network to meet the impending need for assessment and management of fishery resources.
2. Session (during PICES annual meeting)
   - ✓ Better assessment fisheries production in marine systems (Invited talk).
   - ✓ Integrating ecosystem drivers with stock assessment for future management scenarios (Invited talk).
   - ✓ Presentations of latest study cases on linking zooplankton with assessment and management of fisheries resources in PICES nations.
3. PICES scientific report
   - ✓ Submit a final scientific report to PICES.

Deliverables

1. Reports or Peer-reviewed articles summarizing the assumptions, recent advances, and limitations of both zooplankton data collection, data availability and quantitative fisheries models.
2. Guidelines on recommendations and procedures for both biological oceanographers and quantitative fisheries modelers on practical application of linking zooplankton production in fisheries stock assessment and make these available broadly to users in PICES countries.
3. Lists of contact information on scientists and laboratories conducting zooplankton and quantitative fisheries research among PICES nations as well as developing countries.

4. A final report summarizing the results of the WG as a Scientific Report in PICES.

Data Management Plan (if applicable)
**see PICES Data Management Policy,*

N/A

Suggested Members
** Member expertise (Z: Zooplankton, F: Fisheries, M: Modeling, S: Stock Assessment)*

Name (expertise)	Country	ECOP? (Y or N)	Email Address
Hui Liu (Z/F/M)	USA	N	
Jennifer L. Boldt (Z/F)	Canada	N	
Gen Kume (Z/F)	Japan	N	
Yongqiang Shi (Z/F)	China	Y	
Jung Jin Kim (Z/F)	Korea	unknown	
Yong Chen (F/M/S)	USA	N	
John Dower (Z/F)	Canada	N	
Toru Kobari (Z/F)	Japan	N	
Fan Zhang (F/M/S)	China	N	
Jung-Hoon Kang (Z/F)	Korea	unknown	
Julie E. Keister (Z/F)	USA	N	
Akash Sastri (Z/F)	Canada	N	
Motomitsu Takahashi (F/M/S)	Japan	unknown	
Ping Du (Z/F)	China	Y	
Sukyung Kang (Z/F)	Korea	unknown	
Lidia Yebra (Z/F)	Spain	N	

Any other information

Agenda Item 14: PICES-2026

14.1 PICES-2026 Basic Information

Secretariat, Chiba, explained the basic information on PICES-2026 and rough schedule of the sessions/workshop development, and pre-PICES-2026 business meetings of EGs and Committees.

Conference Title: Actionable Science for a Changing Ocean
Date: October 24-30, **Location:** Vancouver Island Conference Centre, Nanaimo, BC, Canada
Local Organizer: DFO Canada
Website: TBA
Format: in-person (with hybrid option for business meetings)

SCOPE: Earths' changing climate and environmental stressors present global problems for the sustainability of marine ecosystems and management of marine resources. Scientists, policy makers, Indigenous peoples, and communities, at regional, national and international scales, must work together to identify the best pathway to take care of the ocean. This includes developing actionable science through interdisciplinary and transboundary research, the inclusion of human dimensions in research and management, and the inclusion of policy and regulatory decision makers in science processes to bridge the science/policy interface. Interdisciplinary science collaboration is needed to understand complex issues, such as the impacts of climate extremes on marine resources and coastal communities, cumulative impacts of multiple stressors, changes in biodiversity, and the effectiveness of marine protected areas. Recent advancements in research and monitoring tools, artificial intelligence, as well as social and economic -oriented investigations show promise in improving our understanding of marine ecosystems and our ability to resolve socioeconomic and environmental conflicts. Key is the communication of science, along with uncertainty and risk, to policy and decision makers. Research by PICES expert groups can feed into actionable science, such as projections, status assessments, and solution-based science. The PICES 2026 annual science meeting will bring together early, mid, and late- career ocean professionals to discuss, develop, and advance science that is actionable for a rapidly changing ocean.

Pre - PICES-2026 schedule (no change)

Session/WS planning		
~ Jan 2026	Sessions/WS are selected	
March-June	Call for abstracts and Financial support request. Invited speakers confirmed	Website open upon the abstract call
~ August	Presentations and detailed schedule confirmed	
Pre-PICES-2025 Online Business Meetings		
September	EG online business meetings	Report to Parents CMT
early October	Committees (& FUTURE) online business meetings	Review Children EG Reports

Business meeting rules
Committees/FUTURE are requested to hold **at least one virtual business meeting before the Annual Meeting** and one in-person meeting (evening) during the Annual Meeting.

EGs are requested to virtually hold at least one virtual business meeting prior to the Annual Meeting to discuss items to report or request to SB. The optional in-person business meetings, in addition to above virtual meetings, would be approved upon request. The proposal for the in-person business meeting will be submitted to the upcoming ISB meeting.

14.2 PICES-2026 Schedule in 8-day model

While SB meeting and GC meeting are scheduled on Friday - Saturday and Saturday - Sunday, respectively, at the current PICES Annual Meeting, GC members (member countries) have expressed a desire to conclude their meeting on Saturday rather than Sunday. This change would reduce the overall meeting duration from the current 9 days to 8 days. GC has requested SB to develop an 8-day model for the PICES-2026 basic schedule as a trial. If the new schedule proves effective, it can be considered for future annual meetings.

To ensure SB recommendations are conveyed to GC, and GC decisions are made at the end of the Annual Meeting in an 8-day model, the current arrangement SB and GC schedules needs to be revised. Secretariat suggested the model plan in which Day 1 of SB meeting is to be held mid-week, either Tuesday, Wednesday or Thursday afternoon, Day 2 on Friday afternoon, and Day 3 on Saturday Morning (see below). Secretariat also suggested three examples for the Session schedules for Monday to Friday morning, holding the Day 1 SB meeting in mid-week in parallel with some side events (Cases 1, 2 and 3 on the next page). SB reviewed these suggestions but preferred the plan to conclude the Annual Meeting on Thursday evening rather than Friday morning, which would allow SB Day 2 meeting to be held as a full-day session on Friday (Cases 4 and 5). To accommodate more qualified topic sessions, all SB members except one preferred holding four parallel sessions after the opening session on Monday (Case 4) over holding the Science Board Symposium (S1) (Case 5). SB recommended GC consider Case 4 as the PICES-2026 general schedule, while also presenting Case 5 as an alternative plan.

=> GC felt that a final decision could not be made until the session proposals have been received, reviewed and the necessary program space to accommodate all selected sessions is known, but GC preferred Case 4 over Case 5 (with SB meeting on Tuesday if an SB Symposium is part of the program).

Current SB/GC meeting schedule

HPI4GC = High Priority Items for GC

<table>
<tr><th colspan="2"></th><th>SB meeting (1.5 day)</th><th>GC meeting (1.5 day)</th></tr>
<tr><td rowspan="2">Friday</td><td>PM</td><td>Day 1 meeting</td><td></td></tr>
<tr><td>Evening</td><td colspan="2">Chairs reception</td></tr>
<tr><td rowspan="2">Saturday</td><td>AM/PM</td><td>Day 2 meeting</td><td>Day 1 meeting</td></tr>
<tr><td>Evening</td><td>(by 8-9 PM) Secretariat summarise the SB recommendations and submit HPI4GC to GC members</td><td rowspan="2">Members individually review HPI4GC</td></tr>
<tr><td rowspan="2">Sunday</td><td>AM</td><td rowspan="2"></td></tr>
<tr><td>11AM-</td><td>Day 2 meeting
SB Chair report SB recommendation to GC</td></tr>
</table>

Proposed SB/GC meeting schedule (in 8-day model)

HPI4GC = High Priority Items for GC

<table>
<tr><th colspan="2"></th><th>SB meeting (1.5 day)</th><th>GC meeting (1.5 day)</th></tr>
<tr><td rowspan="2">Thursday (or Tue or Wed)</td><td>PM</td><td>Day 1 meeting
For Agenda requiring SB recommendation to GC</td><td rowspan="2"></td></tr>
<tr><td>Evening</td><td>(by 8-9 PM) Secretariat summarise the SB recommendations and submit HPI4GC to GC members</td></tr>
<tr><td rowspan="2">Friday</td><td>PM</td><td>Day 2 meeting
For Partner Organization updates
And Agendas NOT requiring SB recommendation to GC</td><td>Day 1 meeting</td></tr>
<tr><td>Evening</td><td colspan="2">Chairs reception</td></tr>
</table>

Saturday	AM	Day 3 meeting Mainly for discussion	Members individually review HPI4GC
	PM		Day 2 meeting SB Chair reports SB recommendation to GC

Proposed PICES-2026 Schedule in 8-day model

Case 1: Session time slots are reduced by the total 2.0 days (0.5 x 4 parallel)

PICES-2026		
Date	**Session/WS (In-person only)**	**Business Meeting (Hybrid)**
Oct 24 (Sat)	Parallel Workshops x 4	Day: EG meetings Evening: CMT meetings
Oct 25 (Sun)	Parallel Workshops x 4	Day: EG meetings Evening: CMT meetings
Oct 26 (Mon)	AM: Opening Session, Keynote, Town hall) PM: S1 Symposium	
Oct 27 (Tue)	Parallel Sessions x 4	EG meeting, F&A meetings?
Oct 28 (Wed)	Parallel Sessions x 4 Evening: Poster session	EG meetings, F&A meetings?
Oct 29 (Thur)	AM: Parallel Session x 4 PM: On-site and Off-site Side Events, excursion	AM: EG meetings PM: SB Day 1
Oct 30 (Fri)	AM Parallel Session x 4 Noon Closing Session	PM: SB Day 2, GC Day 1
Oct 31(Sat)		AM SB Day3 , PM GC Day2

Case 2: Not holding S1 Symposium, available Session time slots are the same as PICES-2025

PICES-2026		
Date	**Session/WS (In-person only)**	**Business Meeting (Hybrid)**
Oct 24 (Sat)	Parallel Workshops x 4	Day: EG meetings Evening: CMT meetings
Oct 25 (Sun)	Parallel Workshops x 4	Day: EG meetings Evening: CMT meetings
Oct 26 (Mon)	AM: Opening Session, Keynote, Town hall) PM: Parallel Sessions x 4	
Oct 27 (Tue)	Parallel Sessions x 4	EG meeting, F&A meetings?
Oct 28 (Wed)	Parallel Sessions x 4 Evening: Poster session	EG meetings, F&A meetings?
Oct 29 (Thur)	AM: Parallel Session x 4 PM: On-site and Off-site Side Events	AM: EG meetings PM: SB Day 1
Oct 30 (Fri)	Plan A: AM Parallel Session x 4 Noon Closing Session	PM: SB Day 2, GC Day 1
Oct 31(Sat)		AM SB Day3 , PM GC Day2

Case 3:
Not holding S1 Symposium, plenary talk x 2 and town hall on Friday (available time slots are same as Case 1)

PICES-2026		
Date	**Session/WS (In-person only)**	**Business Meeting (Hybrid)**
Oct 24 (Sat)	Parallel Workshops x 4	Day: EG meetings Evening: CMT meetings
Oct 25 (Sun)	Parallel Workshops x 4	Day: EG meetings Evening: CMT meetings
Oct 26 (Mon)	AM: Opening Session, Keynote, Town hall) PM: Parallel Sessions x 4	
Oct 27 (Tue)	Parallel Sessions x 4	EG meeting, F&A meetings?
Oct 28 (Wed)	Parallel Sessions x 4 Evening: Poster session	EG meetings, F&A meetings?
Oct 29 (Thur)	AM: Parallel Session x 4 PM: On-site and Off-site Side Events	AM: EG meetings PM: SB Day 1
Oct 30 (Fri)	AM: Plenary talk x 2, Town hall Noon: Closing session	PM: SB Day 2, GC Day 1
Oct 31(Sat)		AM SB Day3 , PM GC Day2

Case 4: supported by HD, BIO, RU, AP-UNDOS, FUTURE, FIS, TCODE.
Not holding S1 Symposium, plenary talk x 2 and town hall on Friday (available time slots are same as Case 1)

PICES-2026		
Date	**Session/WS (In-person only)**	**Business Meeting (Hybrid)**
Oct 24 (Sat)	Parallel Workshops x 4	Day: EG meetings Evening: CMT meetings
Oct 25 (Sun)	Parallel Workshops x 4	Day: EG meetings Evening: CMT meetings
Oct 26 (Mon)	AM: Opening Session, Keynote, ECOP awardees presentations and Plenary?) PM: Parallel Sessions x 4	PM: SB Day 1
Oct 27 (Tue)	Parallel Sessions x 4	EG meeting, F&A meetings?
Oct 28 (Wed)	Parallel Sessions x 4 Evening: Poster session	EG meetings, F&A meetings?
Oct 29 (Thur)	AM: PM Parallel Session x 4 Closing Session	AM: EG meetings
Oct 30 (Fri)		SB Day 2, GC Day 1
Oct 31(Sat)		AM/PM GC Day2

Case 5: supported by MEQ.
Not holding S1 Symposium, plenary talk x 2 and town hall on Friday (available time slots are same as Case 1)

PICES-2026		
Date	**Session/WS (In-person only)**	**Business Meeting (Hybrid)**
Oct 24 (Sat)	Parallel Workshops x 4	Day: EG meetings Evening: CMT meetings
Oct 25 (Sun)	Parallel Workshops x 4	Day: EG meetings Evening: CMT meetings
Oct 26 (Mon)	AM: Opening Session, Keynote, ECOP awardees presentations and Plenary?) PM: Parallel Sessions x 4 or S1	
Oct 27 (Tue)	Parallel Sessions x 4	EG meeting, F&A meetings?
Oct 28 (Wed)	Parallel Sessions x 4 Evening: Poster session	EG meetings, F&A meetings?
Oct 29 (Thur)	AM: Parallel Session x 4 Noon Closing Session	AM: EG meetings PM: SB Day 1
Oct 30 (Fri)		SB Day 2, GC Day 1
Oct 31(Sat)		AM/PM GC Day2

Another option to consider
Hold Committee Paper Sessions with poster presentations only to save up to 2.5 day slots.

14.2 Session/Workshop Proposal Selection Protocol

SB reviewef the timeline for the PICES-2026 Session/Workshop proposal selection, based on the GC2023/S/14 decision, and discussed the optimal procedure for the Committees (including FUTURE, AP-UNDOS) review and ranking of the proposals. Given the challenges and issues during the Committee ranking methods for PICES-2025 proposals (see below), Secretariat proposed an online scoring system using MS Form (see next page) to enable more standardized review across all Committees and to reduce the workload of Committee chairs. SB agreed to adopt the proposed new scoring and ranking methods. SB was scheduled to meet virtually to review the Committees' proposal rankings, select the workshops/sessions for PICES-2026 and recommend them for GC approval by mid-December.

GC2023/S/14
Council 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. Committees will work inter-sessionally by correspondence to review, rank and report to Science Board by the end of November. Science Board will review and provide to GC in early December for approval before year-end.

Rough timeline for PICES-2026 Session/Workshop proposal selection (TBC)

Date	Action
Nov 24, 2025	Session/Workshop proposal submission due
~ early Dec, 2025	Committees review & rank proposals (via virtual meeting or email basis)
~ Dec 10, 2025	Science Board reviews Committee's' proposal ranking, selects the workshops/sessions for PICES-2025, and recommends them for GC approval (via virtual meeting or email basis) **SB met online on Dec 15/16.*
mid Dec 2025 ~	GC meets to makes the decision. **GC met dec 17/18*

Review of Committee scoring methods taken for the PICES-2025 proposal.

Step-1: Secretariat provided the submitted proposals and score sheet to Committee chairs.

Step-2: Committee chairs asked their members to score each proposal based on basic scoring rule below.

How to score the proposals in your Committee/FUTURE
As we agreed at the SB meeting, we leave Committee chairs to decide how to reach an agreement among Committee members on evaluating each proposal. But when you input your Committee Score on the shared form, please score each proposal based on the quality of proposals (timeliness of the topic, relevance to PICES, clarity of objectives and outcomes etc.) as;

3: Your Committee Will Sponsor: High priority
2: Your Committee MAY Sponsor: Mid Priority
1: Your Committee Does not Sponsor: Low Priority (See Note below)
0: Poor quality/or less relevant to PICES and should be rejected

Note: If a proposal is low priority for your Committee but members agree that the topic may be important for PICES, you can score it 2 or 3, or leave the cell "blank" (the average score will be calculated without your score).

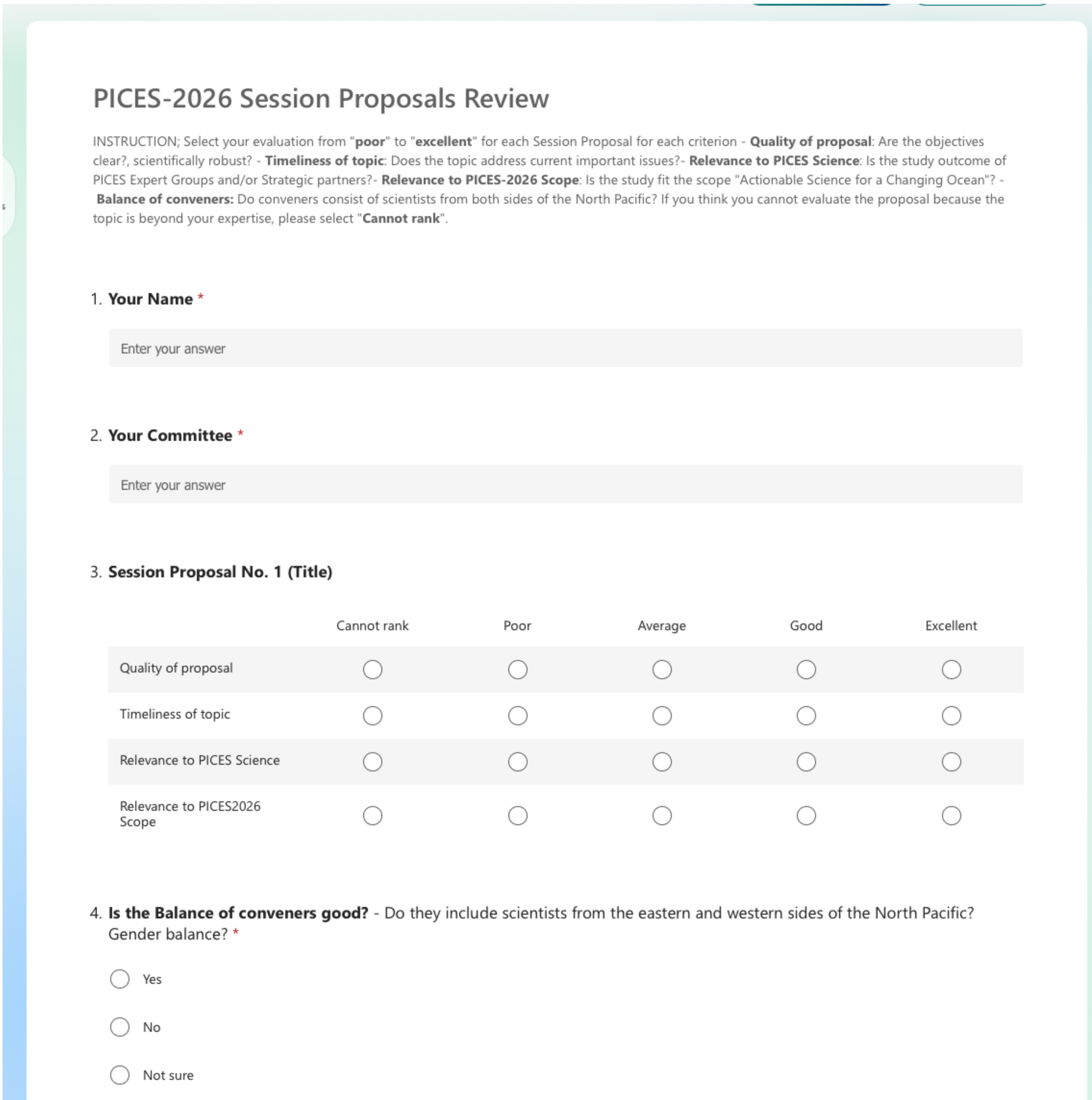
Step-3: Each Committee collected the members' scores, and identified the collective Committee's score, either email basis or by holding an online meeting. The methods of calculating the Committee's score varied from simple average of members' scores to the chairs' discretion based on the discussion. *(at PICES-2024, SB preferred to summarize Committee scores in Committee-specific ways, rather than setting standardized instructions for all)*.

Step-4: SB members met online to select Sessions and Workshop for PICES-2025 with the Committees' ranking as the starting point, considering various factors.

Issues: Because the interpretation of scoring criteria (above), and the method to summarize Committee score varied among members and Committees, it was difficult to compare the Committee outcomes. Due to the argument on the methods, SB meeting took 4 hours to finalize the selection. It was challenging for most of the Committees to hold an online meeting in a short time period during the holiday season.

Alternative Committee scoring methods for PICES-2026 proposals

Step-1: Secretariat provides the submitted proposals to all Committee members, and asks each member to review all proposals to several criteria (see below) on the MS Form. The inputs are automatically summarized on the online table that SB members can see through the link.



PICES-2026 Session Proposals Review

INSTRUCTION; Select your evaluation from "**poor**" to "**excellent**" for each Session Proposal for each criterion - **Quality of proposal**: Are the objectives clear?, scientifically robust? - **Timeliness of topic**: Does the topic address current important issues?- **Relevance to PICES Science**: Is the study outcome of PICES Expert Groups and/or Strategic partners?- **Relevance to PICES-2026 Scope**: Is the study fit the scope "Actionable Science for a Changing Ocean"? - **Balance of conveners:** Do conveners consist of scientists from both sides of the North Pacific? If you think you cannot evaluate the proposal because the topic is beyond your expertise, please select "**Cannot rank**".

1. **Your Name** *

Enter your answer

2. **Your Committee** *

Enter your answer

3. **Session Proposal No. 1 (Title)**

	Cannot rank	Poor	Average	Good	Excellent
Quality of proposal	○	○	○	○	○
Timeliness of topic	○	○	○	○	○
Relevance to PICES Science	○	○	○	○	○
Relevance to PICES2026 Scope	○	○	○	○	○

4. **Is the Balance of conveners good?** - Do they include scientists from the eastern and western sides of the North Pacific? Gender balance? *

○ Yes

○ No

○ Not sure

5. **Should your committee sponsor this Session?** *

- ◯ Yes
- ◯ No
- ◯ Not sure

6. **Comments on Proposal No.1** *

Enter your answer

7. **Session Proposal No. 2**

	Cannot rank	Poor	Average	Good	Excellent
Quality of proposal	◯	◯	◯	◯	◯
Timeliness of topic	◯	◯	◯	◯	◯
Relevance to PICES Science	◯	◯	◯	◯	◯

Step-2: Secretariat summarise the FM Form inputs of each Committee (as a table) and provides it to respective Chairs.

Step-3: Chair and Vice-chair (or co-chair) of each Committee discuss either via online chat or emails to finalize the Committee rank for each proposal and select the **Top 1, 2, 3 proposals for Workshop and Sessions.** Committees do not need to hold an online Committee meeting for this (though they can if they wish).

Step-4: SB members meet online to select Sessions and Workshop for PICES-2026 with the collective Committees' ranking as the starting point, considering various factors.

(Suggested selection process)

4.1. SB to agree (or not agree) to select **Rank 1** from each committee (7 plus FUTURE and AP-UNDOS), max total 9, adjust the duration (0.5 or 1.0) of each if needed.
4.2. Depending on how many slots remain, SB to discuss which proposals from the **Rank 2 group** should be selected.
4.3. If needed, repeat the above for the **Rank 3 group**

Agenda Item 15: Upcoming Capacity Development Events and Activities

Secretariat reported the upcoming Capacity Development events and activities organized by partner organizations.

15. 1 PICES Events

No approved events organized by PICES EGs.

15. 2 Partner Organizations' Activities and Events

15.2.1 SCOR Capacity Development (link)

Sanae Chiba, PICES Deputy Executive Secretary: SCOR CD Committee member (July 2021~)
Core Programmes:

- Visiting Scholars Programme
  Funds for scientists from any country to provide a short training/lecture course at an institution in the developing countries.
  Application for 2026 Scholarship open (submission deadline: December 15, 2025)
- Fellowship Programme (with POGO)
- Travel support for Conference (proposal must be submitted by Organization)
  To support ECOPs from developing countries
  Funded: US$ 6K for participants of SPF2026 (May 2026)

15.2.2 GOOD-OARS-CLAP-COPAS Summer School 2025

- Date: November 4 – 11, 2025, Penang, Malaysia
- Venue: Centre for Marine and Coastal Studies (CEMACS)
- Sponsors: OARS (Global Acidification Research for Sustainability)
  GOOD (Global Ocean Oxygen Decade), etc.
- Organizing Committee (IOC-UNESCO)

PICES approved to support this Summer School at PICES-2024, and two ECOPs have been selected to participate.

15.2.3 SOLAS Summer School 2026

- Date: March 9-27, 2026, Tamandare, Brazil
- Venue: CEPENE: a marine research centre in the Northeast of Brazil
- Sponsors: SCOR, Futurearth, WCRP etc.
- Organizing Committee

SOLAS IPO requested funding support to PICES. *See Agenda 12: funding support request*

Agenda Item 16: PICES-Sponsored Conferences / Symposia

Secretariat reported the PICES-sponsored or relevant recent and upcoming international symposia.

1. One Ocean Science Congress 2025, June 2025, France (completed) 2. ICES Annual Science Meeting, Sept 2025, Lithuania (completed) 3. 12th International Conference on Marine Bioinvasions (ICMB XII), Oct 2025, Portugal (completed)	4. International Symposium on Small Pelagic Fish, May 2026, Mexico 5. 5th Early Career Scientists Conference, 2027, China 6. ECCWO6, 2028 7. Global Symposium on Fisheries Management in an Ecosystem Context, Spring, 2027 – new proposal

16. 1 One Ocean Science Congress (OOSC 2025)

- Date & location: June 4-6, 2025, Nice, France
- Primary Sponsors: France, Costa Rica
- Local Organizer: IFREMER, CNRS
- Theme and Session

- Secretariat Chiba served as an International Science Committee member
- SmartNet co-organized a Town Hall "Moving towards integrated evaluation approaches in support of ocean policy
- PICES supported travels of 2 ECOP participants

OOSC was held in conjunction with the 3rd UN Ocean Conference (2025 UNOC) scheduled for 9-13 June 2025 in the same venue in Nice. Ten Congress Themes and up to 100 sessions were set to address respective major ocean-relevant International Treaties, such as UNFCCC, GBF, BBNJ Treaty, and Plastic Treaty. Over 2000 participants attended, including more than 30% of ECOPs engagements. The OOSC submitted a Policy Recommendation to the Ocean Action Panel scheduled during 2025 UNOC. PICES was officially accredited to attend UNOC and Chiba and MONITOR Chair, Sung Yong Kim, represented PICES at UNOC. See the PICES Press article (Vol 33, Nov 2, pp 13-23) for the full report of OOSC2025 and UNOC3.

16. 2 ICES Annual Science Conference 2025

- Date: Sept 15-18 September, Klaipeda, Lithuania
- Local organizer: Klaipeda University

PICES co-convening Sessions

(S-CCME) Managing for species distribution shifts
(SmartNet) Best Practices for Decision Support Tools to Support Climate-Ready Fisheries: Lessons Learned for the UN Decade of Ocean Science for Sustainable Development
(WG51) The human dimension in adaptive marine management

16. 3 12th International Conference on Marine Bioinvasions (ICMB XII)

- Date: 6-10 October 2025, Madera, Portugal
- PICES supported travel of 2 ECOPs from PICES countries (requested by AP-NIS)

This conference series takes place about every two years, and PICES has been represented on the Scientific Steering Committee since the 7th iteration.

16. 4 ICES/PICES/FAO International Symposium on Small Pelagic Fish (SPF) 2026

- Local organizers: CICIMAR, CIBNOR, CICESE, UABCS, etc.
- ICES/PICES WG on SPF convened a 3-day workshop for preparation of SPF-2026 in La Paz, Feb 12-14, 2024
- Abstract submission closed (Oct 20, 2025)

16.5 5th ICES/PICES Early Career Scientists Conference (ECS) 2027

ICES and PICES played as the main organisers of ECS in turn. As the 4th ECS was organized by ICES and held in Newfoundland, Canada, PICES plans to hold the 5th ECS in an Asian nation in summer 2027, and China has confirmed to host the conference (date and location: TBC). ECOPs from ICES and PICES will serve as the conference SSC.

16.6 ECCWO6: 6th International Symposium on the Effects of Climate Change on the World's Ocean

PICES and co-organisers are continuously seeking opportunities to hold ECCWO6 in South Africa in 2028 and are communicating with potential local organizers.

16.7 Global Symposium on Fisheries Management in an Ecosystem Context (FIMEC)

SB reviewed the proposal and recommended GC approve PICES support for its website hosting and registration service as a co-organizer of the Symposium. Upon GC approval, SB will recommend one or more HD and FIS Committee member(s) be included in the conference SSC.

=> GC approved PICES participation as a co-organizer of the Global Symposium on Fisheries Management in an Ecosystem Context (FIMEC) to provide registration, website hosting and other logistical support (GC2025/S/14).

- Date & location: Spring (1st half of), 2027, Penang, Malaysia
- Co-organizers: NOAA, FAO, WorldFish, ICES, CSIRO etc.
- Local host: TBC
- Expected participant size: approx. 500

PICES is being requested to provide the website hosting and registration services for this event.

Proposal for PICES to support
the "Global Symposium on Fisheries Management in an Ecosystem Context (FIMEC)

Background
A group of convenors has been developing plans for a global symposium (approx. 500 attendees) on the ecosystem approach to fisheries, to be held in 2027, and has approached PICES to be a co-organiser (and to provide website and registration logistics).
The co-organisers involve scientists from NOAA, FAO, WorldFish, ICES, CSIRO (amongst others), with an offer from Malaysia to host it in Penang. The exact date is yet to be determined and will take into account other relevant activities happening that year (ICES/PICES annual meetings and ECS conference, the next UNDOS conference, etc.), but is likely to be in the first half of 2027.
The rationale and scope of the conference is below. It is highly relevant to PICES and several PICES members are being invited to join the SSC, including the current SB Chair.

Resource requirement from PICES:
Typical for an International Symposium: Secretariat staff time to manage the website and registration logistics (ICES will manage the communications aspects, which PICES can share with our membership) and for the Exec Sec/Deputy to work as co-organizers (e.g. attending regular online meetings of the organizing committee).
Travel for key Secretariat support staff will be funded from the Conference budget.
Travel support for PICES-member country ECOP (Trust Fund) will be required. Potential travel support for PICES SSC or Convenors may be required. Guideline CAD$15,000 (split between General and Trust Fund).

Rationale
After several discussions in several venues, it is apparent that the need for a global conference on Ecosystem-based Fisheries Management (EBFM) is highly appropriate and timely to revisit the global progress towards EBFM more broadly. The global conference on Ecosystem Approaches to Fisheries (EAF) that substantially launched EAF and EBFM was held in Reykjavik in 2001. The time to evaluate two plus decades of EBFM work is highly warranted given the multiple pressures still facing marine fisheries as well as new challenges and conditions facing the world ocean. The primary interest in this topic has several possible rationales and justifications: chief of which are evaluating progress towards EBFM, spurring on further implementation of EBFM, and cataloguing and reaping the benefits of EBFM in a more codified manner. The main proposed outcome of the conference would be a set of EBFM statements, that espouse guidelines and associated principles highlighting the importance of EBFM for managing fisheries around the globe, as well as how to implement EBFM.
The intended location is in Penang, Malaysia. This was chosen for multiple reasons, including relative ease/accessibility of travel, ease of visa considerations, availability and capacity for IT support, and to emphasis a non-EU or non-North American locale.
The core convening committee is looking for expressions of interest and partnership as they continue to build out this symposium.

Agenda Item 17: Publications update

17.1. Peer-Reviewed Papers (published)

The respective parent committees confirmed that the publications listed are the outcomes of their children Expert Groups' activities. SB endorsed committee evaluations and recommended GC approve these publications to be posted on the PICES website. *=> GC accepted (GC2025/S/15)*

Although WG50 submitted a large number of peer-reviewed papers as WG products, SB considered the list likely included papers which were not direct outcomes of WG activities. SB suggested that WG50 and its parent POC Committee examine their contents and resubmit the list consisting exclusively of papers that are WG outcomes. SB agreed to encourage EG members to acknowledge the contribution of the EG in every peer-reviewed paper, in order to clearly demonstrate them as EG achievements.

EG (Rep. CMT)	**Citation**
FUTURE	Takemura et al. Lessons learned from the PICES FUTURE Program on development of an interdisciplinary international science program to advance ocean sustainability. ICES Journal of Marine Science 82.9 (2025): fsaf145. DOI:10.1093/icesjms/fsaf145
AP-ECOP (FUTURE)	Kaikkonen et al. (2025). Guidelines for ensuring meaningful engagement of early career researchers in scientific collaborations: Recommendations from and for marine and polar scientists. ICES Journal of Marine Science, 82(8), fsaf143. https://doi.org/10.1093/icesjms/fsaf143 Elsler et al. (2025). Leave no one behind in the UN Ocean Decade. One Earth, 8(6), 101344. https://doi.org/10.1016/j.oneear.2025.101344 Li et al. (2025). Early career ocean professionals' declaration on ocean negative carbon emissions for our ocean and future. The Innovation, Volume 6, Issue 9, 101007. http://dx.doi.org/10.1016/j.xinn.2025.101007
S-MBM (BIO)	Huang et al. Conservation Genomics Highlights the Urgency of Protecting Indo-Pacific Humpback Dolphins (*Sousa chinensis*) in Chinese Waters. SCIENCE CHINA Life Sciences, 2025, 2025-08-21. 2025-10-05. https://www.sciengine.com/SCLS/doi/10.1007/s11427-025-3065-y Farchadi et al, 2025. Data Integration Improves Species Distribution Forecasts Under Novel Ocean Conditions. Ecography. DOI: 10.1002/ecog.07997 Lezama-Ochoa et al, 2025. Identifying climate refugia and bright spots for highly mobile species. npj Ocean Sustainability. DOI: 10.1038/s44183-025-00136-3. Santora et al, 2025. Species aggregation models resolve essential foraging habitat and impacts of ocean climate variability. Ecological Applications. DOI: 10.1002/eap70068 Allyn et al, 2025. Contrasting species distribution model predictability under novel temperature conditions. Diversity and Distributions. DOI: 10.1111/ddi.70036 Scales et al, 2025. Climate mediates the predictability of threats to marine biodiversity. Trends in Ecology and Evolution. DOI: 10.1016/j.tree.2025.02.010 Karp et al, 2025. Applications of species distribution modeling and future needs to support marine resource management. Ices Journal of Marine Science. DOI: 10.1093/icesjms/fsaf024. Beltran et al, 2025. Elephant seals as ecosystem sentinels for the northeast Pacific Ocean twilight zone. Science 387, 764–769. DOI: 10.1126/science.adp2244 Cao et al., 2024: Isopycnal submesoscale stirring crucially sustaining subsurface chlorophyll maximum in ocean cyclonic eddies. Geophys. Res. Lett., 51, e2023GL105793. https://doi.org/10.1029/2023GL105793. Masunaga et al (2024): Shoaling internal tides excited by an interaction of background flows and tides over a shallow ridge, J. Geophys. Res. Oceans, Vol. 129, Issue 9, e2023JC020409, doi:10.1029/2023JC020409

	Nisi et al, 2024. Ship collision risk threatens whales across the world's oceans. Science. 386, 870–875. DOI: 10.1126/science.adp1950 Dong et al, 2025. Distinct fecal microbiome communities and functional predictions in spotted seals: age-dependent and dietary transformations. Marine Mammal Science, 41: e70008 https://doi.org/10.1111/mms.70008 Chen et al, 2025. The largest known population of Eden's whale aggregates in the Beibu Gulf, southern China. Marine Mammal Science, 41: e13226 http://dx.doi.org/10.1111/mms.13226 Ding et al, 2024. Chromosome-level genome provides insights into environmental adaptability and innate immunity in the common dolphin (*Delphinus delphis*). BMC Genomics, 25: 373. https://doi.org/10.1186/s12864-024-10268-4 Lin et al. Novel insights into the spatial genetic patterns of the finless porpoise from East to Southeast Asia. Water Biology & Security (2023), 2(1).https://www.sciencedirect.com/science/article/pii/S2772735122001226?via%3Dihub
S-MPP (MEQ)	Savoca, et al., Monitoring plastic pollution using bioindicators: a global review and recommendations for marine environments. Environ. Sci.: Adv., 2025, 4, 10–32. https://pubs.rsc.org/en/content/articlelanding/2025/va/d4va00174e
WG47 (BIO)	Osawa et al. 2023. Bathymetric segregation among demersal benthos and its contributions to the differences in the bycatches on bottom fisheries in the Emperor Seamounts area, Northwestern Pacific Ocean. Regional Studies in Marine Science 68: 103261. doi:10.1016/j.rsma.2023.103261
WG45 (FIS)	Lin Z., S. Ito, A. Baudron, C. Stawitz, T. Tomiyama, K. Fujiwara, P. D. Spencer, J. Morrongiello, 2025, A state-space approach reveals that competition drives variation in fish body weight, with influences from environmental conditions and fishing pressure, Progress Oceanography, 103582. doi.org/10.1016/j.pocean.2025.103582
WG50 (POC)	Decision deferred to ISB 2026 Ross et al (2025). Coral and float-derived observations of flow around SGáan Kínghlas-Bowie Seamount in the Northeast Pacific: revisiting the Taylor cone. Deep Sea Research Part I: Oceanographic Research Papers, 220,104499. https://www.sciencedirect.com/science/article/pii/S0967063725000585 Qiu et al, 2025: Fine-scale upper ocean variability in the Kuroshio Extension region from the wide-swath SWOT measurements. J. Phys. Oceanogr., 55, in press, https://doi.org/10.1175/JPO-D-25-0042.1. Kosako et al (2025): Dispersal of rafting eelgrass seed and associated population connectivity in the Seto Inland Sea, Japan, Coastal Eng. J., doi: 10.1080/21664250.2025.2474345. Prants, S. Dynamical systems theory approach in oceanography: a review on achievements, limitations, verification and validation of Lagrangian methods. Frontiers in Marine Science. V.12. 1621820 2025 doi: 10.3389/fmars.2025.1621820 Fayman, et al. Simulation and Lagrangian analysis of coastal upwelling in the northwestern East/Japan Sea. Continental Shelf Research. V. 294, November 2025, 105535. https://doi.org/10.1016/j.csr.2025.105535 Zhong et al. The Important Role of High-Frequency Processes for the Entrainment Heat Flux in the Southern Ocean, Journal of Physical Oceanography, 2025, 55, 663-673. https://doi.org/10.1175/JPO-D-24- 0046.s1. Li et al, The summer Kuroshio intrusion into the East China Sea revealed by a new mixed-layer water mass analysis. Journal of Geophysical Research: Oceans, 2024, 129, e2023JC020827. Prants S. Fisheries at Lagrangian fronts. Fisheries Research. Volume 279, 2024, 107125 https://doi.org/10.1016/j.fishres.2024.107125 https://doi.org/10.1007/s10946-024-10226-1

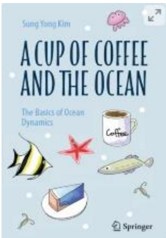
	Smith et al. Under-ice mixed layers and the regulation of early spring phytoplankton growth in the Southern Ocean. Geophysical Research Letters, 2024, 51, e2023GL106796 Wang et al. A model study of buoyancy driven cross-isobath transport over the Ross Sea continental shelf break. Journal of Geophysical Research: Oceans, 2024, 129, e2023JC020078. Wang et al. Mixed layer warming in the southeast Indian Ocean. Acta Oceanologica Sinica, 2023, 42(12), 32-38. doi: 10.1007/s13131-023-2151-4 Zhang et al. Chemodynamics of Polycyclic Aromatic Hydrocarbons and Their Alkylated and Nitrated Derivatives in the Yellow Sea and East China Sea. Environmental Science & Technology, 2023, 57, 20292-20303. Zhang et al. Combined Effects of Fronts, Upwelling and the Biological Pump on Organophosphate Esters in the Changjiang (Yangtze) River Estuary During Summer. Journal of Geophysical Research: Oceans, 2023, 128, e2023JC020081. Prants et al, Lagrangian Oil Spill Simulation in Peter the Great Bay (the Sea of Japan) with a high-resolution ROMS model. Pure and Applied Geophysics. 2023. V.180, pages 551–568 DOI: 10.1007/s00024-022-03197-4 https://doi.org/10.1007/s00024-022-03197-4 Prants, S. Transport Barriers in Geophysical Flows: A Review. Symmetry-Basel 2023, 15, Issue 10, p. 1942 - 1966. https://doi.org/10.3390/sym15101942 Zhang et al., 2023: Submesoscale inverse energy cascade enhances Southern Ocean eddy heat transport. Nature Communications, 14, 1335, https://doi.org/10.1038/s41467-023-36991-2. Zhang et al, 2023: Parameterizating submesoscale vertical buoyancy flux by simultaneously considering baroclinic instability and strain-induced frontogenesis. Geophys. Res. Lett., 50, e2022GL102292. https://doi.org/10.1029/2022GL102292. Takeyasu et al (2023): Quantifying connectivity between mesophotic and shallow coral larvae in Okinawa Island, Japan: A quadruple nested high-resolution modeling study, Front. Mar. Sci., Sec. Coastal Ocean Processes, Vol. 10. doi:10.3389/fmars.2023.1174940 (Open Access) Uchiyama et al (2022): A storm-induced flood and associated nearshore dispersal of the river-derived suspended 137-Cs, Sci. Total Environ., Vol. 816, 151573, doi: 10.1016/j.scitotenv.2021.151573 Budyansky et al, The impact of circulation features on the dispersion of radionuclides in the Chazhma Bay: a Lagrangian simulation. Marine Pollution Bulletin. V. 177. 113483. 2022 https://doi.org/10.1016/j.marpolbul.2022.113483 Prants. Marine life at Lagrangian fronts. Progress in Oceanography. V.204 102790 (2022). https://doi.org/10.1016/j.pocean.2022.102790 Prants et al, Simulation of Winter Deep Slope Convection in Peter the Great Bay (Japan Sea). Fluids. V.7(4) 134 (2022) https://doi.org/10.3390/fluids7040134 Kulik et al, Lagrangian characteristics in the western North Pacific help to explain variability in Pacific saury fishery. Fisheries Research. V.252 106361 (2022) https://doi.org/10.1016/j.fishres.2022.106361 Zhang et al (2022): Seasonal variability of upper ocean primary production along the Kuroshio off Japan: Roles of eddy-driven nutrient transport, Front. Mar. Sci., 9:990559. doi: 10.3389/fmars.2022.990559 Gan et al (2022): Identifying marine debris source position using adjoint marginal sensitivity method and stranded beach litter data in Singapore, Mar. Pollut. Bull.. Vol. 182, 113997, doi: 10.1016/j.marpolbul.2022.113997

	Masunaga et al (2022): Modulation of submesoscale eddies and associated Lagrangian transport due to tides and shallow ridge along the Kuroshio, Deep-Sea Res. Part I, Vol. 186, 103828, doi: 10.1016/j.dsr.2022.103828 Matsushita et al (2022): Fate of river-derived microplastics from the South China Sea: Sources to surrounding seas, shores, and abysses, Environ. Pollut., Vol. 308, 119631, doi:10.1016/j.envpol.2022.119631. Dong et al. Dynamical controls of the eastward transport of overwintering Calanus finmarchicus from the Lofoten Basin to the continental slope. Journal of Geophysical Research: Oceans, 2022, 127, e2022JC018909. Li et al. The role of fronts in horizontal transports of the Changjiang River plume in summer and the implications for phytoplankton blooms. Journal of Geophysical Research: Oceans, 2022, 127, e2022JC018541. Chen et al. Effects of mixing and stratification on the vertical distribution and size spectrum of zooplankton on the shelf and slope of the South China Sea. Frontiers in Marine Science, 2022, 9, 870021. Qiu, B. et al, 2022: Bi-directional energy cascades in the Pacific Ocean from equator to subarctic gyre. Geophys.Res. Lett., 49, e2022GL097713. Sasaki et al, 2022: Interannual variations of submesoscale circulations in the subtropical Northeastern Pacific. Geophys. Res. Lett., 49, e2021GL097664. Song et al, 2022: Air-sea latent heat flux and anomalies induced by oceanic submesoscale processes: An observational case study. Front. Mar. Sci., 9, 850207. doi:10.3389/fmars.2022.850207. Howatt et al (2022). Canyon downwelling and water mass influences on winter zooplankton distributions in the coastal Northeast Pacific. Journal of Geophysical Research: Oceans, 127(11), e2022JC018540h. https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2022JC018540 Kuss et al. The impact of typhoon “Mangkhut” on surface water nutrient and chlorophyll inventories of the South China Sea in September 2018. Journal of Geophysical Research: Biogeosciences, 2021, 126, e2021JG006546. Zhong et al, Seasonal variation of the surface Kuroshio intrusion into the South China Sea evidenced by satellite geostrophic streamlines. Journal of Physical Oceanography, 2021, 51, 2705-2718. Li et al. Mixed layer water mass analysis on the East China Sea inner shelf. Estuarine, Coastal and Shelf Science, 2021, 107561. Dong et al. Transport barriers and the retention of Calanus finmarchicus on the Lofoten Shelf in early spring. Journal of Geophysical Research: Oceans, 2021, 126, e2021JC017408. Prants et al, Lagrangian fronts and saury catch locations in the Northwestern Pacific in 2004-2019. J. Marine Systems. 2021. V. 222. Art. No. 103605 DOI: 10.1016/j.jmarsys.2021.103605 Kamidaira et al (2021): A modeling study on the oceanic dispersion and sedimentation of radionuclides off the coast of Fukushima, J. Environ. Radioact., 106724, pp. 238–239, doi:10.1016/j.jenvrad.2021.106724. Wang et al (2021): A nearshore oceanic front induced by wave streaming, J. Phys. Oceanogr., Vol. 51, No. 2, pp. 1967-1984, doi: 10.1175/JPO-D-21-0004.1 Takeda et al (2021): Identification of coral spawn source areas around Sekisei Lagoon for recovery and poleward habitat migration by using a particle-tracking model, Sci. Rep., Vol. 11, 6963, doi: 10.1038/s41598-021-86167-5

WG53 (FIS)	Jac et al, 2025. Tracking the schools: a review of approaches to address knowledge gaps in the migratory ecology and habitat use of Canadian forage fishes. *Rev Fish Biol Fisheries* **35**, 1751–1780 https://doi.org/10.1007/s11160-025-09981-4 Boldt et al, 2025. Incorporating ecosystem information into science advice for fisheries management—a case study for Haida Gwaii Pacific herring Canadian Journal of Fisheries and Aquatic Sciences 82:1-26 DOI: 10.1139/cjfas-2024-0150 Catalán et al, 2025. Worldwide Appraisal of Knowledge Gaps in the Space Usage of Small Pelagic Fish: Highlights Across Stock Uncertainties and Research Priorities. *Reviews in Fisheries Science & Aquaculture*, *33*(4), 497–558. https://doi.org/10.1080/23308249.2025.2458869 Chen et al, 2025. Continuing Long-Term Shifts in Larval Fish Phenology in the Southern California Current Ecosystem Are Matched by Rapid Advances in the North. Glob Change Biol, 31: e70141. https://doi.org/10.1111/gcb.70141 Tran et al, 2025. Temporal dynamics and distributions of sardine and anchovy in the southern California Current Ecosystems. Canadian Journal of Fisheries and Aquatic Sciences 82: 1-15. dx.doi.org/10.1139/cjfas-2024-0151 Hinchliffe et al, 2025. Long-term population trend of northern anchovy (*Engraulis mordax*) in the California Current system. ICES Journal of Marine Science doi:10.1093/icesjms/fase177. Satterhwaite et al, 2025. The essential role of large research vessels in marine ecosystem observations and ocean sustainability. Limnology and Oceanography doi:10.1002/lno.70110. Ahmed et al, 2025, Patterns in marine surface fish biodiversity and community composition detected by different eDNA metabarcoding sampling methods. Journal of Oceanography, in press. https://doi.org/10.1007/s10872-025-00771-x Yoshikawa et al, 2025, Nitrogen and carbon isotopic relationships in the diet and eye lenses of chub mackerel revealed in a laboratory rearing experiment. Progress in Earth and Planetary Science, 12, 57. https://doi.org/10.1186/s40645-025-00731-5 Enomoto et al, 2025, Geographical Variation in Carbon and Nitrogen Stable Isotope Ratios and Feeding Habits of Japanese Jack Mackerel (Trachurus japonicus). Fisheries Oceanography, 34, e12722. https://doi.org/10.1111/fog.12722 Mondal et al, 2025, Nonunidirectional Habitat Changes Associated With Global Climate Change: The Example of the Indo-Pacific King Mackerel (*Scomberomorus guttatus*) in the Taiwan Strait. Fisheries Oceanography, 34, e12718. https://doi.org/10.1111/fog.12718

17.2. Other Products (published)

The respective parent committees confirmed that the publications listed below are the outcomes of their children's Expert Groups' activities. SB endorsed committee evaluations and recommended GC approve these publications to be posted on the PICES website. *=> GC accepted (GC2025/S/15)*

EG (RPT CMT)	**Type of publication & Title**
WG53 (FIS)	(Technical Report) Burbank et al, 2025. Proceedings of the Technical Expertise in Stock Assessment (TESA) national workshop on ' Assessment and Monitoring of Small Pelagics', 21 November to 23 November, 2023 in Moncton, New Brunswick. Can. Tech. Rep. Fish. Aquat. Sci. 3672: v + 34 p. https://doi.org/10.60825/3vrk-bs15 Craig et al, 2025. The subpopulation problem in Pacific sardine, revisited. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-SWFSC-713. https://doi.org/10.25923/zzvw-x557
AP-CREAMS (MONITOR)	Nam and Lobanov. 2025. CREAMS 30th anniversary & CSK-II Joint Workshop PICES Press Vol. 33, No. 1. pp.47-50. The article reports the outcome of "International collaboration for science of East Asian Marginal Seas in a changing climate: circulation, biogeochemistry, and socio-economic research", held in July 25-26, 2024, Seoul, Korea.
AP-UNDOS (SB)	Satterthwaite et al, 2025. PICES 2024 Session and Workshop Reports: W5-Exploring International knowledge co-production and the science-policy interface. PICES Press, Vol 33, No.1. pp. 21-23 SmartNet (2024) Capacity sharing to promote sustainability in Small Island Developing States. In: *An ocean of file: how the UN Decade of Ocean Science for Sustainable Development is supporting implementation of the Kunming-Montreal Global Biodiversity Framework*. Intergovernmental Oceanographic Commission. **2024**, Ocean Decade series, 57, p. 25. https://unesdoc.unesco.org/ark:/48223/pf0000391687
MONITOR SmartNet	(Introduction to oceanography for middle and high students) Sun Yong Kim, 2025, A cup of Coffee and the Ocean: The Basics of Ocean Dynamics. Springer Nature Singapore Pte Ltd. pp. 172. https://doi.org/10.1007/97 *featured by UNDOS DCC for Coastal Resilience. 

17.3. Expert Group Final Reports (Science & Technical Reports etc.)

BIO Committee reviewed and endorsed the manuscript submitted as the WG47 final report. SB agreed with BIO's evaluation and recommended GC approve the report to be published as their Final Report.

=> GC accepted WG47 final report to be published in the PICES Scientific Report. WG47 is disbanded (GC2025/S/15).

EG	Type of publication & Title	Stages
WG47	PICES Scientific Report Appendix 3	Endorsed by BIO To be disbanded upon the approval of final report

Note on the Protocol of WG Final Report Submission and the Timing of Disbandment of WG.
(agreed at ISB-2022)

- **Format of the final report** will be typically a PICES Science / Technical Report (PICES Rule) but also be in a various format such as Peer-reviewed Journal Special Issue, Peer-reviewed Journal Review Paper, etc.
- **WG disbands** upon the submission of its Final Report to Secretariat after review and approval of Parent Committee(s).

17.4. EG Final Report in Progress

Committee chairs of the respective children EGs reported that these Final Reports (see the table below) were in various stages (1. In preparation, 2. Being reviewed by the parent Committee, 3. submitted to Secretariat, 4. previously approved by SB and nearly completed).

EG	Type of publication	Stages	comments
WG48 (BIO)	A peer reviewed review paper titled "A primer for underwater plankton imaging systems" on Annual Reviews in Marine Science.	3. Submitted to the Journal of Plankton Research (under review). Manuscript submitted to parent Committee and Secretariat.	WG48 accomplishments & PICES contribution are acknowledged in the paper.
WG50 (POC)	TBC		
WG51 (HD)	Peer Journal Review Paper	1. In preparation Preparing a draft proposal of a Special Issue for ICES-JMS with ICES colleagues	To be submitted in December 2026

Agenda Item 18: Other issues

18.1 ISB-2026 Date

A 3-day ISB-2026 meeting will be held virtually from late April to mid-May 2026. Secretariat will set the date depending on the SB members' availability by January 2026.

18.2 ECOP Presentation Award Judging Strategy

Given an increasing number of ECOP presentations at recent Annual Meetings (c.a. 40%), some SB members claimed that judging duty or ECOP presentation award was becoming a burden on Committee members. The others also criticized that the majority of awardees were absent from the award presentation ceremony at the closing session. SB suggested a change in the online registration system so that only the presenters who applied for the award would be eligible and judged. Secretariat confirmed to amend the online registration system for PICES-2026 as recommended.

Given the increasing number of ECOP presentations at recent Annual Meetings (approximately 40%), some SB members noted that judging duty for the ECOP presentation award was becoming burdensome for Committee members. Others also raised concerns that the majority of awardees were absent from the award presentation ceremony during the closing session. The SB suggested modifying the online registration system so that only presenters who apply for the award would be eligible and judged. The Secretariat confirmed that the online registration system for PICES-2026 would be amended accordingly.

//End of SB-2025

Appendix 1

PICES Executive Secretary report on current status of MoUs and collaboration framework

Report to Science Board on status of MoUs

Science Board requested a review of the current strategic partner collaborative frameworks or MoUs. The table below lists the existing agreements and their status.

Organization	Date Agreement Signed	Status of Cooperation
Intergovernmental Oceanographic Commission (IOC)	1994	The MoU has not been modified since signed in 1994 and is mostly still appropriate/relevant. The reciprocal interaction has been maintained: PICES participates annually in IOC Executive Council/Assembly meetings. PICES supports/participates in IOC activities such as UNDOS, GOOS, GOOD-OARS (via capacity development support), and IODE. IOC co-sponsors the ECCWO Symposium Series as well as some others, and has an ex-officio IODE member on TCODE. However, with a new General Secretary recently in post it would be a good time to revisit the MoU and discuss a revision.
International Council for the Exploration of the Seas (ICES)	1998 then had a joint study group in 2011 to review cooperation.	MoU language is still appropriate. PICES most significant partnership. High-level reciprocal interaction is consistent (SB to SciCom, GC to Bureau) with in-person participation at ASC/Annual meetings. Approximately monthly Secretariat meetings. ICES co-sponsors ALL PICES Symposia series (some are shared and alternate). There is reciprocal sponsorship of sessions at ASC/AM. Many joint expert groups (8 WG, 1 Section, SmartNet).
North Pacific Anadromous Fish Commission (NPAFC)	1998	MoU language is still appropriate. Regular participation in FIS Committee, co-sponsor relevant Symposia (5) and occasional Wshops/sessions at Annual meetings. Partner in the UNDOS-BECI project.
Memorandum of Understanding with the International Pacific Halibut Commission (IPHC)	2000, 2019, and July 6 2024.	Very recently renewed MoU. Regular participant in FIS Committee. Co-sponsor wshops/sessions (3, but all recent)
Northwest Pacific Action Plan (NOWPAP)	2015	Framework for Scientific Cooperation in the North Pacific Ocean written in 2015. Cooperation is mostly with MEQ, particularly HAB/NIS. Have co-sponsored many (15) sessions/workshops at PICES AM from 2011 to 2023. Exec Sec recently met with the person drafting NOWPAPs next mid-term strategy (2025-2030) document and suggested that the Framework is revisited and revised soon, taking into account their new strategy, although much of their work is currently suspended because of geopolitical issues. Other areas of mutual interest may include the Global Biodiversity Framework and BBNJ agreement.
International Scientific Committee for Tuna and Tuna-	2015	The Framework for Cooperation does still apply. This was an active collaboration a few years ago, with a joint WG (WG34) and co-sponsored sessions (2013/14 and 2018) at PICES AM.

like Species in the North Pacific Ocean (ISC)		Invited to participate each year but not certain how active this collaboration is now, and it should be re-invigorated.
North Pacific Fisheries Commission (NPFC)	2019, but revised in 2024 and will be presented at PICES-2024 for approval	The first Framework for Scientific Cooperation has produced strong collaboration with NPFC supporting activities of WG32 and 47 and co-sponsoring sessions/workshops (including financial support). NPFC has also endorsed the BECI project. There has been annual reciprocal participation in FIS/SB and the NPFC SSC meetings in recent years, as well as co-sponsorship of the Small Pelagic Fish Symposia. Over summer 2024 PICES and NPFC members met to review and revise the Framework which will be brought to SB by the FIS Committee at PICES-2024.
Pacific Salmon Commission PSC	2022	This was the first MoU for the PSC. Interaction is via the FIS Committee and quarterly inter-Secretariat calls. PICES has also presented at PSC annual meetings in 2023/24 and PSC members have attended PICES-2023 and -2024. PICES successfully applied for funding from the PSC for the Indigenous workshop at PICES-2023 (W9) and they have voiced interest in co-sponsoring a session, potentially at PICES-2026.
Asia-Pacific Network for Global Change Research (APN)	2023	A recent agreement. APN has a wide geographic coverage and is not only marine focused but the Framework focusses on priorities, including food security and marine plastics through their Pacific sub-regional committee. Interactions so far have been at the Secretariat level with regular (bi-monthly) calls. Capacity development has been a focus, and we were invited to send ECOP to a proposal development training workshop this August. A second will be coming up in the PICES region in 2025.

In summary, of the nine agreements listed here:

- Four (those with NPFC, IPHC, PSC and APN) have been very recently developed/revised and are active.
- Three (those with ICES, NPAFC, IOC) have language that is still relevant and are active (although reviewing the MoUs could be useful).
- Two (with NOWPAP and ISC) should be revisited/revised with a view to stimulating the partnership.

Sonia Batten October 2024

Appendix 2

Report to Science Board on past travel and funding support

During the 2024 Intersessional Science Board meeting, under Agenda item 12 “Travel Support Requests”, Science Board requested information on historic amounts of travel support, to facilitate the discussion and prioritization of amounts to recommend. A subsequent request was made concerning the funds spent when implementing the Governing Council Decisions that resulted from Science Board recommendations. The Executive Secretary agreed to provide a summary of such spending, which follows below and has been updated for 2024/25.

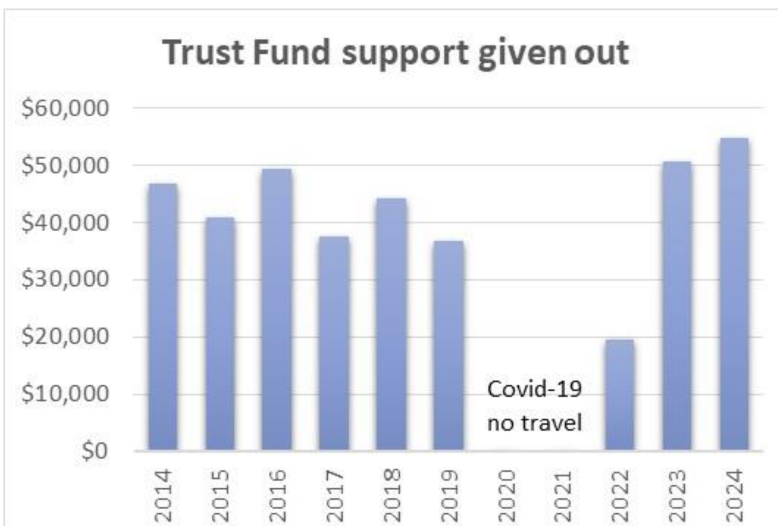
Background

Support for capacity development activities that Science Board reviews (summer schools or supporting Early Career Ocean Professionals to attend international events organized by partner organizations) are funded from the PICES Trust Fund. The balance of the Trust Fund is reset at the beginning of each year to $110,000. It is funded by voluntary contributions and topped-up, when necessary, from the PICES Reserve Fund. The Trust Fund also supports the PICES Intern Program expenses, travel of ECOP to the PICES annual meeting and to other PICES-co-sponsored large international symposia or events. Science Board does not typically make recommendations on the amounts used for these latter purposes (the Finance and Administration Committee reviews the annual expenditures of the Trust Fund) so these items are not included in this report.

Science Board also recommends to Governing Council other financial support priorities and sets a guideline amount. Support for non-ECOP travel, or other items with a cost, comes from the PICES General Fund or Working Capital Fund which is funded by annual fees from member countries and supplemented by the PICES Reserve Fund (typically 12-22% of the annual budget comes from the Reserve Fund). A table is included below which lists the GC Decisions, and the expenditures that resulted from them, during the current Executive Secretary’s term.

Trust Fund support for ECOP

The figure shows annual totals expensed from the Trust Fund. Number of events supported ranged from 0 to 4 per year (the number of individuals per event varies considerably depending on the level of support per individual). A full list of events and amount spent per event is included in the Appendix and excludes PICES annual meetings and PICES-organized Symposia.



Things to note:

- This analysis does not include events that *were* approved for funding by Science Board, but that either did not happen or had no eligible PICES participants attending in the end (some of this information can be found from the table of GC Decisions below).
- Events were cancelled/postponed during 2020-2022 because of COVID-19. So, 2023 was the first "normal" year since 2019.

- The Trust Fund budget has not changed during this period, therefore because of inflation we can assume that the number of individuals supported, or the amount of support per individual, has declined.

Governing Council Decisions

The table below shows the GC Decisions taken at each meeting since 2020, and the related expenditures.

The Secretariat does not always know why funds were not requested for travel to an approved event, and could be for a variety of reasons such as a last-minute conflict for the traveler, or a cancelled/postponed event.

For capacity development activities, the Secretariat works with organizers/sponsors of approved events to select eligible ECOP that have applied for the summer school/Symposium/activity according to PICES criteria (citizens or residents of PICES countries). Sometimes PICES transfers funds to the organizer to disburse travel grants, or to support an activity, sometimes PICES transfers the funds directly to the ECOP.

GC Decision	Funds spent (Cad$)	Notes
2025/S/3 CIce2Clouds-BEPSII-CATCH sea-ice school February/March 2026, Hokkaido, Japan. A few ECOP. AP-ARC	TBD	Event in 2026
At PICES-2024 – SB recommendations but no GC Decision (Exec Sec discretion on amounts due to budget uncertainties)		
• IPHAB meeting, 18-20 March 2025. S-HAB member to attend.	$1563.18	Pengbin Wang attended
• One Ocean Science Congress, Nice, June 2025. A few ECOP. AP-UNDOS	$4003.51	Support for 2 ECOP (Canada - Rimmer and USA - Bif)
• ESSAS OSM, June 2025, Tokyo. A few ECOP (AP-ARC)	$0	Candidate couldn't attend due to illness
• ICES ASC, 15-18 September 2025, Lithuania 1-2 ECOP at S-CCME, AP-UNDOS sessions	$0	No ECOP participated
• 12th International Conference on Marine Bio-invasions 6-10 October, 2025, Portugal – 1-2 ECOP AP-NIS	$2,614.18	Partial support for ECOP - 2 from USA (Velasquez, Kiley-Bergen) and 1 from Canada (Lim)
• GOOD_OARS Summer School, November, 2025, Malaysia. PICES ECOP, S-CC	~$4,000	In prep – two ECOP have been selected

• APN training workshop, Korea	$3000	Support for two ECOP (Xu, Japan and Kurnosova, Russia)
GC Decision 2024/S/12. Metadata records transfer. Council approves the use of up to $6,500 for the work to be done.		Not yet done – still in discussion
2024/S/5. • IMBeR IMBIZO7, 22-24 Sept 2024, Morocco. Up to $6,000 for 2-3 eligible ECOP • SOLAS OSC,10-14 November, 2024 Goa, India. Up to $6,000 to support 2-3 eligible ECOP • APN Proposal Development Training Workshop, Uva, Fiji, 26-30 August 2024, up to $3,000 to support 1-2 eligible ECOP	$0 $6,000 $3,000	Event cancelled by organizers in June 2024 Approved a list of 7 ECOP from USA, Japan, China and transferred funds (USD $4394) for organizers to provide travel grants. 4 supported (US and China) ZW (Japan) travel grant
2024/S/6. Contribution to the SPF-2026 Symposium in line with previous support (~$15,000) to be divided between travel support for PICES ECOP from the Trust Fund and from the General Fund towards other costs of the Symposium.	TBD	Symposium scheduled for May 2026
2023/S/12. • 30th Anniversary of the CREAMS program. 2~3 days in July 2024. Partial travel support for 4 participants (3 students or ECOPs and 1 invited speaker) up to CA$7,000 • UN Ocean Decade Conference 10-12 April 2024, Barcelona, Spain. Travel support up to CA$ 6,000 for AP-UNDOS Chair and 1 ECOP. • Travel support up to CA$6-7,000 for 2 ECOP in SmartNet side events • ICES ASC 2024, PICES-cosponsored theme session. Partial travel support up to CA$6000 for BIO member and 1 ECOP • S-HAB intersessional meeting member, upto $3,500 from Western NP and 1 ECOP	$3,702 $6,011 $7,006 $0 $3,163	Partial travel support for 3 requested: Lobanov, Wang and Yin SB (AP-UNDOS Chair) and 1 ECOP JH (Japan) 2 ECOP KJ, NS (Canada, Japan) BIO member in field & could not attend No ECOP request S-HAB member could not attend. 1 ECOP - YW (China/USA)
2023/S/3.	$101	Joined in January 2024

Sonia Batten 08/10/2025

Joining the DataCite Canada Consortium at Tier I, to add DOI to official PICES publications		
2023/S/4. Open access publication of WG38	$3,819	Paid Sept 2023
2023/S/5. Science communication videos. Council approved the travel support ($6,000) for a videographer/film-maker to attend PICES-2023 to produce three short videos	$6,000	Kincentric Cinema Media Solutions produced 3 videos from PICES-2023 [Videos - PICES - North Pacific Marine Science Organization]
2023/S/9. Up to $5,000 to support PICES ECOP to participate in the IMBeR ClimEco8 summer school	$1,000 $3,000	Sponsored ECOP food RD (Canada) travel grant
2022/S/10. • GOOD-OARS Summer School, November 6 – 12, 2023, Coquimbo-La Serena, Chile. 2-3 ECOPs up to EUR 5000 • AP-ECOP Virtual International Open Science Training. Travel support for 2 participants of this workshop to attend PICES-2023, up to $7,000 • SC member T. Ono to attend ECCWO5, CA$2745 and 2 ECOP ($6,000) • PICES-ICES workshop on eDNA. $3,000 partial support for 1 ECOP • IPHAB, $3,000 for 1 S-HAB member • Int Conference on Marine Bio-invasions for an ECOP or Convenor $3,000 (deferred from 2020)	$4,229 TBD $5,400 $0 $2,969 $0	4 ECOP initially approved but only 3 travelled in the end (USA/Can) Deferred to PICES-2024 Ono unable to attend. 5 ECOP supported (China/Canada) Not requested MW participated Not requested
2022/S/5. SOLAS OSC September 25-29, 2022. US$4,500 to partially support travel of PICES ECOP and/or an ECOP event scheduled during the conference.	$5,823.90	Sponsored ECOP event
2022/S/6. • 7th ICES WGICA Annual Meeting, Oct 11-13 Copenhagen, Denmark. $3,000 partial support for WG39 Chair • WG45 organized session and Joint ICES/PICES WG-GRAFY meeting at ICES	$4,936.43 $0	WG39 Chair participated Not requested

ASC. $3,500 for EG45 member/ECOP/Inv speaker		
2021/S/16 Virtual registration fee for an ECS to attend and present at Ocean Sciences Meeting 2022	$662.34	MS (USA)
2021/S/17 • AP-CREAMS. Summer school on Ocean turbulence (Prof. Yu Fei, Qingdao, China, Summer 2022). US$9,000 deferred from 2020 • AP-NPCOOS Ocean big data virtual summer school Aug 2022, $15,000 deferred from 2019	$0 $15,000	China still impacted by COVID-19. Event did not occur Virtual event. PICES agreed to provide $15,000 towards Ocean Network Canada's costs for running the event
2021/S/4. SOLAS Summer School in Cape Verde. $10,000 for PICES ECS. Deferred to 2023	$10,000	5 ECOP approved from USA/Canada, Funds transferred to organizers to disburse travel grants
2020/S/10. • WG-39 travel support in the amount of $3000 to attend the WGICA in-person meeting in the Fall of 2021, at ICES HQ • S-HAB $3000 Travel Support for travel for one PICES representative to attend the IOC Intergovernmental Panel on HABs (IPHAB) in 2021	$0 $0	No travel in 2021 because of COVID-19 No travel in 2021 because of COVID-19
2020/S/12. PICES-NPFC 2021 Co-Sponsored course on Vulnerable Marine Ecosystem Indicator Taxa ID. Vladivostok, Russia. Co-sponsorship: up to $15,000	$0	Postponed indefinitely because of COVID-19

Appendix. List of events where ECOP were supported by the Trust Fund

Activity	Year	Amount
2014 FUTURE OSM	2014	$5,755
2014 IMBER Summer School	2014	$6,030
2014 PICES Summer School	2014	$12,974
ECS-Brazil Symposium and HAB Symposium	2015	$15,798
Training Course on “Freshwater discharge and coastal environments”	2016	$4,610
9th International Marine Bioinvasions Conference	2016	$4,071
IMBER ClimECO5 Summer School	2016	$6,747
CLIVAR Open Science Meeting, Qingdao, China	2016	$4,282
IMBIZO V	2017	$5,230
ESSAS Open Science Meeting	2017	$15,569
FishGIS workshop	2018	$6,047
PICES Summer School	2018	$3,000
IMBeR ClimEco6	2018	$5,000
SOLAS Summer School	2018	$5,000
IMBeR Future Oceans 2	2019	$6,086
SOLAS Open Science Meeting	2019	$6,016
PICES/ICES/NAFO Shellfish Symposium	2019	$6,000
Travel of ECOP to UN Oceans Conference	2022	$4,095
SOLAS Summer School	2023	$10,000
IMBeR ClimEco8	2023	$3,000
GOOD OARS Summer School	2023	$4,229
SOLAS Open Science Conference	2024	$6,026
APN Wshop - ECOP	2024	$3,000
S-HAB intersessional ECOP	2024	$2,525

Appendix 3

WG47 Final Report (draft)

PICES Scientific Report No. xx
202x

Report of PICES Working Group (WG 47) on Ecology of Seamounts

edited by
Janelle Curtis

Month year

North Pacific Marine Science Organization (PICES)
P.O. Box 6000, Sidney, BC, V8L 4B2, Canada
www.pices.int

PICES Scientific Reports

Published since 1993, the PICES Scientific Report series includes final reports of PICES expert groups, proceedings of PICES workshops, data reports and reports of planning activities. Formal peer reviews of the scientific content of these publications are not generally conducted.

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This report was developed under the guidance of the PICES Science Board and its Biological Oceanography Committee. The views expressed in this report are those of participating scientists under their responsibilities.

Front cover:
Seamount taxa along the Cobb-Eickelberg seamount chain in the northeast Pacific Ocean. The dolphin photo is by NOAA Fisheries/Paul Hillman and the three photos with corals are by Fisheries and Oceans Canada/NOAA Fisheries.

This document should be cited as follows:

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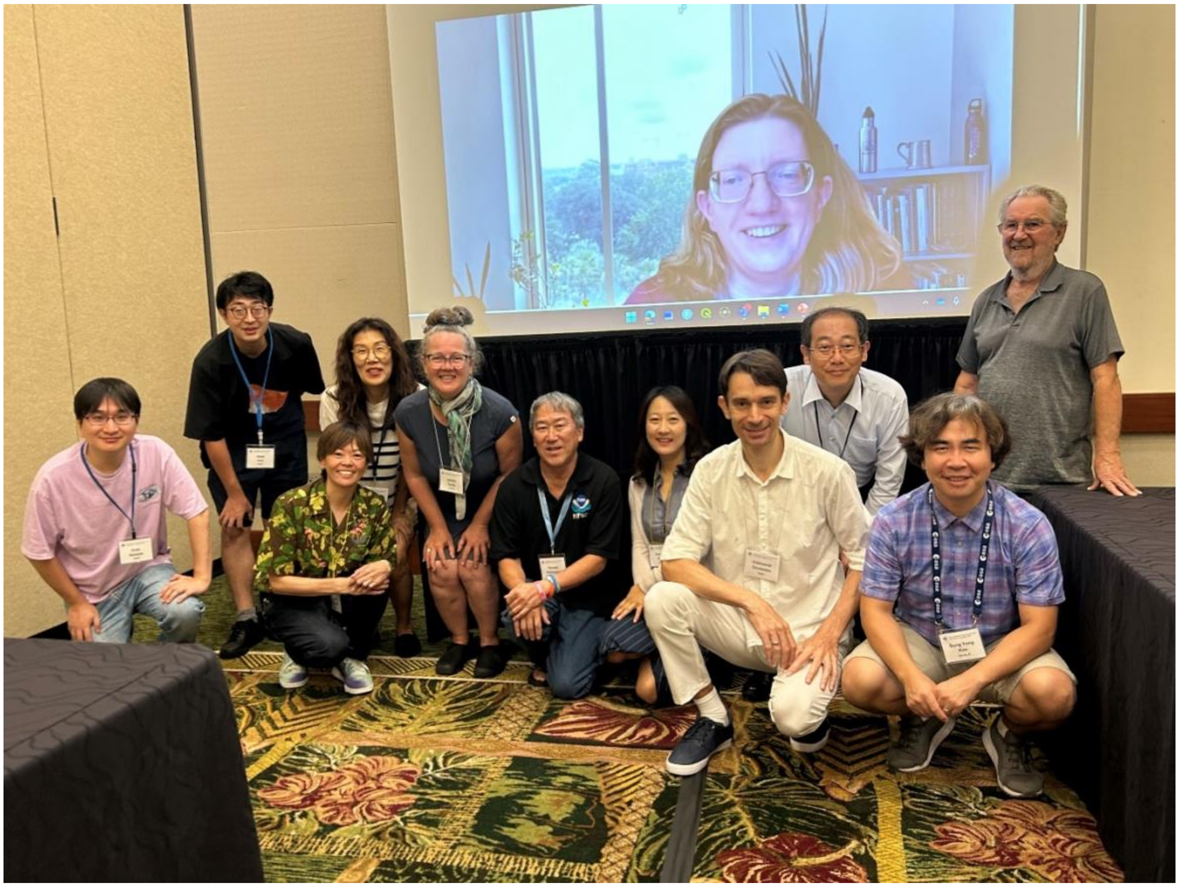

Participants and observers of the final WG 47 hybrid business meeting on 31 October 2024. On the screen (virtual participant) is Amy Baco-Taylor. From left to right in person: Kota Sawada, Satoi Arai, Mai Miyamoto, Seonock Woo, Janelle Curtis, Don Kobayashi (observer), Hye-Won Moon, Alex Zavolokin (observer), Hiroe Yutaka (observer), Sung Yong Kim, and Les Watling.

1 Acknowledgements

Many thanks go to the PICES Secretariat for their ongoing support of WG 47 from 2020-2024. The PICES Secretariat helped convene a virtual annual meeting during the pandemic (2021), virtual intersessional meetings from 2022-2024, and facilitated hybrid meetings in Busan, Korea (2022), Seattle, USA (2023), and Honolulu, USA (2024). PICES Science Board and WG 47's parent committee – the Biological Oceanography (BIO) Committee – provided thoughtful guidance.

Thank you to Mai Miyamoto for ably co-chairing WG 47. Participants of WG 47 are gratefully acknowledged for their contributions to meetings and the research to address WG 47's terms of reference. All participants, observers, and invited speakers shared their knowledge of seamounts and associated biological communities during the business meetings, workshop (2022), and topic session (2023). This was especially true of WG 47's invited speakers, Telmo Morato and Ashley Rowden, who contributed to the success of the workshop and topic session, respectively. Approximately half of WG 47's participants also participated in scientific meetings of the North Pacific Fisheries Commission (NPFC) and had particular interests in the identification and conservation of vulnerable marine ecosystems (VMEs). NPFC also co-sponsored the workshop and topic session convened by WG 47 during PICES Annual Meetings.

~ Janelle Curtis

2 Executive Summary

There are approximately 100,000 seamounts worldwide and their abundance is greatest in the North Pacific Ocean. Most seamounts are deep, remote, and difficult to study. This means the ecology of seamounts is poorly understood as are the habitats of the pelagic, demersal, and benthic species they support.

The PICES Working Group on Ecology of Seamounts (WG 47) was established in 2020 and was extended by one year to 2024 due to COVID-19 restrictions that slowed the group's work. Janelle Curtis (Canada) and Mai Miyamoto (Japan) were the co-chairs.

Annual virtual business meetings from 2021-2024 focused on introductions of national representatives and observers, discussions of WG 47's terms of reference (TOR), and the exchange of information and ideas about participants' seamount research activities. Hybrid business meetings were also held at the PICES 2022 Annual Meeting in Busan, South Korea, the PICES 2023 Annual Meeting in Seattle, USA, and the PICES 2024 Annual Meeting in Honolulu, USA. Hybrid meetings were attended by colleagues from the PICES FUTURE Scientific Steering Committee (FUTURE-SSC), the PICES Section on Marine Birds and Mammals (S-MBM), and the North Pacific Fisheries Commission (NPFC).

Many WG 47 members shared an interest in the spatial ecology of benthic organisms and also supported the research activities of PICES WG 32 on Biodiversity of Biogenic Habitats. Most WG 47 members also shared an interest in identification of vulnerable marine ecosystems (VMEs) in the North Pacific Fisheries Commission's Convention Area. Some of the key research activities of WG 47 members included:

- Gathering data on species associated with seamounts and submitting these to publicly accessible biodiversity databases, including Canada's Open Government Portal, the National Oceanic and Atmospheric Administration's (NOAA) Deep Sea Coral Portal, and Genbank (TOR 1, Year 1)
- using an underwater stereo camera system to visually survey randomly-placed transects to about 850 m in depth on seamounts in the Cobb-Eickelberg Seamount Chain and collect environmental data hypothesized to influence the distribution and diversity of seamount taxa (TOR 2, Year 1).
- Convening a 2-day workshop on "Distributions of pelagic, demersal, and benthic species associated with seamounts in the North Pacific Ocean and factors influencing their distributions" during the PICES-2022 annual meeting in Busan, Korea (TOR 3, Year 1)
- using visual and environmental data to identify VMEs on Cobb Seamount and predict the distribution of likely VMEs throughout the Cobb-Eickelberg Seamount Chain (TOR 1 and 2, Year 2 and TOR 1, Year 3).
- Convening a topic session on the pelagic, demersal, and benthic species associated with seamounts at the PICES 2023 Annual Meeting in Seattle, USA (TOR 4, Year 2)undertaking genomic assessment of deep-sea corals on seamounts in the Western Pacific Ocean (TOR 1, Year 3).
- evaluating the use of e-DNA as a potential tool for learning about splendid alfonsino and North Pacific armorhead on the Emperor Seamount Chain (TOR 1, Year 3).

- analyzing the genetics and abundances of coral taxa on fished and unfished seamounts in the Emperor Seamount Chain and North Hawaiian Ridge (TOR 1, Year 3).
- evaluating the biogeography of North Pacific seamount communities to inform the location of marine protected areas (MPAs) (TOR 2, Year 3).
- Preparing scientific reports and disseminating results (TOR 3, Year 3).

Although WG 47 members recognized the importance and value of TOR 3 in Year 2, specifically to *Use available data to predict climate induced changes in the distributions of seamount fauna*, there were be insufficient resources or capacity to complete this TOR. Also several of the TOR called on members to focus on pelagic, demersal and benthic taxa, but most research by WG 47 members centered primarily on benthic species, thus some TOR were only partially addressed. Such information could be useful for guiding next steps for PICES work on seamounts. WG 47 contributions to the TOR are described in Section 4.

Potential next steps for PICES include the establishment of working groups to focus on (1) using available data to predict climate induced changes in the distributions of seamount fauna, (2) identifying VMEs and/or assessing the relative risk of significant adverse impacts (SAI) to those VMEs in the North Pacific Fisheries Commission's Convention Area, and (3) clarifying the life history of seamount taxa, with an emphasis on reproduction, connectivity and a better integration of biology and physics.

3 Introduction

Members of the PICES Working Group on *Biodiversity of Biogenic Habitats* (WG 32) recommended the establishment of a Working Group on *Ecology of Seamounts* with a focus on understanding the diversity and distribution of benthic, demersal, and pelagic species that are associated with seamounts. Working Group 47 on *Ecology of Seamounts* built on the contributions of WG 32 by mapping the distribution of seamount fauna and expanding research into some of the unique and abundant ecosystems of the North Pacific Ocean.

There are approximately 100,000 seamounts worldwide and their abundance is greatest in the North Pacific Ocean. The ecology of only a few has been studied, in part because of how deep and remote most seamounts are. The difficulty in studying the ecology of seamounts means that they are poorly understood habitats in terms of the benthic, demersal, and pelagic species that they support.

Seamounts are unique habitats for deep-sea organisms and are biodiversity hotspots with relatively high rates of endemism (in some cases as high as 50%). Marine biodiversity is important for maintaining ecosystem structure and function, which in turn supports numerous ecosystem goods and services, including sustainable fisheries. Seamounts can host diverse communities of benthic filter feeders, including corals and sponges. The biodiversity of fishes is also high; almost 800 species of fish have been recorded from seamounts, representing half of the orders of fishes. As such, seamounts can be important sources of food. Indeed, the North Pacific Fisheries Commission (NPFC) manages commercial fisheries in international waters for several bottom fish associated with seamounts in its Convention Area, including sablefish (*Anoplopoma fimbria)*, North Pacific armorhead (*Pentaceros wheeleri*) and splendid alfonsino (*Beryx splendens*).

Interspecific interactions can also influence seamount biodiversity. Biogenic habitats can affect the communities of fish and other organisms that are distributed on seamounts. For instance, fish have been notably absent at sites without sea whips in some parts of the North Pacific Ocean. There may be a direct link between the abundance and diversity of commercial fish species and the presence of biogenic organisms. WG 47 members reported on a significant relationship between the density of deep sea corals and sponges (DSCS) and the number of species associated with those corals and sponges (see section 4.5.1).

Oceanographic variables and other physical factors including depth, steepness, substratum, currents, isolation, and the upwelling of nutrient-rich water may also influence the life histories and diversity of taxa on seamounts. Invertebrates and fishes associated with seamounts generally tend to be K-selected (i.e. they are long-lived, slow-growing, and have late age at maturity, and low reproductive potential), in part as a consequence of the limited food supply on seamounts. Many pelagic taxa associated with seamounts, including cephalopods are relatively short-lived, fast-growing, and semelparous. Another group of species, including, many marine mammals, sharks, and turtles use seamount areas as foraging posts or migration stops.

The next section of this report summarizes science products developed by WG 47 on *Ecology of Seamounts,* including (1) predictive modelling in the unique and abundant seamount ecosystems in the North Pacific Ocean to produce maps of the known and potential distributions of seamount taxa, (2) integration of data to better understand factors that influence trends in the distribution of seamount taxa, and (3) identification of potential indicators to monitor changes in the diversity of seamount taxa.

4 Working Group 47 Achievements with Respect to General Terms of Reference

This section includes summaries of some of the contributions to the WG 47 terms of reference by this expert group's members. All of WG 47's terms of reference were addressed, at least in part, with the exception of using available data to predict changes to the distributions of seamount fauna caused by climate change (TOR 3 in Year 2). Although WG 47 members had considerable interest in this topic, there was insufficient time, expertise and required resources for members to address it.

Members also recognized that the first TOR in Year 1, the first, second, and fourth TOR of Year 2, and the first TOR of Year 3 specify a focus on pelagic, demersal, *and* benthic taxa. But because most research and contributions by members focused on benthic (and in some cases demersal) taxa, WG 47's contributions mainly focused on benthic species, including deep-sea corals and sponges.

WG 47 contributions are outlined in the table that follows:

Term year	**TOR**	**Contributions to the TOR**
Year 1	Section 4.1: Gather data on the distribution and life history of pelagic, demersal, and benthic taxa, including fish and invertebrate assemblages associated with seamounts in the North Pacific Ocean and facilitate their submission to appropriate biodiversity databases, e.g., Ocean Biogeographic Information System (OBIS).	***This TOR has been partially completed***. Janelle Curtis submitted benthic data collected using an autonomous underwater vehicle (or AUV) and a remotely operated vehicle (or ROV) on Cobb Seamount in 2012 to Canada's Open Government Portal and to the Ocean Biogeographic Information System (OBIS). (See Cobb Seamount Visual Survey 2012 (ROV) - Open Government Portal and Cobb Seamount Visual Survey 2012 (AUV) - Open Government Portal). Chris Rooper submitted benthic data collected with a stereo camera system along the Cobb-Eickelberg seamount chain in 2022 to the NOAA Deep Sea Coral Portal at https://www.ncei.noaa.gov/maps/deep-sea-corals-portal/. Seonock Woo shared deep sea coral bioinformatics data in Genbank that are shared as open data. And Les Watling is anticipating submitting data on benthic taxa from the Emperor Seamounts to OBIS.
Year 1	Section 4.2: Gather data on key environmental variables (e.g. temperature, depth, steepness, substratum, current velocity, isolation, ocean acidification) hypothesized to influence the distribution and diversity of species associated with seamounts.	***This TOR has been completed***. The World Ocean Atlas data that was compiled for use by PICES WG 32 on the Biodiversity of Biogenic Habitats a few years ago was updated by Samuel Georgian and was made available to WG 47 members. Chris Rooper also collected oceanographic data along the Cobb-Eickelberg seamount chain in 2022 and 2024.

Year 1	Section 4.3: Convene a 2-day workshop on "Distributions of pelagic, demersal, and benthic species associated with seamounts in the North Pacific Ocean and factors influencing their distributions".	***This TOR was completed during the PICES 2022 Annual Meeting.*** For more details, seeee the *PICES Press* article about this workshop *"PICES-2022 W1: Distributions of pelagic, demersal, and benthic species associated with seamounts in the North Pacific Ocean and factors influencing their distributions"* in Vol. 31, No. 1 (Winter 2023) (PICES-Press-2023-Vol31No1.pdf).
Year 2	Section 4.4: Identify environmental and ecological predictors of patterns in the distribution and biodiversity of pelagic, demersal, and benthic taxa associated with seamounts in the North Pacific Ocean.	***This TOR has been partially completed*** by a team led by Janelle Curtis for benthic seamount taxa along the Cobb-Eickelberg seamount chain in the northeast Pacific Ocean.
Year 2	Section 4.5: Apply one or more modeling approaches (e.g. MaxEnt, Boosted Regression Trees, or high-resolution bathymetry-based models) to predict the distribution of pelagic, demersal, and benthic biodiversity associated with seamounts in the North Pacific Ocean.	***This TOR has been partially completed*** by WG 47 members including a team led by Janelle Curtis for benthic seamount taxa in the northeast Pacific Ocean. Specifically, they used MaxEnt in 2021 and ensemble models in 2022 to predict the distribution of VME indicator taxa along the Cobb-Eickelberg seamount chain in the Northeast Pacific Ocean. The ensemble model coupled a random forest, generalized additive model (GAM), and a boosted regression tree model. In 2023, a GAM model predicted the distribution of potential VMEs in the same area. Chris Rooper noted that guidelines and code for developing predictive habitat models, including random Forest (RF), Generalized Additive Models (GAM), Generalized Linear Models (GLM) and Boosted Regression Trees (BRT) are available through ICES.
Year 2	Section 4.6: Use available data to predict climate induced changes in the distributions of seamount fauna.	***This TOR was not addressed*** because of insufficient capacity, time, and resources within WG 47.
Year 2	Section 4.7: Convene a topic session on the pelagic, demersal, and benthic species associated with seamounts at the PICES Annual Meeting.	***This TOR was completed during PICES 2023***: see Session 14 under the Scientific Program and Structure of PICES 2023 Annual Meeting - Program - PICES, specifically https://meetings.pices.int/meetings/annual/2023/PICES/program#s14.
Year 3	Section 4.8: Identify potential indicators for assessing and monitoring the	***This TOR has been partially completed*** by a few WG 47 members. Kota Sawada noted that indicators, including e-DNA, that have been applied to other areas might also be applicable to seamounts. A team led by Janelle Curtis estimated an indicator for benthic seamount taxa

	biodiversity of pelagic demersal, and benthic taxa associated with seamounts.	in the northeast Pacific Ocean. Specifically, a density of 0.6 vulnerable marine ecosystem (VME) indicator taxa (stony corals, black corals, gorgonian and non-gorgonian soft corals, glass sponges, and demosponges) per m^2 are indicative of the presence of VMEs in the North Pacific Fisheries Commission (NPFC) Convention Area. This density is associated with higher species richness of non-VME indicator taxa. Amy Baco-Taylor noted that precious corals may be indicators of the effects of disturbance. Other participants noted that different suites of indicators may be appropriate for different seamounts (e.g. shallow vs deep) and the size distribution of seamount taxa may indicate recruitment dynamics.
Year 3	Section 4.9: Use cluster analysis and/or association analysis to review and document ecological interactions among seamount taxa.	***This TOR has been partially completed.*** Janelle Curtis and Devon Warawa undertook an analysis of species richness associated with structurally complex habitats and showed that species richness of benthic and demersal seamount taxa is associated with higher densities of vulnerable marine ecosystem (VME) taxa. Chris Rooper collected data for association analysis with visual survey data from the Cobb-Eickelberg seamount chain in 2022 and he suggested that it would be interesting to compare similar analyses on Cobb Seamount and in the Emperor Seamounts. Les Watling described his research defining large-scale biogeographic patterns and contributed to multivariate analyses over broad scales of benthic organisms.
Year 3	Section 4.10: Prepare scientific reports for dissemination of results.	***This TOR has been completed.*** Canada published a series of working papers about seamount taxa in the northeast Pacific Ocean to the North Pacific Fisheries Commission (NPFC) in 2021, 2022, and 2023. Most WG 47 members described primary papers or reports that address this TOR. See Related Publications on page 54 of this report.

4.1 Gather data on the distribution and life history of pelagic, demersal, and/or benthic taxa, including fish and invertebrate assemblages associated with seamounts in the North Pacific Ocean and facilitate their submission to appropriate biodiversity databases, e.g., Ocean Biogeographic Information System (OBIS).

WG 47 members made data available through the Government of Canada Open Data Portal, Ocean Biodiversity Information System (OBIS https://obis.org/), the NOAA Deep Sea Coral Portal, Genbank, and through data in the supplemental sections of primary papers.

Mai Miyamoto (Japan) also collaborated on a study to investigate the distributional properties of some of the North Pacific Fisheries Commission's vulnerable marine ecosystem (VME) indicator taxa, including specimens from three orders of corals (Antipatharia, Scleractinia, and gorgonians) as well as Porifera (sponges).

4.1.1 Submission of seamount data in the Northeast Pacific Ocean to Canada's Open Government Portal

Janelle Curtis and Devon Warawa submitted benthic data collected using a remotely operated vehicle (or ROV) and an autonomous underwater vehicle (or AUV) on Cobb Seamount in 2012 to Canada's Open Government Portal. The ROV dataset (Cobb Seamount Visual Survey 2012 (ROV) - Open Government Portal) contains observations of species occurrences from seafloor imagery collected by ROV during the 2012 Expedition to Cobb Seamount. The ROV operated by Fisheries and Oceans Canada was a customized Deep Ocean Engineering Phantom HD2+2 which collected photographic images from 12 transects ranging from 35 m to 211 m in depth. The AUV dataset (Cobb Seamount Visual Survey 2012 (AUV) - Open Government Portal) contains observations of species occurrences from seafloor imagery collected by the AUV during the 2012 Expedition to Cobb Seamount. The National Oceanographic and Atmospheric Administration-operated SeaBED-class AUV which collected photographic images from four transects ranging from 436 m to 1154 m in depth. More details about this dataset can be found here: Curtis, J.M.R., Du Preez, C., Davies, S.C., Pegg, J., Clarke, M.E., Fruh, E.L., Morgan, K., Gauthier, S., Gatien, G., and Carolsfeld, W. 2015. 2012 Expedition to Cobb Seamount: Survey methods, data collections, and species observations. Can. Tech. Rep. Fish. Aquat. Sci. 3124: xii + 145 p.

4.1.2 Submission of seamount data in the Northeast Pacific Ocean to NOAA's Deep Sea Coral Portal

Chris Rooper submitted benthic data collected with a stereo camera system along the Cobb-Eickelberg seamount chain during surveys in 2022 to the NOAA Deep Sea Coral Portal at https://www.ncei.noaa.gov/maps/deep-sea-corals-portal/.

4.1.3 Genbank data submission

Seonock Woo shared deep sea coral bioinformatics data in GenBank that are shared as open data. The deep-sea octocorals *Calyptrophora lyra* and *Chrysogorgia stellata* were collected in a survey of the West Pacific seamounts area and the transcriptomic reads have been deposited in GenBank under BioProject IDs PRJNA750563 and PRJNA750568. The transcriptome shotgun assemblies for the two corals have been deposited in the FASTA format at DDBJ/EMBL/GenBank under accession numbers: GJII00000000 and GJIJ00000000,
respectively (https://www.ncbi.nlm.nih.gov/sra/?term=srr15421486, https://www.ncbi.nlm.nih.gov/sra/?term=srr15421489).

4.1.4 Bathymetric segregation among demersal benthos and its contributions to the differences in the bycatches on bottom fisheries in the Emperor Seamounts area, Northwestern Pacific Ocean.

What follows is a summary of a published paper by Osawa, Y., Okuda, T., and Miyamoto, M. 2023. Bathymetric segregation among demersal benthos and its contributions to the differences in the bycatches on bottom fisheries in the Emperor Seamounts area, Northwestern Pacific Ocean. *Regional Studies in Marine Science* **68**: 103261. doi:10.1016/j.rsma.2023.103261.

Background

Seamounts have attracted both commercial and research attention since the earliest ages of ocean exploration. As a consequence of their geographical and hydrological properties, seamounts induce unique local currents, leading this geographically ubiquitous landform to be one of the most enriched maritime ecosystems. The need for the management of commercially targeted species and surrounding ecosystems has become more apparent in conjunction with the thriving commercial exploration of open seas. Despite the growing global interest in how fishing activity impacts seamount ecosystems, data regarding the fishing impacts of bottom contact fishing gears are still scarce. The aim of this study was to reveal the potential effects of fishing operations and to investigate the distributional properties of demersal benthic species using data collected during fishing activities.

Research summary

Among the data provided by scientific observers onboard vessels of the Japanese commercial bottom fisheries (five of the bottom trawlers and one of the gillnetter) operating in the southern Emperor Seamounts area, data of the operations caught benthic bycatches during the fishing seasons (January to October) from 2009 to 2020 were used in this study. We mainly focused on the bycatches of four taxonomic benthic groups, including three orders of corals (Antipatharia, Scleractinia, and “gorgonian”, Alcyonacea excluding soft coral) and Porifera that are designated as “Vulnerable marine ecosystem (VME) indicator taxa” in the Convention Area of The North Pacific Fisheries Commission (NPFC).

Regarding the spatial segregation of fishing vessels, our principal components analysis (PCA) analysis indicated that the operational tactics of vessels using the two fishing gears were slightly different: trawlers mainly operated in shallower areas at higher longitudes and gillnetters operated in deeper areas at relatively higher latitudes. Despite these substantial differences, our quantitative comparative studies revealed that the bycatch trends were highly variable among vessels, even within vessels using the same fishing gear (Fig. 4.1.4.1). This may indicate that variations in fishing tactics, particularly the positions/fishing depth, are the major factors affecting the occurrence of benthic bycatches, rather than the features of the gears *per se*. Our study also indicates the contribution of water depth to the individual sizes and the morphological variations of VME indicator taxa. The fishing operational features shifted, especially in the gillnetter, between early (2009-2014) and later (2015-2020) fishing periods toward deeper and higher latitude. Consequently, the species composition of coral bycatches differed significantly between the two fishing periods (Fig. 4.1.5.2). Overall, our study revealed that (1) the distributions of the VME indicator taxa and their individual sizes seem to vary among bathymetric ranges and local topographies, and (2) operational features, such as geographic positions and depth, may strongly affect the bycatches of demersal benthos.

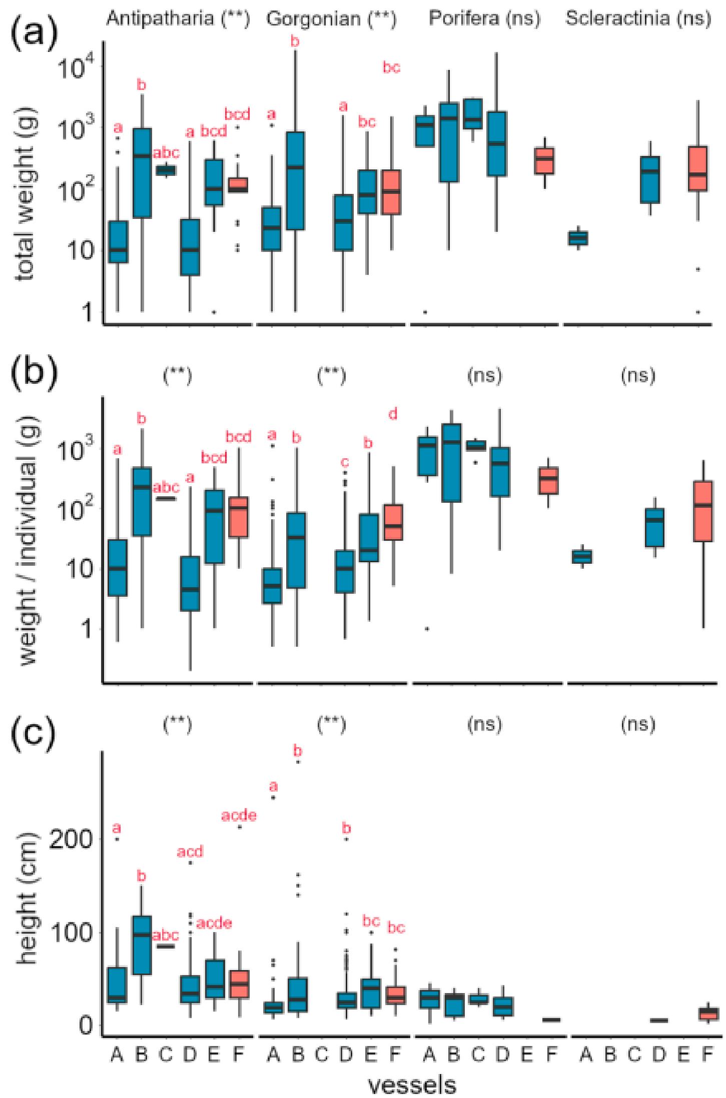

Fig. 4.1.4.1 Boxplots of (a) total catch weight, (b) individual weights and (c) individual height of bycatches (Antipatharia, Gorgonian, Porifera, Scleractinia) per vessel (trawls in blue and gillnet in orange). Boxes show the 75%, median and 25% interval and upper and lower whiskers show the greatest and least values excluding outliers. Outliers, black circle over or below the whiskers, were plotted if the values were less than 1.5 times the upper and lower quartiles. Symbols in parenthesis are the results of statistical analysis using Kruskal–Wallis rank sum test (** - $p < 0.01$; * - $p < 0.05$; ns - no significant difference), and the results of the post-hoc comparisons (Holm adjusted pairwise comparisons using t-tests with pooled SD) are shown above boxes in red alphabets (a–e).

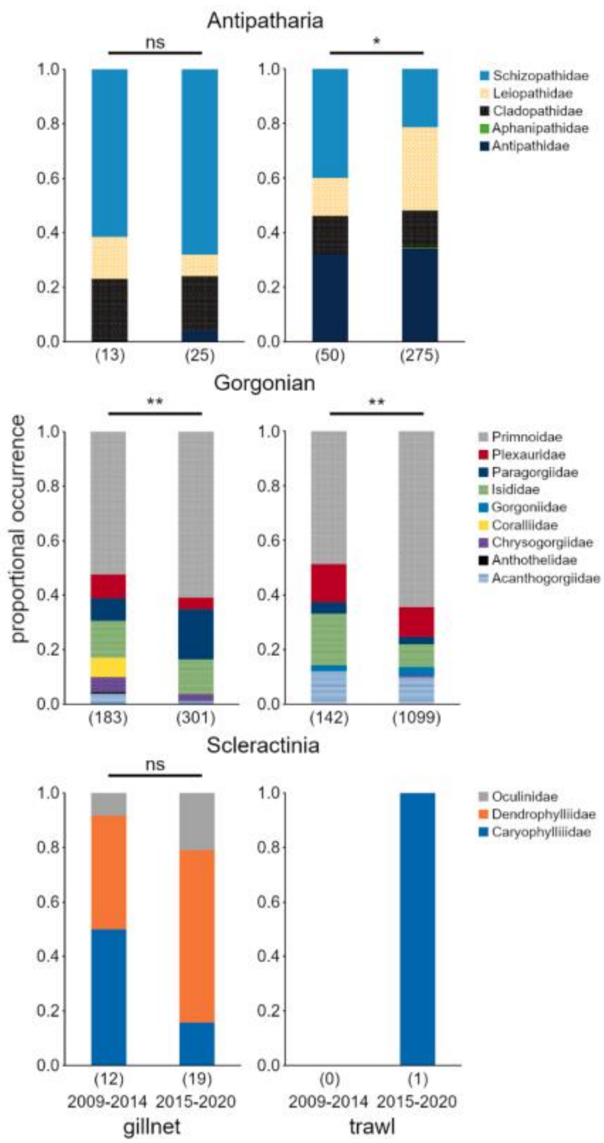

Fig. 4.1.5.2 Differences in the proportional occurrence of antipatharian, gorgonian, and scleractinian families collected in 2009–2014 (left) and 2015–2020 (right) by gillnets and trawls. Statistical differences in proportional compositions between two fishing periods are shown above bars (** - $p < 0.01$; * - $p < 0.05$; ns - no significant difference with Fisher's exact test for count data).

4.2 Gather data on key environmental variables (e.g. temperature, depth, steepness, substratum, current velocity, isolation, ocean acidification) hypothesized to influence the distribution and diversity of species associated with seamounts.

The World Ocean Atlas data that was compiled for use by PICES WG 32 on the Biodiversity of Biogenic Habitats a few years ago was updated by Samuel Georgian and was made available to

WG 47 members. These members recognize that potential environmental and ecological predictors of the distribution and biodiversity of seamount taxa in the Pacific Ocean may be used to develop one or more species distribution models for seamount taxa. Those data may also be used to predict climate-induced changes in the distribution of seamount taxa during the coming years. Chris Rooper also collected oceanographic data along the Cobb-Eickelberg seamount chain in 2022 and 2024.

4.2.1 Joint Canada-USA International Seamount Surveys – 2022 and 2024

Chris Rooper[1], Christina Conrath[2], Pam Goddard[2]

[1]Pacific Biological Station, Fisheries and Oceans Canada, Nanaimo British Columbia, Canada

[2]AFSC-RACE, National Marine Fisheries Service, Seattle, Washington, USA

Acknowledgement:
The authors wish to thank Paul Hillman (NOAA Fisheries) for his work on editing the images that appear in this section of the report, including on the cover. Paul also prepared blogs on the NOAA/DFO cruise in 2022 (see Joint Canada-U.S. Deep-Sea Coral Seamount Survey Post #1 | NOAA Fisheries; Joint Canada-US Deep-Sea Coral Seamount Survey Post #2 | NOAA Fisheries; Joint Canada-US Deep-Sea Coral Seamount Survey Post #3 | NOAA Fisheries; Joint Canada-US Deep-Sea Coral Seamount Survey Post #4 | NOAA Fisheries; Joint Canada-US Deep-Sea Coral Seamount Survey Post #5 | NOAA Fisheries).

Background and Objectives:

The Joint Canada-USA International Seamount Survey (JCUISS) was designed to study deep-sea coral and sponge communities on seamounts in international waters. Deep sea coral and sponge distributions outside of US and Canada EEZ's are relatively under explored, with the exception of a handful of studies conducted at the Cobb Seamount complex off of southern British Columbia. Historically (1970's – 1990's) many of these offshore seamounts were fished by both domestic (Canada and USA) and foreign (Russia, Korea and Japan) fishing fleets. Currently, there is limited fishing by the Canadian Sablefish longline trap fleet at seamounts in international waters. The intersection between deep-sea coral and sponge distribution and fisheries is an ongoing concern of the North Pacific Fisheries Commission, the Regional Fisheries Management Organization for international waters of the North Pacific Ocean (www.npfc.int). The NPFC manages fisheries and vulnerable marine ecosystems (VMEs) to monitor potential significant and adverse impacts on deep sea corals and sponges.

In 2022 and 2024, two two-week surveys using an underwater stereo camera was undertaken at 5 seamounts in the Cobb-Eickelberg Seamount Chain using a depth stratified-random survey design. Data were collected at 78 transects in 2022 and 56 transects in 2024. Preliminary analyses of these data have shown that deep-sea corals are widespread at relatively low densities across all the seamounts examined and especially at depths below 400 m where the majority of the sampling occurred. Preliminary species distribution models have been developed for coral and sponge taxonomic groups based on these data, but data from these international seamounts are limited.

The objectives of this study were to map and model the distribution of deep-sea coral and sponge in the seamount chain, determine important species associations with these communities and collect data on the oceanography of the seamounts and observations of marine mammal and birds over the seamount chain.

Approach:

The main tool used in this work was the underwater stereo camera system developed during the Alaska Coral and Sponge Initiative in 2012-2015. The stereo-camera survey followed a standard protocol outlined in Rooper et al. (2016), with a target of 15 minutes of on-bottom time for each transect. Images were processed to determine substrate type, density and size of structure forming invertebrates and density and size of fish species using Sebastes software (Williams et al. 2015). The visual survey was designed in a robust statistically sound method so that inferences about the deep-sea coral and sponge communities on seamounts can be made. An estimate of the total abundance of deep-sea coral and sponge (and associated fishes) will be generated using the sampling for each of the seamounts and the seamount chain. Further species distribution modeling will also be conducted to predict hotspots of abundance and diversity in the seamounts that may warrant protection as vulnerable marine ecosystems (FAO 2009).

In addition to the visual survey, we collected temperature data and water samples with adjoining images that can contribute to ongoing eDNA studies and taxonomic studies at each transect. Acoustic data from scientific echosounders was also collected during nighttime benthic mapping. A series of benthic grabs were collected to document the sediment at selected locations on Cobb seamount.

Substrate data were collected at each survey transect, as well as temperature and depth profiles (including steepness). Profiles of current velocity and direction were collected continuously throughout the cruise as well as surface temperature and salinity. Additionally, temperature, oxygen, chlorophyll and zooplankton were collected at oceanographic stations on each seamount and between seamounts along the vessel path.

Significant Results to Date:

In total 78 stations were occupied in 2022. In 2024, 56 of the 86 stations were occupied on Brown Bear and Cobb Seamounts (Figure 4.2.21).

Preliminary image analysis showed that gorgonian corals were present at 71% of the transects occupied. Most of the corals occurred at depths below 400 m and corals were present at most transects on all seamounts below this depth (Figure 4.2.2.2). Coral taxa appeared to consist of Primnoidae, Isididae and other Octocorallians and Antipatharians at deeper depths. Hexactinellid sponges had a similar distribution to the corals, although they occurred in only 46% of the transects. Hydrocorals were common at shallow depths on Cobb and Corn Seamounts, while sea whips and sea pens were not common, but found at most depths. Reef building scleractinians were observed at 8 transects across both years. Figure 4.2.2.3 shows the density for VME indicator taxa and Figure 4.2.2.4 shows the height of VME indicator taxa measured with the stereo camera system.

Discarded longline gear was observed at ~10% of transects and a single furrow believed to be indicative of bottom trawl gear was observed. Most of the fishing gear occurred on Cobb Seamount.

Figures:

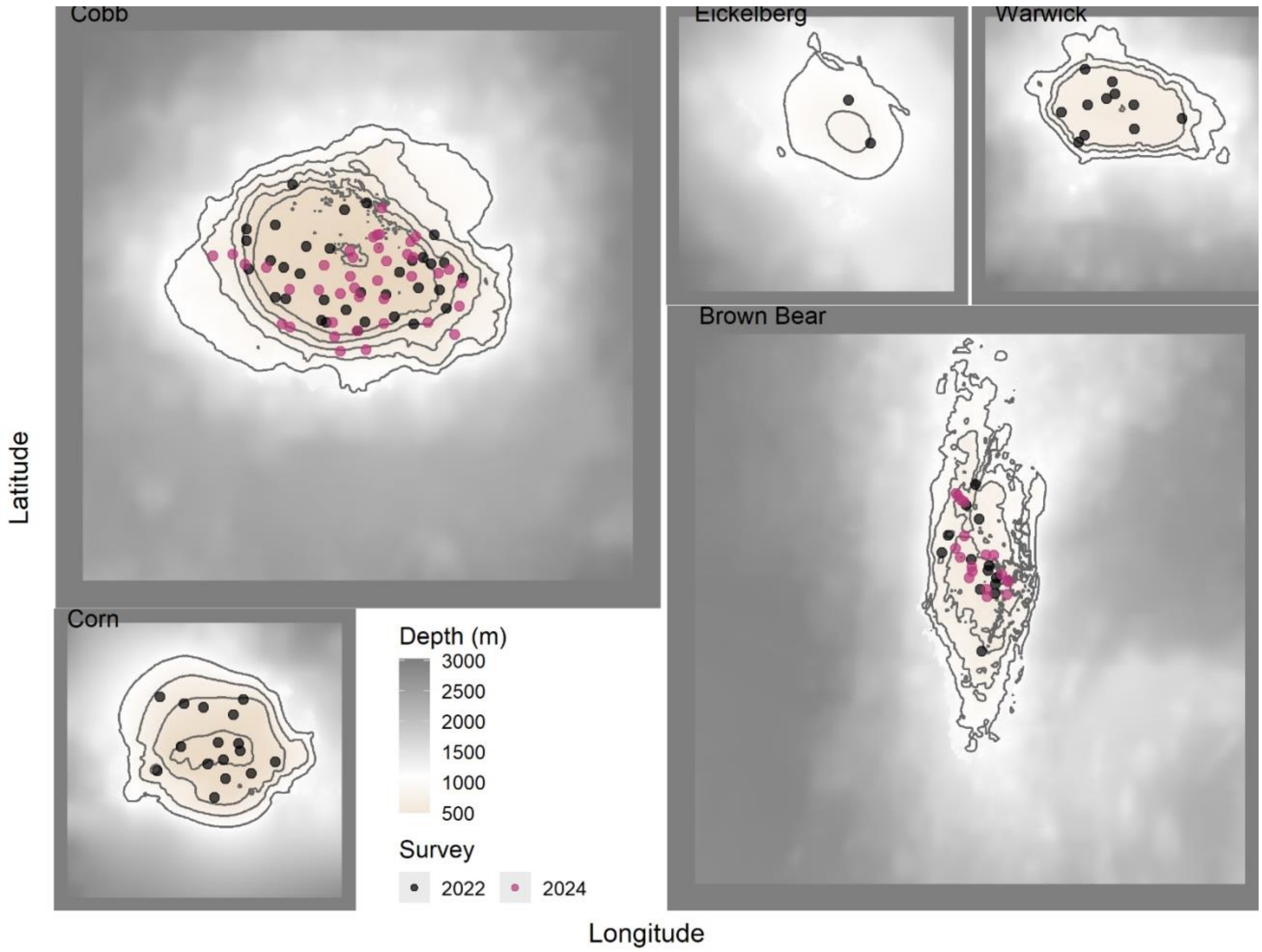

Figure 4.2.2.1 Map showing distribution of randomly sampled transects in 2022 and 2024 at the five seamounts surveyed on the cruise in bold text (Cobb, Corn, Warwick, Eickelberg and Brown Bear Seamounts).

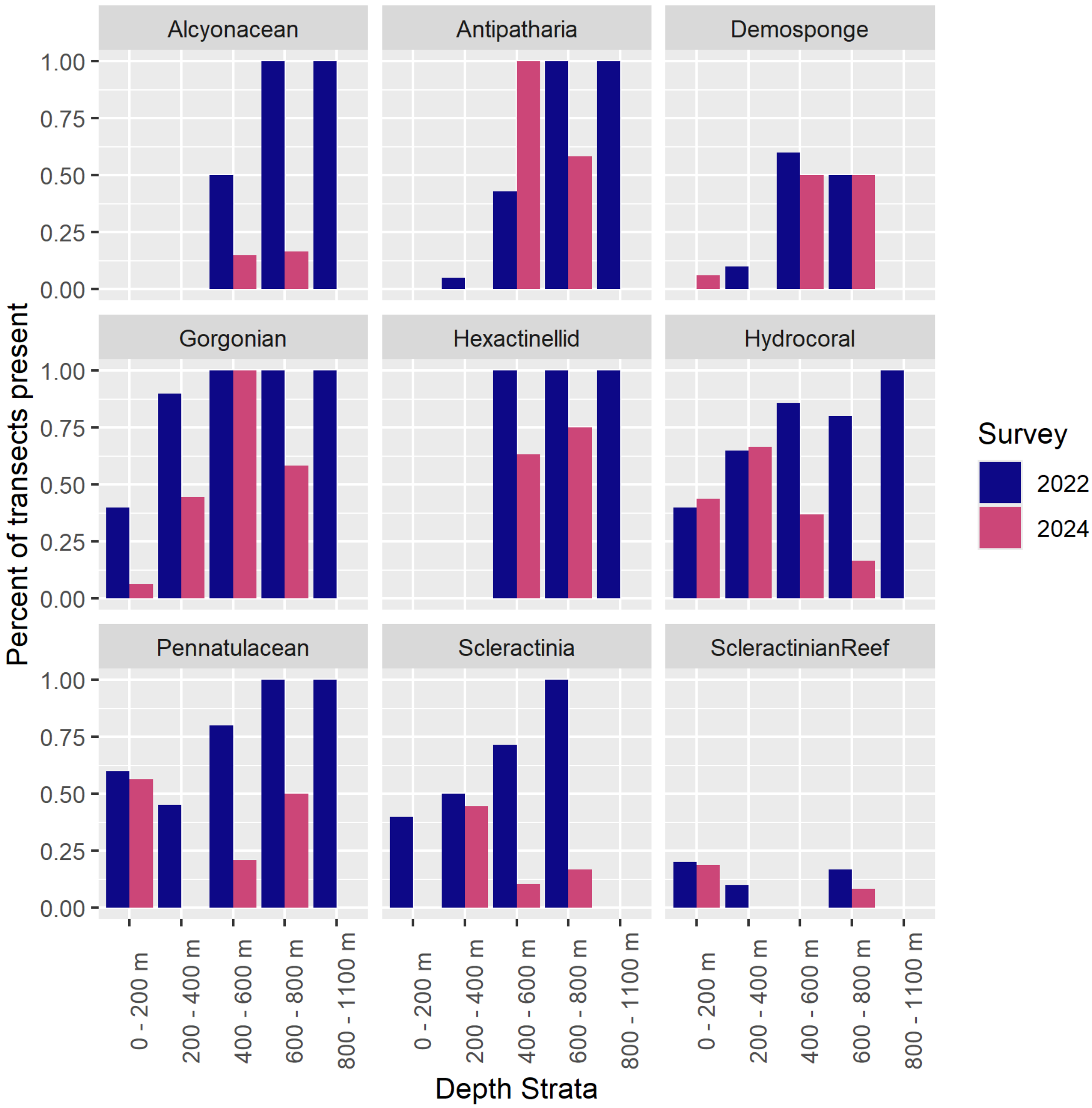

Figure 4.2.2.2 Percentages present for the most common structure forming invertebrates at the five seamounts surveyed during the Joint Canada-USA International Seamounts cruise.

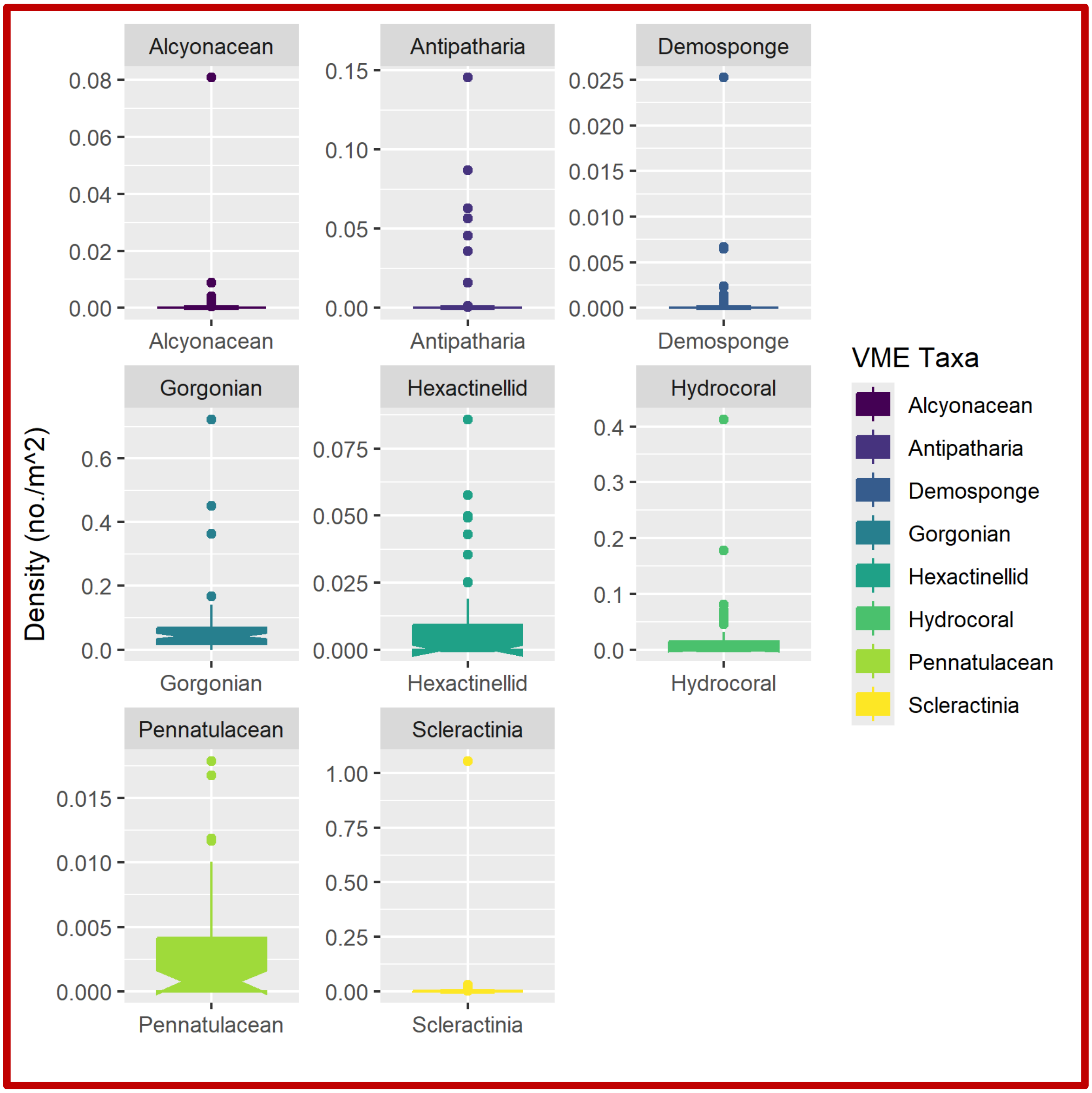

Figure 4.2.2.3 Densities of the most common structure forming invertebrates occurring at the five seamounts surveyed during the Joint Canada USA International Seamounts cruise.

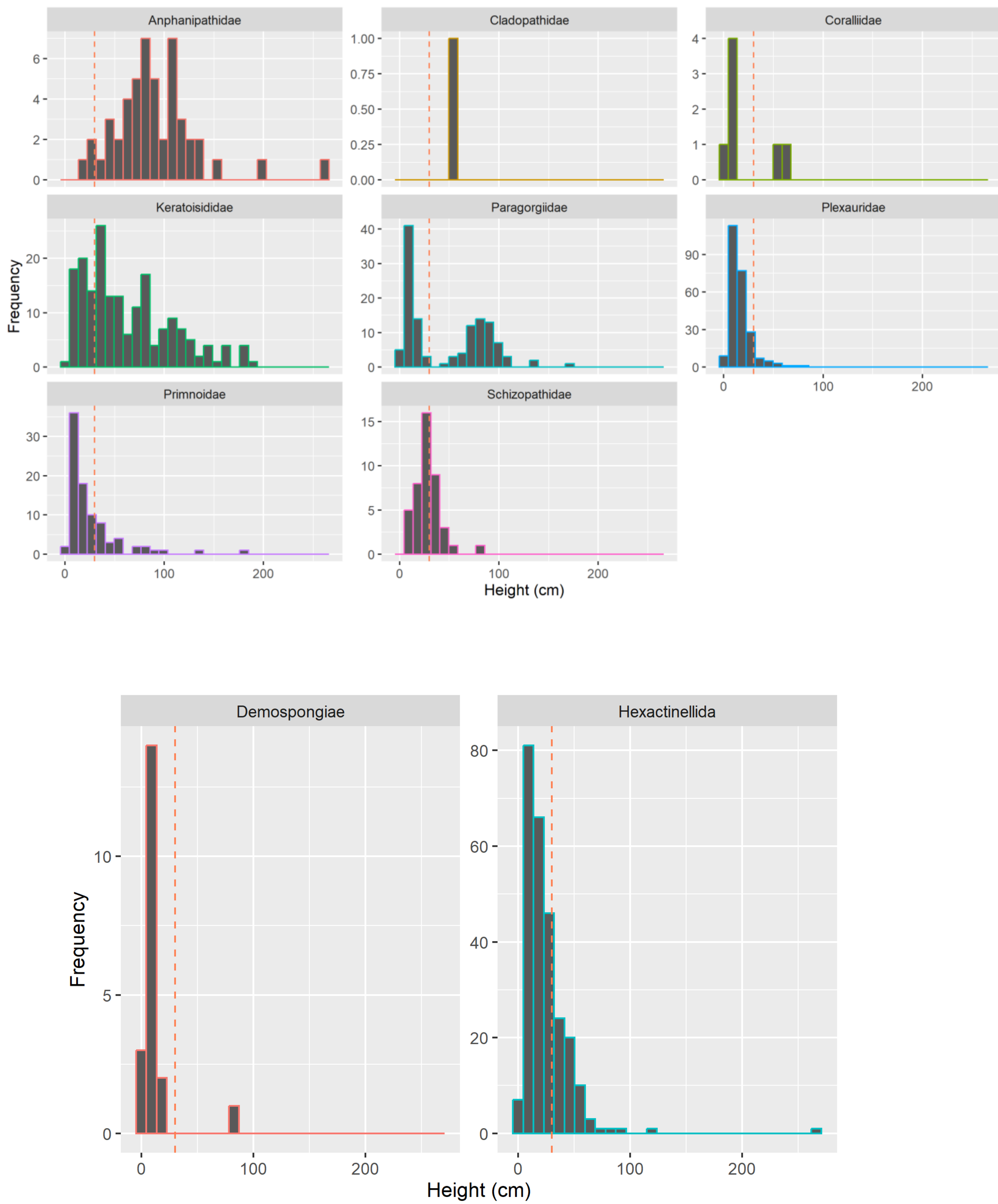

Figure 4.2.2.4 Height distributions of common families of corals and classes of sponges observed at seamounts in international waters.

4.3 Convene a 2-day workshop on "Distributions of pelagic, demersal and benthic species associated with seamounts in the North Pacific Ocean and factors influencing their distributions.

WG 47's 2-day workshop on "Distributions of pelagic, demersal, and benthic species associated with seamounts in the North Pacific Ocean and factors influencing their distributions" was convened from 24-25 September 2022 during the 2022 PICES Annual Meeting in Busan, Korea. The workshop was co-chaired by Janelle Curtis, Mai Miyamoto, Akash Sastri, Chris Rooper, and Samuel Georgian. Workshop participants identified and discussed environmental and ecological predictors of species associated with seamounts. Some of the highlights of the workshop included discussions about the importance of considering bentho-pelagic coupling when predicting distributions of benthic taxa, including deep-sea corals and sponges. There was also considerable discussion of methods to identify VMEs, and how best to model climate-induced changes in the distribution of seamount taxa. See the Vol. 31, No. 1 (Winter 2023) *PICES Press* article about this workshop in: *"PICES-2022 W1: Distributions of pelagic, demersal, and benthic species associated with seamounts in the North Pacific Ocean and factors influencing their distributions"* (PICES-Press-2023-Vol31No1.pdf).

4.4 Identify environmental and ecological predictors of patterns in the distribution and biodiversity of pelagic, demersal, and/or benthic taxa associated with seamounts in the North Pacific Ocean.

This TOR has been partially addressed by a team led by Janelle Curtis for benthic seamount taxa along the Cobb-Eickelberg seamount chain in the northeast Pacific Ocean. This team identified environmental predictors of patterns of the distribution of stony corals (Scleractinia), black corals (Antipatharia), gorgonian corals and non-gorgonian corals. The top predictors of the distribution of these corals included oxygen, photosynthetically-active radiation (PAR), roughness, and chlorophyll-a.

4.4.1 Predictive Habitat Models (PHMs) and Visual Surveys to Identify Vulnerable Marine Ecosystems (VMEs) on Seamounts in the North Pacific Fisheries Commission (NPFC) Convention Area

What follows are excerpts of text relevant to this TOR from:

Warawa, Devon R., Chu, Jackson W. F., Rooper, Chris N., Georgian, Samuel, Nephin,, Jessica, Dudas, Sarah, Knudby, Anders, and Janelle M. R. Curtis. (2021). Predictive Habitat Models and Visual Surveys to Identify Vulnerable Marine Ecosystems on Seamounts in the North Pacific Fisheries Commission Convention Area. North Pacific Fisheries Commission NPFC-2021-BFME02-WP05, 44 pp.

Introduction:

Predictive habitat models (PHMs), also referred to as species distribution models, can be used to predict areas of high habitat suitability for marine species of interest. In general, PHMs are statistical methods that relate known presences of a species to a set of environmental variables. Models can then be used to extrapolate where species are likely to occur within the extent of the environmental variables, including in areas where biological survey data are lacking (Franklin 2010). Model outputs can also be used to generate hypotheses about the factors that influence species distributions, such as key environmental drivers, which can help identify priority areas for future data collection. Prediction maps generated from a standard PHM are usually presented as a logistic index with values ranging from 0 to 1. Depending on the model and data used, the logistic index is commonly interpreted as a probability of presence or as an index of habitat suitability, with predictions corresponding to low (0) and high (1) probability of presence or habitat suitability. We interpret the output of our four models as the probability that there is suitable habitat for the corresponding VME indicator taxon and we assume that the taxa can exist where there is suitable habitat.

PHM development requires a dataset of georeferenced species presences as well as gridded environmental data layers representing variables that potentially influence the distribution of the modeled species. In addition, data on species absences – areas where a species has been observed to not exist – can also be valuable. The environmental data should cover the entire extent of the area of interest, and the species presence/absence data should ideally be broadly distributed across the spatial and environmental gradients in the same area.

In this study, we use the Maximum Entropy model (MaxEnt) to develop PHMs for each of our four vulnerable marine ecosystem (VME) indicator taxa. MaxEnt is a machine learning, statistical method that originated in the fields of statistical mechanics and information theory (Phillips et al. 2006). MaxEnt has also been the most commonly applied PHM for examining distributions of cold-water corals and sponges when only presence data are available which is most often the case for deep-sea taxa (Winship et al. 2020). By default, MaxEnt uses 'pseudo-absences' sampled from the surrounding background area to generalize the habitat conditions of an area; presence is unknown at the location of these background sampled locations. Although MaxEnt is known as a 'presence-only' model by default, absence data, instead of 'pseudo-absences', can be used with the MaxEnt algorithm. For our PHMs both presence and absence observations were sampled mostly within the adjacent exclusive economic zones of Canada and the United States of America. The availability of presence and absence observations of VME indicator taxa allows for the exploration of alternative models (e.g. Generalized Additive Models (GAM), Boosted Regression Trees, Random Forest models) in future iterations of PHM development.

Methods:

We compiled a large dataset of georeferenced species records of the North Pacific Fisheries Commission's (NPFC's) VME indicator taxa in the northeast Pacific Ocean. Records were queried as of September 2021 and come from scientific surveys data and museum records deposited in (1) the NOAA deep-sea coral data portal (https://deepseacoraldata.noaa.gov/), (2) standardized bottom trawl catch data from research surveys in the Gulf of Alaska, Aleutian Islands and eastern Bering Sea, (3) standardized bottom trawl catch data from DFO research surveys in British Columbia, Canada, and (4) standardized bottom trawl catch data from research surveys on the U.S. West Coast of Washington Oregon and California (Stauffer 2004, Nottingham et al. 2018).

Records were identified to various levels of taxonomy and required up-to-date taxonomy verification with the World Register of Marine Species (WoRMS, Horton et al. 2021). After updated taxonomy was appended to the records, records with at least an order (black corals, stony corals) or family (gorgonian corals, non-gorgonian soft corals) level of identification were pooled for use as the presence data for each of their respective PHMs. Final sets of presence records used for PHM model development were also spatially restricted to those occurring within the four marine ecoregions of the world (MEOW) that characterize the oceanographic conditions from the Gulf of Alaska to the West Coast of North America (Spalding et al. 2007). No commercial bycatch records were included in the data used for PHMs.

Multiple depth-stratified research trawl surveys record the occurrence of all species captured over the latitudinal extent of our study area. We generated absence records from the fishing events that did not yield a species corresponding to our VME indicator taxa (e.g. Beazley et al. 2018, Chu et al. 2019). Because the trawl surveys occurred only on the continental shelf and slope, there is a sampling bias in location of the absence records relative to the presence records which include observations of VME indicator taxa at several offshore seamounts. With the exception of visual data from Cobb Seamount (Curtis et al. 2015), we prioritized keeping as many of these rare seamount observations in our models as possible and addressed this sampling bias by restricting the inclusion of offshore presence records to those occurring within the sampling depth range of the absence records which sampled a maximum depth of 1,600 m.

We used the gridded environmental data from Chu et al. (2019) developed by the North Pacific Marine Science Organization (PICES) Working Group 32 on Biodiversity of Biogenic Habitats, which were created for the development of PHMs for the North Pacific Ocean (Chu et al. 2019, 2020). This set of 30 environmental layers are gridded at a 1 km^2 resolution and include bathymetry-derived variables, physiochemical variables, and oceanographic properties that can be strong predictors of benthic species distributions. Davies and Guinotte (2011), Chu et al. (2019), and Georgian et al. (2021) provide general background on the data layers, original data sources, processing steps involved in their creation, and examples of their general use in PHM development for VME indicator taxa and identifying VMEs in the Pacific Ocean.

We followed the general MaxEnt model workflow described by Chu et al. (2019) and developed a PHM for each of the four VME indicator taxa. Species data were spatially thinned models and to prevent general overfitting (e.g. Merow et al. 2013, ICES 2021). Collinearity among predictors was addressed by examining variance inflation factors (VIF) and iteratively reducing the set of environmental data layers used for each model until the final subset of variables all had VIF < 10 (Table 4.4.1.1). Model performance was assessed using the area under the receiver operating characteristic curve (ROC) (Phillips et al. 2006). AUC values of 1.0 indicate a model that can perfectly predict presence and absences and 0.5 indicates a model that performs no better than random. We tested a range of MaxEnt regularization coefficient values (to balance model overfitting, see Merow et al. 2013) and set the value to 1.0 which yielded models with the highest AUC. We used five-fold cross validation to assess how well each model performed. Occurrence (presence and absence) data was randomly sampled and split into five equal data partitions and models were trained on four partitions and tested with the remaining fold; this procedure was repeated five times with a unique partition used for testing in each iteration. Final models used the entire set of species presences and absences from each taxon to generate maps of presence probability.

Results:
All MaxEnt models developed using presence-absence data performed well with AUC scores ranging from 0.86-0.91 among modelled taxa. The most important predictors varied slightly among models but

all shared dissolved oxygen among their top two ranked predictors. Additional importance predictors included water column properties associated with surface water conditions (photosynthetically active radiation, particulate organic carbon, sea surface temperature, chlorophyll-A), seafloor characteristics (roughness), and broad scale currents (regional current velocity). The slight differences among the most important predictors also resulted in differences in the general footprint of areas predicted to have a high habitat suitability varied among models. However, shared areas of high habitat suitability among models were generally concentrated along the continental shelf in domestic waters and mostly at seamount areas within the international waters of the NPFC Convention Area. These results mirror those of Chu et al. (2019) who used a similar PHM approach but focused within a smaller study area inside Canadian domestic waters. The complimentary findings reinforce the importance of the expansive oxygen minimum zone in the Northeast Pacific ocean and its influence on the distribution of VME indicator taxa in this region.

Table 4.4.1.1 Summary of final MaxEnt model parameters. Training AUC and the top three most important predictor variables based on their relative importance in each model are presented. Values are the mean among the 100 bootstrap resampling model runs that used the entire occurrence dataset. Variable acronyms: PAR – photosynthetically active radiation, POC – particulate organic carbon, BPI20000 – bathymetric position index at a 20,000 m scale, Regfl – Regional current velocity, SST – Sea Surface Temperature.

VME group	Training AUC	1st ranked	2nd ranked	3rd ranked
Black corals	0.90	Oxygen (48%)	PAR (19%)	Regfl (7%)
Stony corals	0.90	Oxygen (48%)	Chl-A (13%)	SST (13%)
Gorgonian corals	0.85	PAR (37%)	Oxygen (16%)	BPI20000 (11%)
Non-gorgonian soft corals	0.92	Roughness (36%)	Oxygen (16%)	POC (8%)

4.5 Apply one or more modeling approaches (e.g. MaxEnt, Boosted Regression Trees, or high-resolution bathymetry-based models to predict the distribution of pelagic, demersal, and/or benthic biodiversity associated with seamounts in the North Pacific Ocean.

This TOR has been partially addressed by a team led by Janelle Curtis for benthic seamount taxa in the northeast Pacific Ocean. Specifically, they used MaxEnt in 2021 and ensemble models in 2022 to predict the distribution of VME indicator taxa along the Cobb-Eickelberg seamount chain in the Northeast Pacific Ocean. The ensemble model coupled a random forest, generalized additive model (GAM), and a boosted regression tree model. In 2023, a GAM model predicted the distribution of potential VMEs in the same area. Chris Rooper noted that guidelines and code for developing predictive habitat models, including random Forest (RF), Generalized Additive Models (GAM), Generalized Linear Models (GLM) and Boosted Regression Trees (BRT) are available through ICES.

4.5.1 Vulnerable Marine Ecosystems (VMEs) in the Northeast Part of the North Pacific Fisheries Commission Convention Area

What follows are excerpts of text relevant to this TOR from:

Warawa DR, Chu JWF, Gasbarro R, Rooper CN, Georgian S, Nephin J, Dudas S, Knudby A, Curtis JMR (2022). Vulnerable Marine Ecosystems (VMEs) in the Northeast Part of the North Pacific Fisheries Commission Convention Area. North Pacific Fisheries Commission NPFC-2022-SSC BRME03-WP03. 23 pp.

Similar analyses are also published in these two publications:

Warawa DR, Nephin J, Rooper CN, Chu JWF, Dudas S, Knudby A, Georgian S, Curtis JMR. (2023b). Identifying potential VMEs on the Cobb-Eickelberg seamount chain based on predictive modelling. NPFC-2023-SSC BFME04-WP12

DFO. 2024. Identification of Vulnerable Marine Ecosystems on Seamounts in the North Pacific Fisheries Commission Convention Area using Visual Surveys and Distribution Models. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2024/038.

Introduction:
This was an update to Canada's proposed quantitative approach to identifying Vulnerable Marine Ecosystems (VMEs) described in (Warawa et al. 2021). In this approach we use predictive habitat models to identify areas likely to be VMEs and visual data to identify VMEs, as outlined by the North Pacific Fisheries Commission (NPFC) framework for identifying data that can be used to identify VMEs in the Northwest and Northeast parts of the NPFC's Convention Area (NPFC 2021). Our quantitative approach is based on work by Rowden et al. (2020) who identify thresholds related to the amount of VME indicator taxa in an area and how it contributes to an increase in associated species richness as a result of providing structural complexity. Canada's proposed approach to identifying VMEs shows an example of an extension of the Rowden et al. (2020) approach to presence absence data and models. Our preliminary results from the Cobb-Eickelberg seamount chain study area detect a VME density threshold of 0.57 VME indicators taxa/m^2 and a VME occurrence threshold of 0.78. Applying these thresholds to visual data and predictive habitat models result in a total area of 750m^2 identified as VMEs on Cobb seamount and a total area of 1,542 km^2 identified as likely to be VMEs along the Cobb-Eickelberg seamount chain, respectively.

Methods:
The main steps in our approach are: 1) develop quantitative VME thresholds, 2) gather data on VME indicator taxa distribution, 3) apply the threshold to the data, 4) identify VMEs or areas likely to be VMEs. The data and criteria differ for identifying VMEs and areas likely to be VMEs (Figure 4.5.1.1). Identifying VMEs is based on applying a density VME threshold to visual data and any areas with visual data showing VME indicator taxa equal to or greater than the threshold are considered VMEs. Identifying areas that are likely to be VMEs is based on applying an occurrence VME threshold to predictive habitat models. Areas where at least one VME indicator taxon has habitat suitability predictions equal to or above the threshold is considered likely to be a VME.

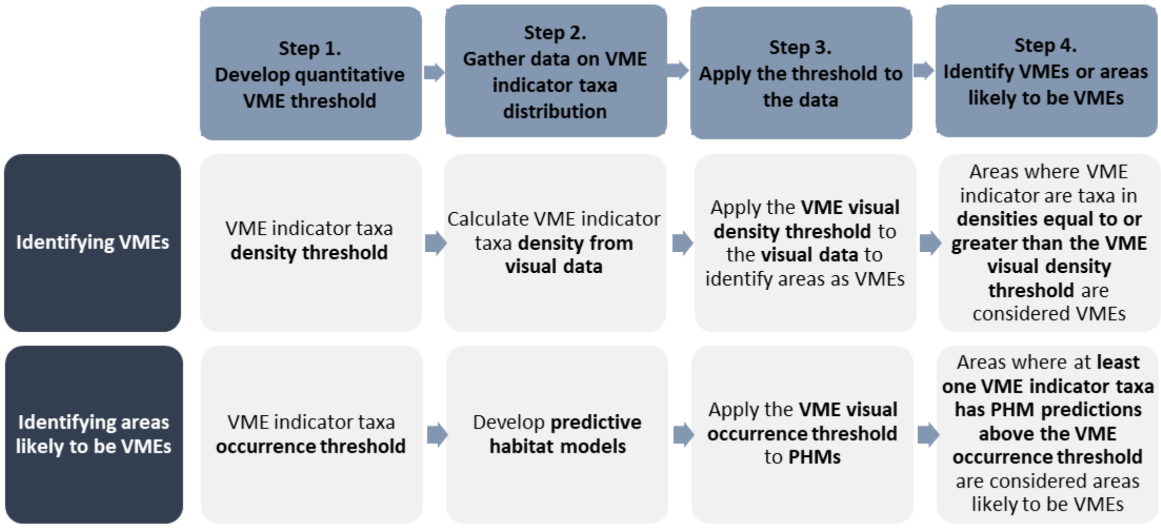

Figure 4.5.1.1. Steps used to identify VMEs and areas likely to be VMEs.

In this update, we used a performance-weighted ensemble modeling approach instead of the Maxent approached used by Warawa et al. 2021). Ensemble modelling has been shown to improve model performance and interpretability (Araújo and New 2007). Three modeling techniques were used that have successfully predicted the distribution of cold-water corals in other studies (e.g. Rooper et al. 2017; Morato et al. 2020; Georgian et al. 2021): Boosted Regression Tree (BRT), Generalized Additive Models (GAM), and Random Forest (RF). Each model outputs a habitat suitability score between 0-1, with 1 indicating more suitable predicted habitat. The outputs of individual model approaches (BRT, GAM, and RF) were combined using the AUC weighted-average into a single ensemble model for each taxon. As each modeling approach relies on differing underlying structures and distinct statistical assumptions, they are therefore likely to produce dissimilar outputs and predictions (see Robert et al. 2016). Ensemble modeling can produce more robust predictions that are less reliant on model selection and parameterization (Araújo and New 2007). BRT, GAM, and RF models were built and tested using a combination of 'biomod2' (Thuiller et al. 2016), 'gbm' (Ridgeway 2004), 'dismo' (Hijmans et al. 2015), 'mgcv' (Wood 2006), and 'randomForest' (Liaw and Wierner 2002) in R (v3.6.1; R Core Team 2019). BRT models were built using a minimum of 3,000 trees, an assumed Bernoulli distribution, and an interaction depth of 7 to prevent limiting interactions between terms. After testing a variety of model parameters during preliminary construction, GAMs were created using a binomial distribution and four degrees of freedom. RF models were constructed as classification models using 1001 trees and a node size of five.

Results:
BRT, GAM, and RF models developed using presence-absence data performed well with test AUC scores ranging from 0.795–0.898, kappa of 0.138–0.501, and TSS of 0.489–0.656 among all taxa. The most important predictors varied among taxa and modeling approaches, with dissolved oxygen, chlorophyll a, roughness, aspect, slope, TPI-20000, PAR, and the saturation state of calcite generally contributing significantly to models. Model predictions varied both among taxa and modeling approach. However, shared areas of high habitat suitability in the final ensemble models were generally concentrated along the continental shelf in domestic waters and mostly at seamount areas within the international waters of the NPFC (Figures 4.5.1.2, 4.5.1.3, 4.5.1.4, and 4.5.1.5). These results mirror those of Chu et al. (2019) who used a similar PHM approach on a subset of the same presence and absence data. The complimentary findings reinforce the importance of the expansive oxygen minimum

zone in the Northeast Pacific Ocean and its influence on the distribution of VME indicator taxa in this region.

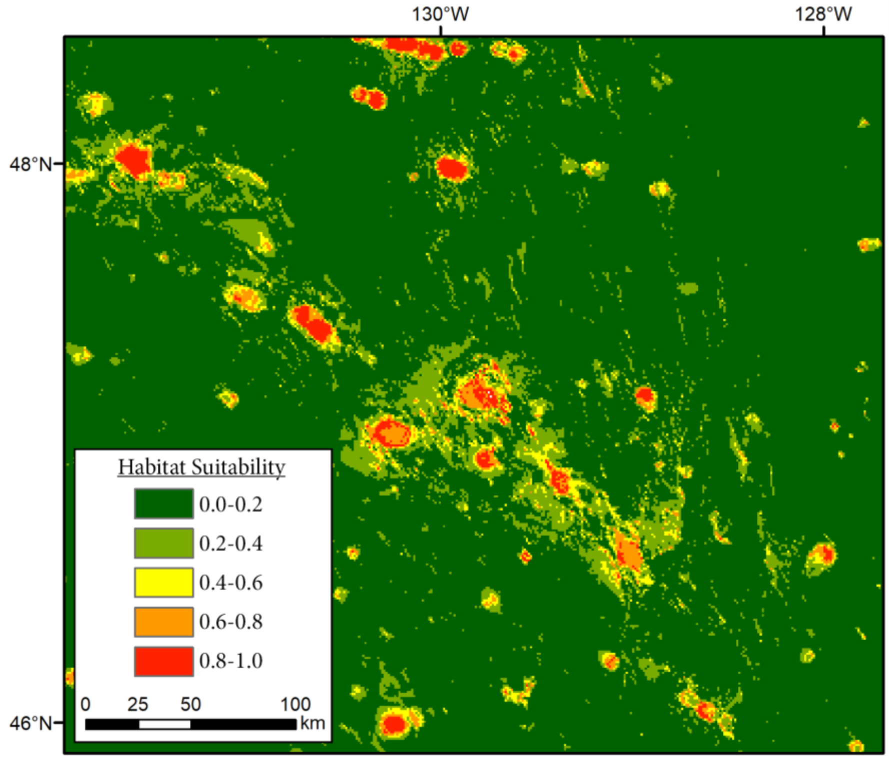

Figure 4.5.1.2. ROC-weighted ensemble model for stony corals in the vicinity of Cobb Seamount.

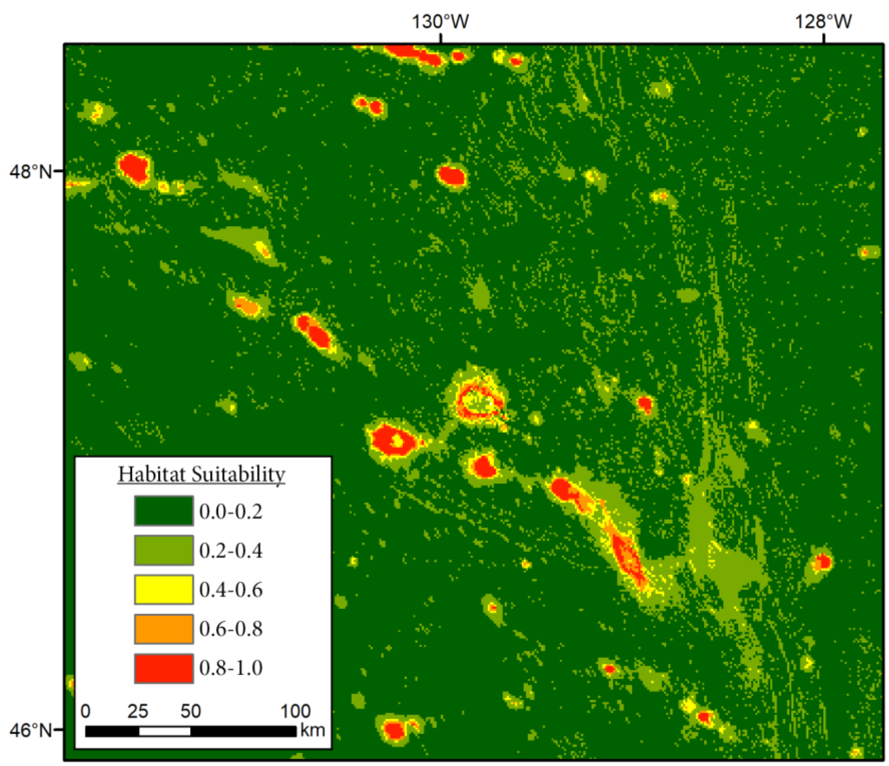

Figure 4.5.1.3. ROC-weighted ensemble model for black corals in the vicinity of Cobb Seamount.

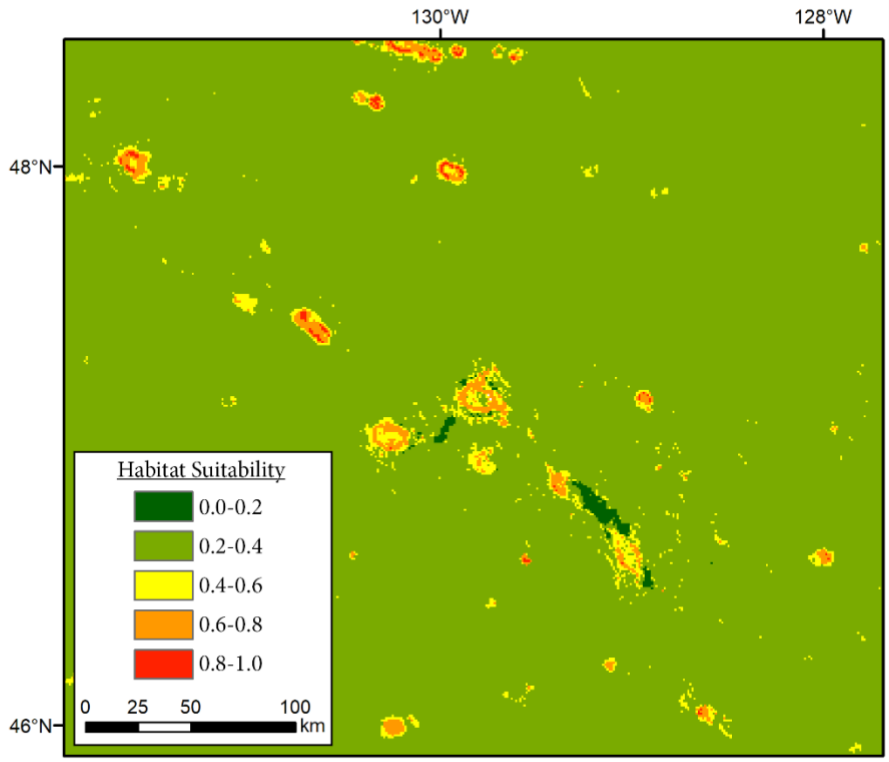

Figure 4.5.1.4. ROC-weighted ensemble model for soft corals in the vicinity of Cobb Seamount.

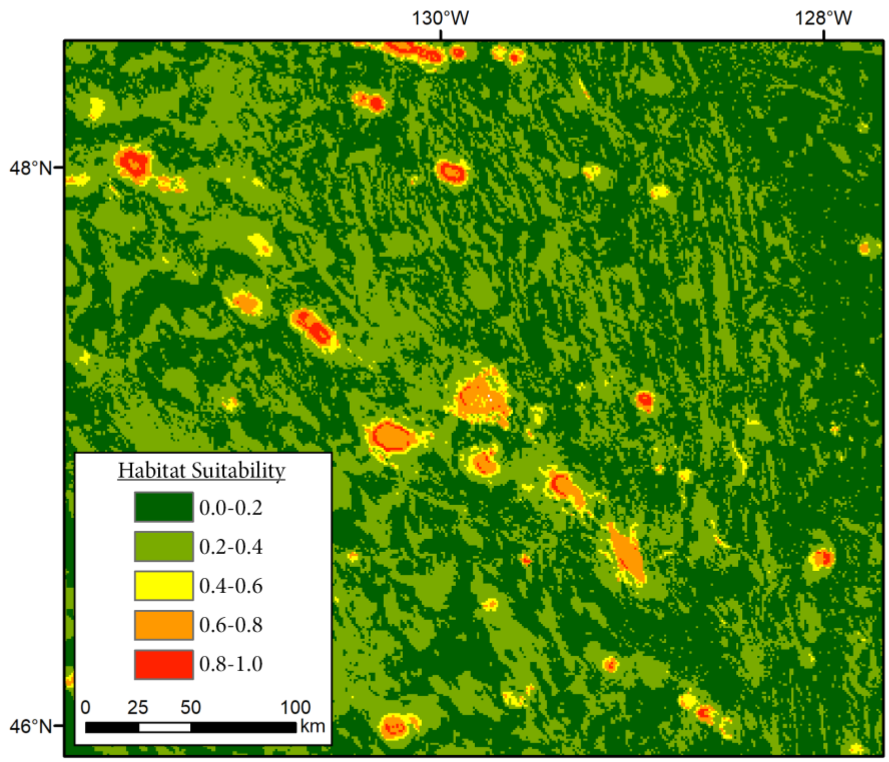

Figure 4.5.1.5. ROC-weighted ensemble model for gorgonians in the vicinity of Cobb Seamount.

Identifying areas that are likely to be VMEs using predictive habitat models (PHMs) will be strongly influenced by the taxa being modelled. Although our PHM models performed well, the NPFC's VME indicator taxa groups (black corals, stony corals, gorgonians and non-gorgonian soft corals) are taxonomically broad and capture a wider range of habitat conditions than what species-specific PHMs would resolve. Ideally, we would develop PHMs for taxa at lower taxonomic levels (e.g., species or family) which could reduce the amount of species-specific habitat requirements being pooled into a single model. This could improve how well our PHMs predict the occurrence of VME indicator taxa on seamounts.

4.6 Use available data to predict climate induced changes in the distributions of seamount fauna.

Although there is considerable interest among WG 47 members to predict climate induced changes in the distribution of seamount taxa, all members agreed during business meetings from 2023-2024 that there were insufficient resources, capacity, and expertise to address this TOR before the end of WG 47's term in 2024.

4.7 Convene a topic session on the pelagic, demersal, and benthic species associated with seamounts at the PICES Annual Meeting.

This TOR was completed during the PICES 2023 Annual Meeting in Seattle, USA. See Session 14 under the Scientific Program and Structure of PICES 2023 Annual Meeting - Program - PICES, specifically https://meetings.pices.int/meetings/annual/2023/PICES/program#s14. Presentations were given by or co-authored by WG 47 members, including Janelle Curtis, Mai Miyamoto, Chris Rooper, Kota Sawada, Les Watling, and Seanock Woo. Janelle Curtis' co-authored presentation was about use of visual data and predictive models to identify VMEs in the northeast Pacific Ocean. Mai Miyamoto presented her association analysis of seamount benthos for validation of VME indicator taxa in the North Pacific Fisheries Commission's Convention Area. Chris Rooper presented his research on the distribution, abundance and size structure of deep-sea corals and sponge seamount communities in the northeast Pacific Ocean. Kota Sawada's presentation was about the biology and fisheries of north Pacific armorhead and splendid alfonsino in the Southern Emperor seamount chain and Northern Hawaiian Ridge. Les Watling presented his work on the biogeography of seamounts in the North Pacific Ocean and co-authored a presentation on bathyal megafauna assemblages. And Seanock Woo's presentation was about coral biodiversity and genetic resources on Godin Guyot in the western North Pacific Ocean.

4.7.1 Biology and Fisheries of North Pacific armorhead and splendid alfonsino in SE-NHR area – A review

What follows is a summary of the oral presentation during Topic Session 14 of the PICES 2023 Annual Meeting given by Kota Sawada and co-authors:

Kota Sawada[1], Kenji Taki[1], Takehiro Okuda[1] and Mai Miyamoto[2]

[1] Japan National Fisheries Research and Education Agency, Yokohama, Japan

[2] Japan NUS CO., LTD., Tokyo, Japan

North Pacific armorhead and splendid alfonsino are the most important targets for bottom fisheries in the Southern Emperor and Northern Hawaiian Ridge (SE-NHR) area. We review original scientific literature and summarize current knowledge of biology and fisheries for the two species.

The bottom fisheries of North Pacific armorhead in the SE-NHR area were first explored by the trawl fleet of the Soviet Union in 1967. The larvae are found in the surface waters over and adjacent to the SE-NHR area whereas juveniles and subadults live in the epipelagic layer of the subarctic water mass of the central and eastern North Pacific. Subadults settle to seamounts, where they mature and spawn in winter. After settlement, they cease growth and gradually lose body weight. North Pacific armorhead on seamounts are largely dependent on plankton and deep scattering layer organisms as prey resources rather than preying on locally produced benthic food.

The fisheries of splendid alfonsino began in the late 1970s as an alternative fishery when North Pacific armorhead showed poor catch. The genetic differentiation for splendid alfonsino has not been detected among the North Pacific populations. The spawning season in the SE-NHR area is likely to be summer. Splendid alfonsino shows an ontogenetic shift from planktivorous to micronektivorous diets in the SE-NHR area.

Given their commercial importance and concerns about their stock status, preparatory work for stock assessments of these species in the SE-NHR area is ongoing to guide a sustainable harvest. We discuss challenges in conducting the stock assessments, including a unique life history and insufficient biological information.

4.8 Identify potential indicators for assessing and monitoring the biodiversity of pelagic, demersal, and/or benthic taxa associated with seamounts.

This TOR has been partially addressed by a few WG 47 members. Kota Sawada noted that indicators, including e-DNA, that have been applied to other areas might also be applicable to seamounts. A team led by Janelle Curtis estimated an indicator for benthic seamount taxa in the northeast Pacific Ocean. Specifically, a density of 0.6 vulnerable marine ecosystem (VME) indicator taxa (stony corals, black corals, gorgonian and non-gorgonian soft corals, glass sponges, and demosponges) per m^2 are indicative of the presence of VMEs in the North Pacific Fisheries Commission (NPFC) Convention Area. This density is associated with higher species richness of non-VME indicator taxa. Amy Baco-Taylor noted that precious corals may be indicators of the effects of disturbance. Other participants noted that different suites of indicators may be appropriate for different seamounts (e.g. shallow vs deep) and the size distribution of seamount taxa may indicate recruitment dynamics.

4.8.1 Environmental DNA as a potential indicator of seamount biodiversity

What follows is a summary of the following two oral presentations: the first was given at the PICES 2023 Annual Meeting in Seattle, USA and the second was given at the PICES 2024 Annual meeting in Honolulu, USA.

1. Environmental DNA as a potential tool for the understanding of demersal ichthyofauna in seamounts: a case study from the Emperor Seamounts area.

Motoomi Yamaguchi[1], Kota Sawada[1], Yumiko Osawa[1], Mai Miyamoto[2], and Bungo Nishizawa[1]

[1] Fisheries Resources Institute, FRA, Japan

[2] Japan NUS

2. Testing the validity of environmental DNA analyses on the benthic fauna of pelagic seamounts

Motoomi Yamaguchi[1], Satoi Arai[1], Kota Sawada[1], Yumiko Osawa[1], Mai Miyamoto[2], Christopher Gardner Ayer[1] and Bungo Nishizawa[1]

[1] Fisheries Resources Institute, FRA, Japan

[2] Japan NUS

Background

Environmental DNA (eDNA) can non-invasively detect organisms inhabiting environments where direct sampling or observation is difficult, such as the deep-sea floor. For elucidating the effectiveness of eDNA in studying the distribution of deep-sea benthic animals on oceanic seamounts, we conducted eDNA samplings in 2022 and 2023 along the Emperor Seamount chain, which is a prominent fishing ground in the high seas of the central North Pacific Ocean. To test the effectiveness of eDNA-based faunal research for different environments and fauna on the deep-sea floor, the first 2022 samplings were conducted on three relatively shallow southern seamounts, and in 2023, the sampling area was expanded to more northern and deeper seamounts, resulting in seven sampled in total. We primarily focused on fishes, because of the existence of established protocols and rich reference data, and the commercial importance of some species. In addition, we expanded our focus to include cold-water corals (octocorals), which are important but sometimes vulnerable organisms in seamount ecosystems. The eDNA analyses results were compared with the data from direct visual surveys of the seafloors in corresponding sites, and with species records from our previous fishery surveys and publications. We made presentations in PICES-2023 and PICES-2024 to report our findings and demonstrate the potential usefulness of eDNA surveys in the study of biodiversity of fishes and octocorals in challenging environmental conditions, such as the deep-sea, while illustrating some caveats.

Research Summary

In this study, eDNA surveys for fishes were conducted in 2022 and 2023, and for octocorals were conducted in only 2023. After sequence analysis for the eDNA of fishes, those which had agreement > 98.5% with sequences in MitoFish database were chosen as candidates (Iwasaki *et al*., 2013). When multiple species had identical agreement, species with records in Emperor seamounts chain were chosen. For the octocorals it basically followed the fish method, and for primers and other processes, it followed Everett & Park (2018).

The results of eDNA analysis for fishes in 2022 are shown in the top of Table 4.8.1.1. In the results three commercially important fishes (North Pacific Armorhead, Splendid Alfonsino and Oxeye Oreo) were detected in all three seamounts where the surveys were conducted, and also the three fish species were observed by camera survey. On the other hand, eDNA detected the DNA fragments of a much greater number of nekton species than what was observed in visual surveys, suggesting that eDNA has better detection sensitivity. While the results in 2023 for fishes are shown in the lower part of Table 4.8.1.1, and the number of survey stations in 2023 is lower than in 2022, and likewise the number of operational taxonomic units (OTUs) detected is about 100 less than in 2022.

The results of eDNA analysis for octocorals are shown in Table 4.8.1.2. That shows the list of 16 taxa/species (2 orders, at least 6 families), and only *Thouarella laxa* in the list have not been recorded from the Emperor Seamounts chain area.

These results shows that eDNA can be a useful tool to assess and monitor biodiversity associated with seamounts. However, in the future, additional analysis of hexacorals, more reference data on fish and corals in the Emperor Seamount chain area, and denser sampling are needed to achieve even higher accuracy.

Table 4.8.1.1 Summary of sampling and results of eDNA analysis for fishes in 2022 and 2023.

Table 1 - Summary of sampling and results of eDNA analysis for fishes (2022 & 2023)

	Seamount	Depth (m)	Stations	Copies	OTUs	Orders	Families	Spp.
2022 7/22~8/20	Koko	653~678	5	206,968	100	14	32	60
	Colahan	596~795	9	392,157	94	14	30	50
	Yuryaku (All)	475~645	8	401,214	142	14	34	71
	Yuryaku (Y40)	475	1	19,643	19	5	8	14
2023 6/27~7/21	Suiko	949	1	64,373	22	8	11	16
	Yomei	1,338	1	23,117	27	8	12	18
	Nintoku	1,040	1	51,215	32	10	16	23
	Jingu	877	1	28,602	32	8	14	21
	Ojin	1,071	1	28,218	25	8	9	15
	Yuryaku (Y40)	469	1	60,865	35	8	18	26

Table 4.8.1.2 Summary of sampling and results of eDNA analysis for octocorals in 2023.

Table 2 - Summary of sampling and results of eDNA analysis for octocorals (2023)

Order	Family	Taxa/Species	Sampling Location						Records		
			Suiko	Yomei	Nintoku	Jingu	Ojin	Yuryaku	Emperor Seamounts	Hawaii	Central Pacific Ocean
Octocorallia *incertae sedis*	??	Octocorallian species	N	N	**Y**	N	**Y**	N	Y	Y	Y
		Pseudothesea sp.	N	N	N	N	N	**Y**	Y	Y	Y
Malacalcyonacea	??	Malacalcyonacean species	Y	N	N	N	N	**Y**	Y	Y	Y
	Acanthogorgiidae	*Acanthogorgia* spp.	N	N	N	**Y**	**Y**	**Y**	Y	Y	Y
		Anthomuricea tenuispina	N	N	N	N	**Y**	N	N	Y	Y
Scleralcyonacea	Keratoisididae	Keratoisididae spp.	**Y**	**Y**	**Y**	N	**Y**	Y	Y	Y	Y
	Chrysogorgiidae	*Chrysogorgia* spp.	N	N	N	**Y**	**Y**	N	Y	Y	Y
		Chrysogorgia geniculata	N	N	N	**Y**	**Y**	N	N	Y	Y
	Keratoisididae	*Isidella* sp.	N	N	N	N	**Y**	N	Y	Y	Y
	Primnoidae	Primnoidaen species	N	N	N	N	N	**Y**	Y	Y	Y
		Callogorgia spp.	N	N	N	N	N	**Y**	Y	Y	Y
		Calyptrophora spp.	N	N	N	N	N	**Y**	Y	Y	Y
		Paracalyptrophora hawaiinensis	N	N	N	N	N	**Y**	N	Y	Y
		Primnoa sp.	**Y**	N	N	N	N	N	Y	Y	Y
		Thouarella laxa	N	N	N	N	N	**Y**	N	N	N
	Sarcodictyonidae	*Telestula* spp.	N	N	**Y**	**Y**	N	N	Y	Y	Y

4.8.2 Identifying VMEs on Cobb Seamount using visual data and a VME indicator density threshold

What follows are excerpts from the North Pacific Fisheries (NPFC) working paper:

Warawa, Devon R., Rooper, Christopher N., Nephin, Jessica, Chu, Jackson WF, Dudas, Sarah, Knudby, Anders, Georgian, Samuel, and Janelle MR Curtis. (2023). Identifying VMEs on Cobb Seamount using visual data. North Pacific Fisheries Commission NPFC-2023-SSC BFME04-WP13, 8 pp.

Abstract
We identify vulnerable marine ecosystems (VMEs) on Cobb Seamount by applying a quantitative approach to assessing the Food and Agriculture Organization (FAO) criterion of structural complexity for identifying vulnerable marine ecosystems (VMEs) (FAO 2009) developed by Rowden et al. (2020). VMEs are identified using visual data as outlined in the North Pacific Fisheries Commission's (NPFC's) framework for identifying data to identify VMEs (See Annex 2.3 in NPFC 2023a and NPFC 2023b). Using Rowden et al.'s (2020) approach, we calculated a VME density threshold of 0.6 VME indicator taxa colonies m^{-2}. Applying our threshold to visual data from autonomous underwater vehicle (AUV) transects on Cobb Seamount, we identify five areas as VMEs ranging in size from 50 – 200 m^2.

Introduction
Canada's quantitative and repeatable methodology for identifying VMEs in the North Pacific Fisheries Commission's (NPFC's) Convention Area (CA) (Warawa et al. 2022) was endorsed by the NPFC's Scientific Committee in December 2022 (NPFC-SC 2022) and adopted by the NPFC Commission in March 2023 (NPFC 2023c). This working paper applies the adopted methodology to Cobb Seamount in the eastern NPFC CA to identify VMEs where visual data is available.

Canada's method for identifying VMEs is an application of the quantitative approach developed by Rowden et al. (2020), which determines a density threshold of VME indicator taxa above which a VME is present, drawing on FAO's VME criterion of structural complexity (FAO 2009). They identified VME density thresholds for *Solenosmilia variabilis*, a widespread VME indicator species in the South Pacific Regional Fisheries Management Organization (SPRFMO) CA, of 0.11, 0.14, and 0.85 coral heads m^{-2}, at spatial scales of 50 m^2, 25 m^2, and 2 m^2, respectively. They hypothesized that the thresholds used to identify VMEs would likely vary regionally. Hence, we applied their methodology to the Northeast NPFC CA using regional data and VME indicator taxa recognized by the NPFC. See Warawa et al. (2021) and Warawa et al. (2022) for NPFC working papers describing previous iterations of Canada's approach to identifying VMEs.

Data and data processing
Visual data were collected from Cobb Seamount in 2012 in a scientific survey to characterize the benthic community structure (Curtis et al. 2015). Photos were taken using a SeaBED-class autonomous underwater vehicle (AUV) deployed by the National Oceanic and Atmospheric Administration (NOAA), capable of diving to 1,400 m. We used the fully annotated dataset created by NOAA, which consisted of data extracted from 2,614 AUV photos. Photos were taken from four transects with an average length of 1805 m and ranging from 435 – 1154 m in depth. Discernable taxa, including corals, sponges, other invertebrates (but not brittle stars or snails), and fishes were identified and counted (Curtis et al. 2015).

To process the AUV data for analysis, transects were divided into area-standardized segments of 50 m^2 by grouping adjacent photos until a combined area of 50 m^2 was reached. Rowden et al. (2020) suggest that observations made at spatial scales between 25 m^2 and 50 m^2 result in more stable and reliable density estimates because they are more likely to capture whole coral reef patches. The area of each photo varied depending on the distance between the AUV and the seafloor when the photo was captured. We omitted transect segments from our analysis if they were 10 % smaller or larger than our target area (50 m^2) to prevent a large variation in the actual final segment size. This resulted in the removal of 5.6 % (13 out of a total of 234) of transect segments. Each 50 m transect segment group was composed of 5 – 12 AUV photos, depending on the area covered by each photo in the grouping.

Threshold estimation
Generalized additive models (GAMs) fitting associated taxa richness (dependent variable) to VME indicator density (independent variable) were used to estimate the VME thresholds after Rowden et al. (2020). Final model selection was based on the lowest Akaike's Information Criterion (AIC) score, while maintaining low standard error values. The GAMs were fit using a gaussian distribution and an identity link function. Depth was included as predictor variable in order to account for any differences in taxonomic diversity related solely to the changes in depth (e.g. decreases in overall diversity at deeper depths as observed by other studies and meta-analysis (Costello and Chaudhary 2017, Davies and Guinotte 2011 , Georgian et al. 2014). Transect was included as a random effect in the model to account for the potential dependence of observations taken from the same transect. The number of basis functions or inflection points in the smooth terms (k) was assessed to ensure dimension choices were adequate. Model accuracy was estimated using the adjusted R^2 values and model fit was compared using AIC score. The final model formula is shown below, where bs="re" indicates the variable treated as a random effect and s indicates a cubic spline smoother:

Species richness ~ s(VME density) + s(depth) + s(transect, bs="re")

We calculated the VME density threshold from the GAM using the same four methods outlined in Rowden et al. (2020) and used the average as the final threshold value as our estimate of the VME indicator density threshold. The methods include: (1) the point of intersection of linear regressions using the initial and final 5% of data, (2) the point of intersection between a linear regression using the initial 5% of data and the maximum cumulative species richness value, (3) the point on the curve that is closest to the top right corner (0,1), and (4) the point on the curve that maximizes the distance between the curve and the line between extreme points (Youden Index). See Figure S2 in Rowden et al. 2020 for a visual explanation of these methods using hypothetical curves.

Identifying VMEs
We identify areas as VMEs that meet the FAO VME criteria of structural complexity (FAO 2009), where visual data report VME indicator taxa in densities equal to or greater than our regional VME density threshold.

Estimated VME density threshold
The density of VME indicator taxa was calculated for n = 221 50 m^2 segments of the AUV transects on Cobb Seamount. The number of associated species (richness) ranged from 2 to 16 per 50 m^2 transect segment, with a mean of 7.4 (SD = 2.5). The density of VME indicators ranged from 0 to 1.16 colonies m^{-2}, with a mean of 0.15 colonies m^{-2} (SD = 0.19).

Assessment of GAM fit showed the model performed well with an adjusted R^2 of 0.46T. The final average density threshold is 0.6 VME indicator taxa colonies m^{-2} (SD = 0.1, lower 95% CI = 0.5 and upper 95% CI = 0.7).

Identification of VMEs

Only 4.5% of the 50 m^2 transect segments (10 of 221) had VME density values above the threshold of 0.6 VME indicator colonies m^{-2}. This resulted in five VME areas identified as VMEs. VMEs ranged in size from 50 – 200 m^2 and ranged in depth from approximately 500 m to 1150 m. VMEs were identified on two out of the four AUV transects on Cobb Seamount (Figure 4.8.2.1). The largest VME areas occurred in the deepest areas of transect AUV 4. VMEs on transect AUV 4 included colonies of gorgonian corals (290 colonies) with some black corals (45 colonies) and a few glass sponges (13 colonies), while the VME on transect AUV 2 consisted of mainly black corals (30 colonies) and only one gorgonian and one glass sponge. The total area assessed for VMEs in this study was 0.011 km^2 and the total area identified as VMEs was 0.0005 km^2, resulting in 4.5% of assessed area identified as VME.

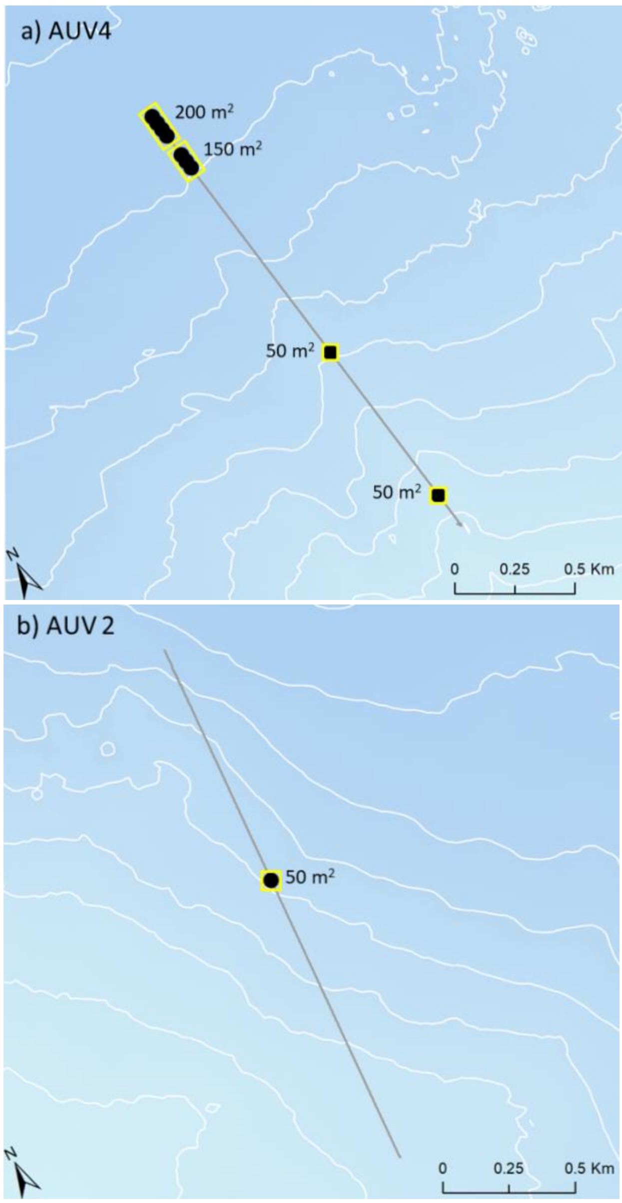

Figure 4.8.2.1. VMEs identified on Cobb Seamount on transect AUV 4 (a) and AUV 2 (b). Yellow boxes surround spatially adjacent transect segments (black dots) grouped into VME areas ranging in size from 50 – 200 m^2. White lines are 100 m depth contour lines and grey lines are AUV transect lines (see Curtis et al. 2015).

4.9 *Use cluster analysis and/or association analysis to review and document ecological interaction among seamount taxa.*

4.9.1 Biogeography of North Pacific Bathyal Seamount Communities: Implications for Locating Marine Protected Areas

Les Watling

University of Hawai`i at Mānoa

Introduction

The first modern analysis of the bathyal biogeography of the Pacific Ocean was based primarily on hydrographic data due to the paucity of biological data (Watling et al., 2013). However, over the years since that paper was written, remotely operated vehicles (ROVs) with high-resolution cameras and frame grabbing capabilities have been used to explore seamounts and ridges in the Central Pacific and Emperor Seamount areas. In all, the NOAA ship Okeanos Explorer used the ROV Deep Discoverer to dive on 72 seamounts, 17 ridges, and 18 island slopes at lower bathyal depths (Kennedy et al 2019). The Schmidt Ocean Institute ship R/V Falkor and ROV Subastian dove on 8 seamounts in the southern and central part of the Emperor Seamount Chain (Watling et al. 2024).

Detailed annotations of videos from the accumulated dives will be used to assess the relative similarity of the bathyal benthic megafaunal assemblages on the seamounts and ridges of the Central and part of the Northern Pacific Ocean. The data will be used to test the proposed biogeographic provinces of the region that were suggested on the basis of hydrography in Watling et al. (2013) and cnidarians in Watling and Lapointe (2022), and from sampling the Emperor Seamounts (Watling et al. 2024).

Methods

For each ROV dive, video was annotated using the VAR program from MBARI. Individuals and colonies were identified to the lowest possible taxonomic level and counted, with location and associated environmental data recorded.

Analysis of similarities of seamount dives at the province-wide scale was conducted using Infomap Bioregions Analysis (https://www.mapequation.org/bioregions/). This method finds networks of associated taxa by geographic grid cell. Preliminary filtering of taxa was based on the following reasons and resulted in many taxa being eliminated from the analysis: they were higher taxonomic categories that likely contained multiple species or genera, e.g., Keratoisidinae, Comatulida; the taxa represented highly mobile pelagic groups, e.g., mysids, Actinopterygii, shrimp; or the category was recorded once or a very few times. The remaining taxa were submitted with their abundance and the coordinates of their occurrence. The submitted records were then assembled into 1˚ squares, with the squares needing to have a minimum of 10 records to enter the network analysis. Each 1˚ square was then assigned to a network group based on the taxa present and their abundance. The network analysis used a cluster cost of 1 for maximum aggregation. The output of the analysis was in the form of shapefiles which were then plotted in ArcGIS 10. To determine which taxa are most characteristic of the network group, an Indicator Index was computed. It is a ratio of the abundance of the taxon in the network group relative to all network groups.

Hierarchical cluster analysis was performed using the routines in Primer7. As with the network analysis, taxa were removed using similar criteria, but records were limited to those remaining taxa that were found more than seven times. Abundance counts of the remaining taxa were square-root transformed, the Bray-Curtis similarity measure was computed to create a resemblance matrix which was then used for cluster analysis based on the group average agglomerative algorithm, with SIMPROF test applied to the clusters to determine the probability of their distinctness. The SIMPER routine was used to determine which taxa contributed the most to each distinct cluster.

Results

The Infomap Bioregions analysis produced four groups, two of which (Hess Rise and Northern Marianas) are each represented by only one 1˚ cell. The two remaining groups represent 1) the five 1˚ cells covering the seamounts north of the Main Gap in the Emperor Seamount Chain, and 2) the 81 1˚ cells from the central part of the North Pacific and the Emperor Seamounts south of the Main Gap. For each region the common total count and the scores for the indicator species are given in Table 4.9.1.1. The distribution of the bioregions is shown in Figure 4.9.1.1.

Table 9.4.1.1. Common and indicator species for the four bioregions defined by the Infomap Bioregions network analysis.

	Central Pacific (81 cells)			
Bioregion	Common Species	Common Species Count	Indicator Species	Indicator Species Score
1	Hemicorallium sp.	2574	Poliopogon sp.	1.04
1	Euryalidae	2258	Candidella gigantea	1.04
1	Poliopogon sp.	1784	Tretopleura sp.	1.04
1	Bathypathes sp.	1257	Stichopathes sp.	1.04
1	Candidella gigantea	1190	Calyptrophora sp.	1.04
1	Plexauridae	1135	Iridogorgia sp.	1.04
1	Chrysogorgia geniculata	1124	Victorgorgia alba	1.04
1	Pleurogorgia militaris	1086	Heteropathes sp.	1.04
1	Paragorgia sp.	1055	Calyptrophora angularis	1.04
1	Stauropathes sp.	915	Hyalonema (Corynonema) sp.	1.04
	Northern Emperor Seamounts (5 cells)			
Bioregion	Common Species	Common Species Count	Indicator Species	Indicator Species Score
2	Crypthelia sp.	362	Calyptrophora cf. clarki	7.42
2	Stylasteridae	293	Primnoa wingi	7.42
2	Lefroyella ceramensis	284	Thalassometra sp.	7.42
2	Walteria sp.	253	Farrea occa	7.42
2	Glyptometra cf. lateralis	222	Hemicorallium cf. niobe	7.42
2	Paragorgia arborea	183	Chaetarcturus cf. beddardi	7.42
2	Farrea nr. occa	182	Candelabridae	7.42
2	Calyptrophora cf. clarki	123	Sebastidae	7.42
2	Rossellidae	116	Paragorgia arborea	7.42
2	Pseudoanthomastus sp.	108	Hydractinia sp.	7.42
	Hess Rise (1 cell)			
Bioregion	Common Species	Common Species Count	Indicator Species	Indicator Species Score
3	Walteria sp.	21	Cetonurus sp.	127.86
3	Aspidodiadema cf. hawaiie	19	Tylaspis sp.	127.86
3	Farrea sp.	11	Trichometra vexator	127.86
3	Trissopathes sp.	11	Mastigoteuthidae	127.86
3	Euryalida	10	Bathygadus antrodes	127.86
3	Paragorgia sp.	9	Asteronyx sp.	79.91
3	Lefroyella ceramensis	9	Heteroptychus sp.	76.71
3	Thalassometridae	9	Euryalida	71.03
3	Paelopatides sp.	8	Radicipes sp.	71.03
3	Farrea nr. occa	8	Asteronychidae	63.93
	North Mariana (1 cell)			
Bioregion	Common Species	Common Species Count	Indicator Species	Indicator Species Score
4	Stylaster sp.	50	Alviniconcha hessleri	53.7
4	Synaphobranchus sp.	20	Conopora unifacialis	53.7
4	Halosauridae	8	Austinograea sp.	53.7
4	Stylasteridae	8	Stylaster sp.	53.7
4	Alviniconcha hessleri	8	Eumunida sp.	30.69
4	Conopora unifacialis	6	Lepidion sp.	26.85
4	Austinograea sp.	6	Neoscopelus macrolepidotus	26.85
4	Eumunida sp.	4	Calyptopora sp.	26.85
4	Lepidion sp.	3	Ventrifossa sp.	17.9
4	Homeryon asper	3	Lamprogrammus sp.	17.9

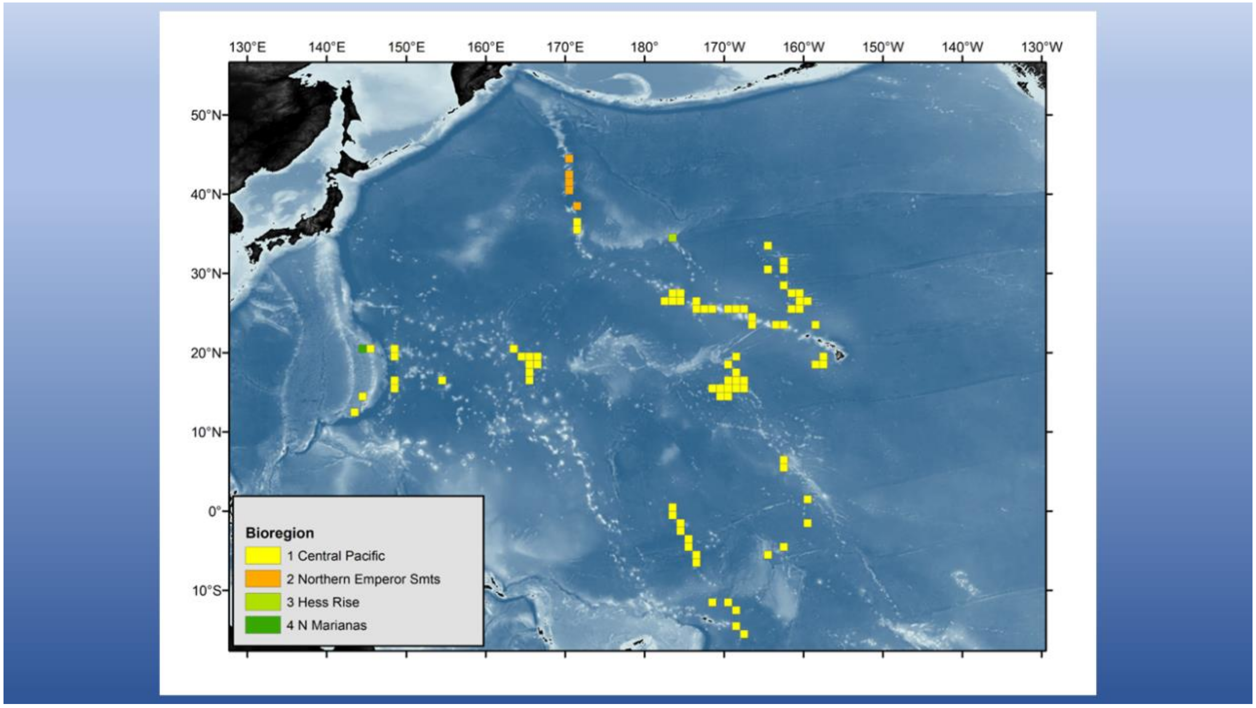

Figure 4.9.1.1. Distribution of Bioregions of the North and Central Pacific resulting from the InfoMap Bioregions analysis.

For the cluster analysis, 107 of the 187 CAPSTONE dives were in the range of the Lower Bathyal (700–3000 m). In addition, 11 Lower Bathyal dives were conducted at Hess Rise and along the Emperor Seamounts. The video annotation produced 536 taxa at various taxonomic levels. Filtering according to the noted criteria removed 297 taxon categories, leaving 239 taxa, most identified to genus, representing a total of 105,023 individuals or colonies at 118 dive locations.

Cluster analysis produced 21 distinct clusters, with several individual dives closely joining some of the distinct clusters. A few clusters, labeled *b*, *n*, *q*, *u*, *w*, *ac*, *af*, and *ag*, comprised 5 or more dives, with cluster *ac* made up of the most dives (13). Clusters *c*, *d*, and *e*, represent the 11 dives of the Emperor Seamounts and Hess Rise. Of the major clusters, *b*, *q*, *w*, and *ac* are the most widespread, while clusters *n*, *u*, *af*, and *ag* were restricted to a narrow range of longitudes in the central part of the North Pacific Ocean. Clusters *c*, *d*, and *e* represent dives along the Emperor Seamounts; those from *c*, and *d*, north of the Main Gap at shallower and deeper depths, respectively, and *e* south of the Main Gaps. See figures 4.9.1.2, 4.9.1.3, and 4.9.1.4. See also Tables 4.9.1.2 to 4.9.1.12 for mean values of environmental and diversity variables associated with the clusters.

Table 9.4.1.2. Mean values of environmental and diversity variables associated with cluster ***ag.***

		ag				
Mean Values			Species	Av.Abund	Contrib%	Cum.%
Depth	1165.80		Plexauridae	6.71	14.56	14.56
Temperature	3.75		Hemicorallium sp.	2.61	5.38	19.94
Oxygen Conc.(ml/l)	2.33		Chrysogorgia sp.	2.44	5.37	25.31
Salinity	34.53		Narella sp.	2.90	5.35	30.66
No. Species	39.55		Iridogorgia magnispiralis	2.06	4.44	35.10
Total Count	354.45		Victorgorgia alba	2.48	4.16	39.26
Evenness (Hill's Ratio)	0.55		Calyptrophora wyvillei	1.94	4.14	43.40
Diversity (J')	0.72		Paragorgia sp.	1.68	3.39	46.79
			Enallopsammia rostrata	3.06	3.29	50.08
			Acanthogorgia sp.	2.20	2.62	52.71
			Chrysogorgia geniculata	1.90	2.46	55.17
			Parazoanthidae	1.07	2.44	57.61
			Actinoscyphia sp.	1.44	2.40	60.01
			Anthomastus sp.	1.35	2.40	62.40
			Chirostylidae	0.88	2.02	64.43

Table 9.4.1.3. Mean values of environmental and diversity variables associated with cluster ***af.***

		af				
Mean Values			Species	Av.Abund	Contrib%	Cum.%
Depth	1829.72		Paragorgia sp.	2.29	5.86	5.86
Temperature	2.55		Plexauridae	2.59	5.81	11.67
Oxygen Conc.(ml/l)	3.12		Ophioplinthaca sp.	1.36	5.51	17.18
Salinity	34.62		Chrysogorgia sp.	1.88	5.45	22.62
No. Species	38.00		Poecilasmatidae	1.74	4.43	27.05
Total Count	225.50		Metallogorgia melanotrichos	1.64	4.35	31.40
Evenness (Hill's Ratio)	0.58		Iridogorgia magnispiralis	1.69	4.33	35.73
Diversity (J')	0.79		Anthomastus sp.	1.79	4.28	40.01
			Hydroidolina	1.53	4.06	44.07
			Parazoanthidae	1.83	3.95	48.02
			Bathypathes sp.	1.24	3.76	51.78
			Brisingidae	1.18	3.69	55.48
			Hemicorallium sp.	1.10	2.64	58.11
			Bassozetus sp.	1.01	2.41	60.52
			Thalassometridae	0.96	2.24	62.76

Table 9.4.1.4. Mean values of environmental and diversity variables associated with cluster ***e***.

		e				
Mean Values			Species	Av.Abund	Contrib%	Cum.%
Depth	1840.27		Farrea nr. occa	5.22	9.92	9.92
Temperature	2.16		Farrea sp.	3.85	7.83	17.74
Oxygen Conc.(ml/l)	2.13		Stylasteridae	8.84	7.68	25.42
Salinity	34.54		Anthomastus sp.	4.90	6.78	32.20
No. Species	55.80		Farreidae	2.91	4.89	37.09
Total Count	721.60		Lefroyella ceramensis	3.65	4.79	41.88
Evenness (Hill's Ratio)	0.57		Chrysogorgia sp.	5.77	4.45	46.33
Diversity (J')	0.77		Munidopsis sp.	1.99	3.81	50.13
			Poecilosclerida	2.40	2.71	52.84
			Paragorgia sp.	2.58	2.47	55.31
			Pseudoanthomastus sp.	5.49	2.35	57.66
			Hemicorallium sp.	2.29	2.15	59.81
			Antipatharia	1.31	2.07	61.88
			Aspidodiadema cf. hawaiiense	2.99	2.04	63.93
			Corbitellinae	2.17	1.92	65.85

Table 9.4.1.5. Mean values of environmental and diversity variables associated with cluster ***u.***

		u				
Mean Values			Species	Av.Abund	Contrib%	Cum.%
Depth	1927.41		Chrysogorgia sp.	11.56	12.74	12.74
Temperature	2.03		Hemicorallium sp.	11.52	12.62	25.36
Oxygen Conc.(ml/l)	2.64		Narella sp.	8.56	8.14	33.50
Salinity	34.61		Candidella gigantea	5.49	5.46	38.95
No. Species	52.17		Acanthogorgia sp.	5.85	4.93	43.89
Total Count	1015.00		Paragorgia sp.	5.99	4.92	48.81
Evenness (Hill's Ratio)	0.60		Chrysogorgia geniculata	5.19	4.46	53.27
Diversity (J')	0.73		Paracalyptrophora sp.	3.45	3.11	56.39
			Jasonisis sp.	3.22	2.77	59.15
			Parazoanthidae	3.42	2.76	61.92
			Poliopogon sp.	2.45	2.12	64.03
			Anthomastus sp.	1.68	1.91	65.94
			Psathyrometra sp.	1.89	1.86	67.80
			Caulophacus sp.	2.20	1.58	69.38
			Munidopsis sp.	1.31	1.47	70.85

Table 9.4.1.6. Mean values of environmental and diversity variables associated with cluster ***w.***

		w				
Mean Values			Species	Av.Abund	Contrib%	Cum.%
Depth	1927.76		Hemicorallium sp.	6.86	7.37	7.37
Temperature	2.14		Chrysogorgia sp.	6.97	7.02	14.40
Oxygen Conc.(ml/l)	3.04		Bathypathes sp.	5.59	5.18	19.57
Salinity	34.62		Paragorgia sp.	4.72	4.29	23.87
No. Species	58.30		Iridogorgia magnispiralis	3.81	4.08	27.94
Total Count	1028.20		Stauropathes sp.	4.54	3.85	31.79
Evenness (Hill's Ratio)	0.54		Pleurogorgia militaris	4.69	3.77	35.56
Diversity (J')	0.75		Poliopogon sp.	4.96	3.55	39.11
			Trissopathes sp.	4.13	3.38	42.49
			Anthomastus sp.	3.52	3.19	45.68
			Acanella weberi	5.36	3.17	48.85
			Psathyrometra sp.	2.80	3.03	51.88
			Chrysogorgia geniculata	3.39	2.91	54.79
			Umbellapathes sp.	3.38	2.91	57.70
			Parazoanthidae	3.53	2.89	60.58

Table 9.4.1.7. Mean values of environmental and diversity variables associated with cluster ***q.***

		q				
Mean Values			Species	Av.Abund	Contrib%	Cum.%
Depth	2129.84		Narella sp.	5.64	9.98	9.98
Temperature	2.00		Tretopleura sp.	5.31	9.18	19.17
Oxygen Conc.(ml/l)	3.31		Poliopogon sp.	4.59	7.89	27.05
Salinity	34.63		Trissopathes sp.	4.65	6.98	34.03
No. Species	42.83		Bathypathes sp.	4.12	6.78	40.82
Total Count	403.00		Chrysogorgia sp.	4.22	6.41	47.22
Evenness (Hill's Ratio)	0.60		Candidella gigantea	3.87	5.91	53.13
Diversity (J')	0.79		Caulophacus sp.	2.62	5.80	58.93
			Antedonidae	1.26	2.78	61.70
			Farrea nr. occa erecta	1.63	2.29	63.99
			Bolosominae	2.05	2.25	66.24
			Actinostolidae	1.16	2.24	68.48
			Dictyaulus sp.	1.31	2.13	70.61

Table 9.4.1.8. Mean values of environmental and diversity variables associated with cluster ***b.***

		b				
Mean Values			Species	Av.Abund	Contrib%	Cum.%
Depth	2260.44		Cladorhizidae	1.18	27.73	27.73
Temperature	2.27		Hydroidolina	0.90	14.54	42.27
Oxygen Conc.(ml/l)	3.51		Bathycrinidae	0.98	14.46	56.72
Salinity	34.61		Hyalonema sp.	1.44	9.99	66.71
No. Species	14.17		Bassozetus sp.	0.57	6.79	73.50
Total Count	51.50					
Evenness (Hill's Ratio)	0.63					
Diversity (J')	0.78					

Table 9.4.1.9. Mean values of environmental and diversity variables associated with cluster ***n.***

		n				
Mean Values			Species	Av.Abund	Contrib%	Cum.%
Depth	2380.81		Chrysogorgia sp.	8.25	16.25	16.25
Temperature	1.75		Pleurogorgia militaris	6.28	10.30	26.55
Oxygen Conc.(ml/l)	3.23		Hemicorallium sp.	5.21	7.66	34.21
Salinity	34.64		Narella sp.	6.18	7.56	41.77
No. Species	39.50		Chrysogorgia geniculata	3.25	5.39	47.16
Total Count	575.17		Stauropathes sp.	4.30	4.20	51.36
Evenness (Hill's Ratio)	0.62		Bolosominae	2.57	4.10	55.45
Diversity (J')	0.73		Poliopogon sp.	3.12	3.98	59.44
			Trissopathes sp.	2.79	3.59	63.03
			Bathypathes sp.	3.42	3.41	66.44
			Anthomastus sp.	4.98	3.27	69.71
			Caulophacus sp.	1.83	2.99	72.70

Table 9.4.1.10. Mean values of environmental and diversity variables associated with cluster ***ac.***

		ac				
Mean Values			Species	Av.Abund	Contrib%	Cum.%
Depth	2469.70		Chrysogorgia sp.	3.29	16.31	16.31
Temperature	1.83		Poliopogon sp.	4.13	14.48	30.79
Oxygen Conc.(ml/l)	3.66		Bolosoma sp.	2.79	7.35	38.14
Salinity	34.65		Narella sp.	2.37	7.06	45.20
No. Species	26.92		Caulophacus sp.	1.86	6.21	51.41
Total Count	184.62		Bolosominae	1.68	5.69	57.10
Evenness (Hill's Ratio)	0.64		Caulophacus (Caulodiscus) sp.	1.60	5.43	62.53
Diversity (J')	0.78		Pleurogorgia militaris	1.78	3.74	66.27
			Caulophacus (Oxydiscus) sp.	1.48	3.62	69.88
			Chrysogorgia geniculata	1.48	3.42	73.30

Table 9.4.1.11. Mean values of environmental and diversity variables associated with cluster ***d.***

		d				
Mean Values			Species	Av.Abund	Contrib%	Cum.%
Depth	1414.82		Gracilechinus cf. multidentatus	22.39	10.35	10.35
Temperature	2.48		Stylasteridae	57.71	9.29	19.64
Oxygen Conc.(ml/l)	1.46		Antipatharia	15.99	8.26	27.90
Salinity	34.46		Paragorgia arborea	14.08	7.00	34.91
No. Species	52.00		Anthomastus sp.	7.21	6.87	41.78
Total Count	11858.25		Lefroyella ceramensis	9.73	6.82	48.60
Evenness (Hill's Ratio)	0.40		Farrea nr. occa	8.00	5.09	53.69
Diversity (J')	0.33		Glyptometra lateralis	6.72	4.76	58.46
			Tretodictyidae	3.70	3.38	61.83
			Parastenella gymnogaster	3.29	2.94	64.77
			Macroregonia macrochira	2.62	2.79	67.56
			Spongiactis sp.	2.64	2.23	69.79
			Stauropathes sp.	2.84	2.03	71.83

Table 9.4.1.12. Mean values of environmental and diversity variables associated with cluster ***c.***

		c				
Mean Values			Species	Av.Abund	Contrib%	Cum.%
Depth	2012.93		Crypthelia sp.	64.89	33.85	33.85
Temperature	1.93		Umbellapathes sp.	5.1	6.7	40.55
Oxygen Conc.(ml/l)	2.70		Alcyoniidae	4.32	6.08	46.63
Salinity	34.59		Stauropathes sp.	5.19	3.98	50.62
No. Species	50.00		Corbitellinae	3.18	3.63	54.25
Total Count	7267.50		Macroregonia macrochira	2.34	3.63	57.88
Evenness (Hill's Ratio)	0.44		Poecilosclerida	4.55	3.63	61.52
Diversity (J')	0.31		Caryophylliidae	2.09	2.81	64.33
			Gorgonocephalidae	6.25	2.81	67.15
			Pseudoanthomastus sp.	4.14	2.81	69.96
			Caulophacus sp.	1.57	2.3	72.26

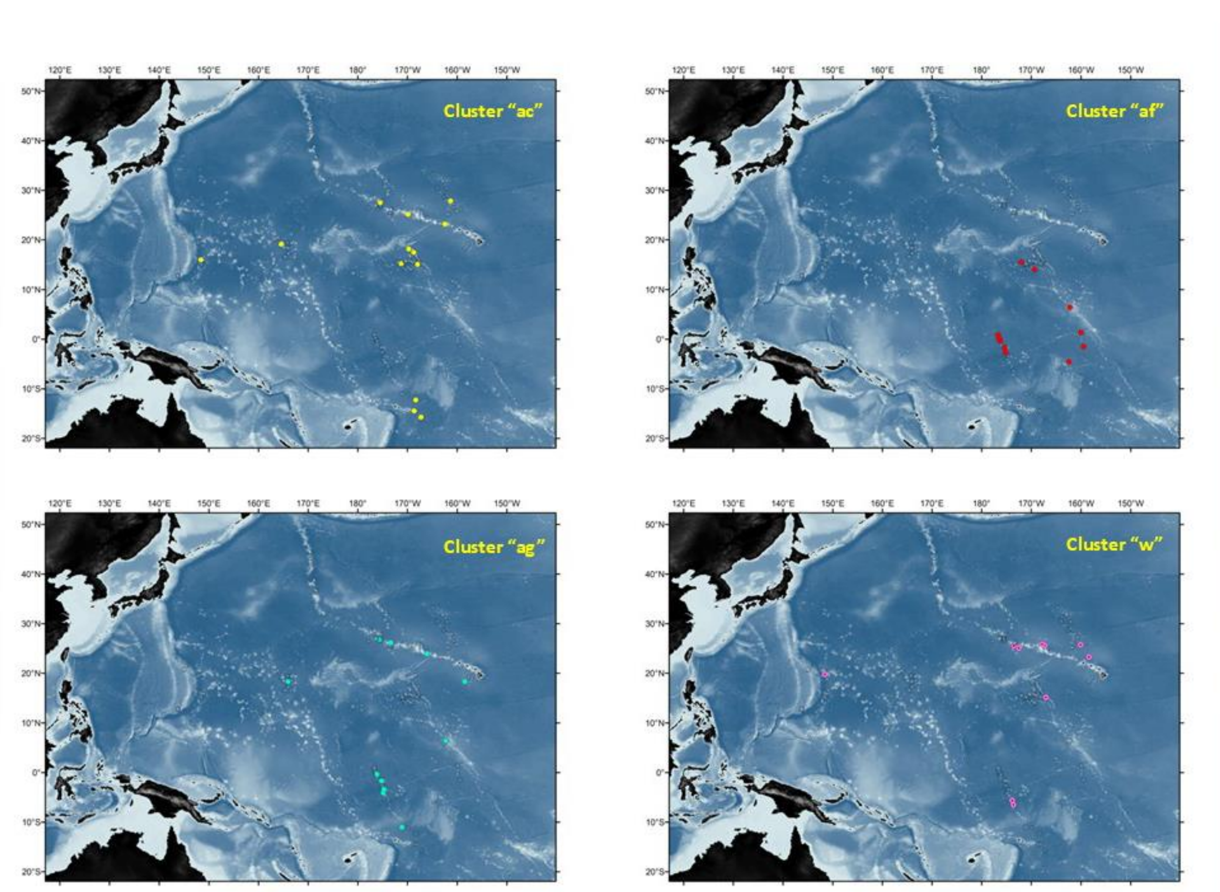

Figure 4.9.1.2. Location of dives in clusters ***ac***, ***af***, ***ag***, and ***w***.

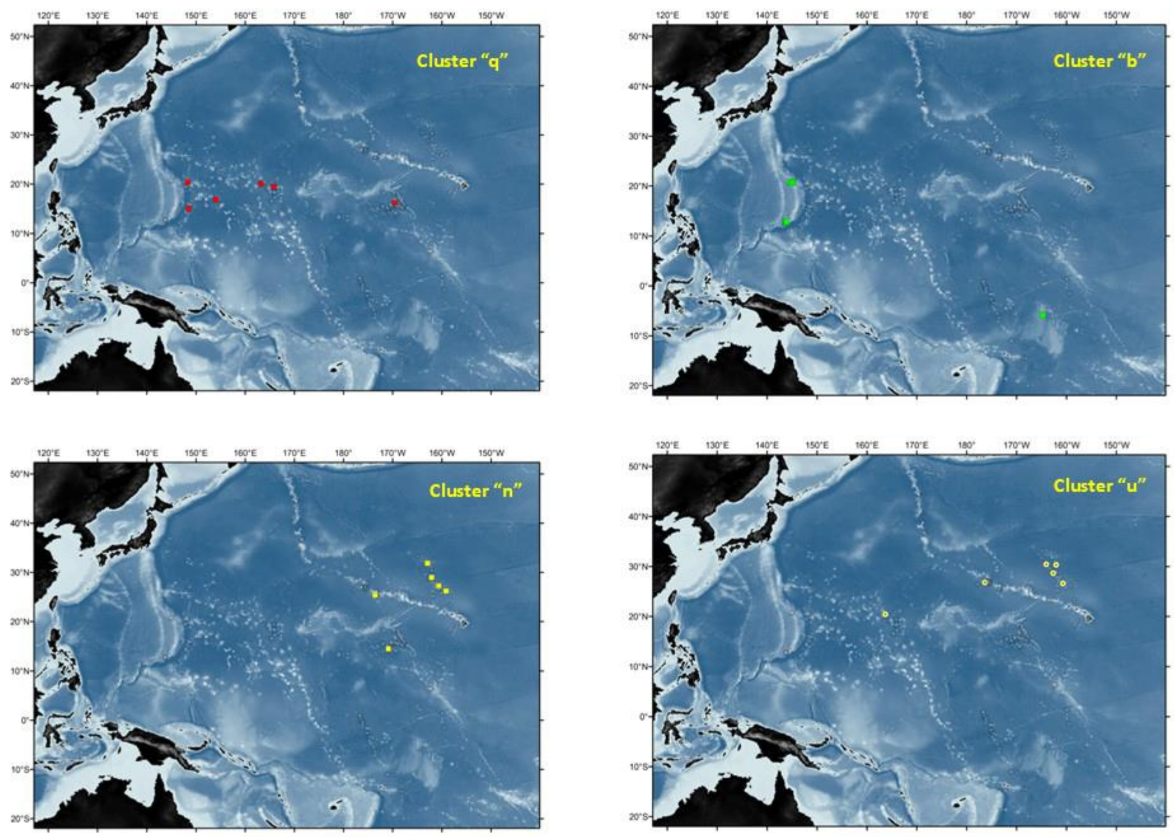

Figure 4.9.1.3. Locations of dives in clusters ***q***, ***b***, ***n***, and ***u***.

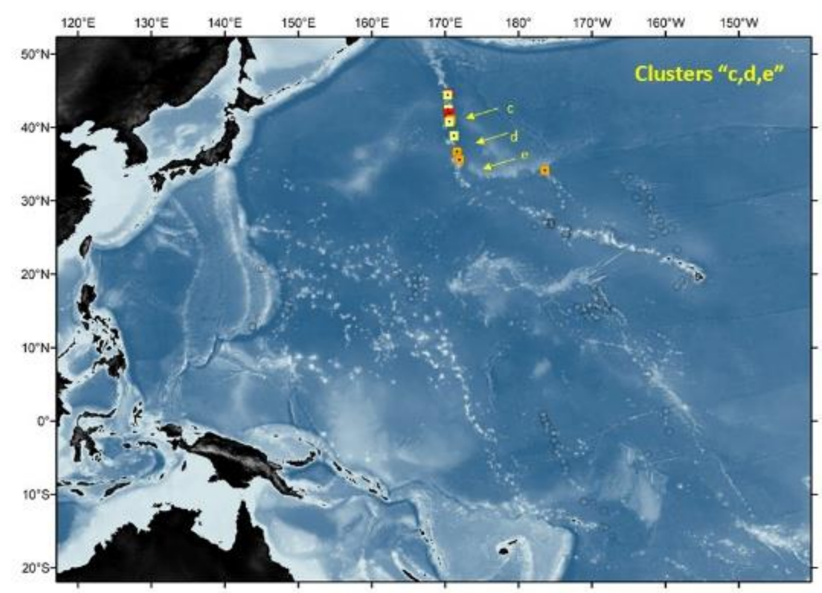

Figure 4.9.1.4. Location of dives in clusters ***c***, ***d***, ***e***.

Discussion

The Infomap Bioregions analysis suggested that the whole of the Central Pacific is one large biogeographic unit at bathyal depths. That is partly due to the settings chosen for the analysis. Altering some settings, such as changing the cluster factor, produces a higher number of bioregions as the network is further subdivided. Using the new Infomap Bioregions 2, where the degree of aggregation of the cells is variable and can be controlled by the user, produces a mostly similar result (Fig. 4.9.1.5) to the output from version 1 with a cluster , including a low number of bioregions with a strong division at the Main Gap of the Emperor Seamounts and primarily one large bioregion encompassing nearly the whole of the Central Pacific. The uniqueness of the Hess Rise bioregion is also maintained.

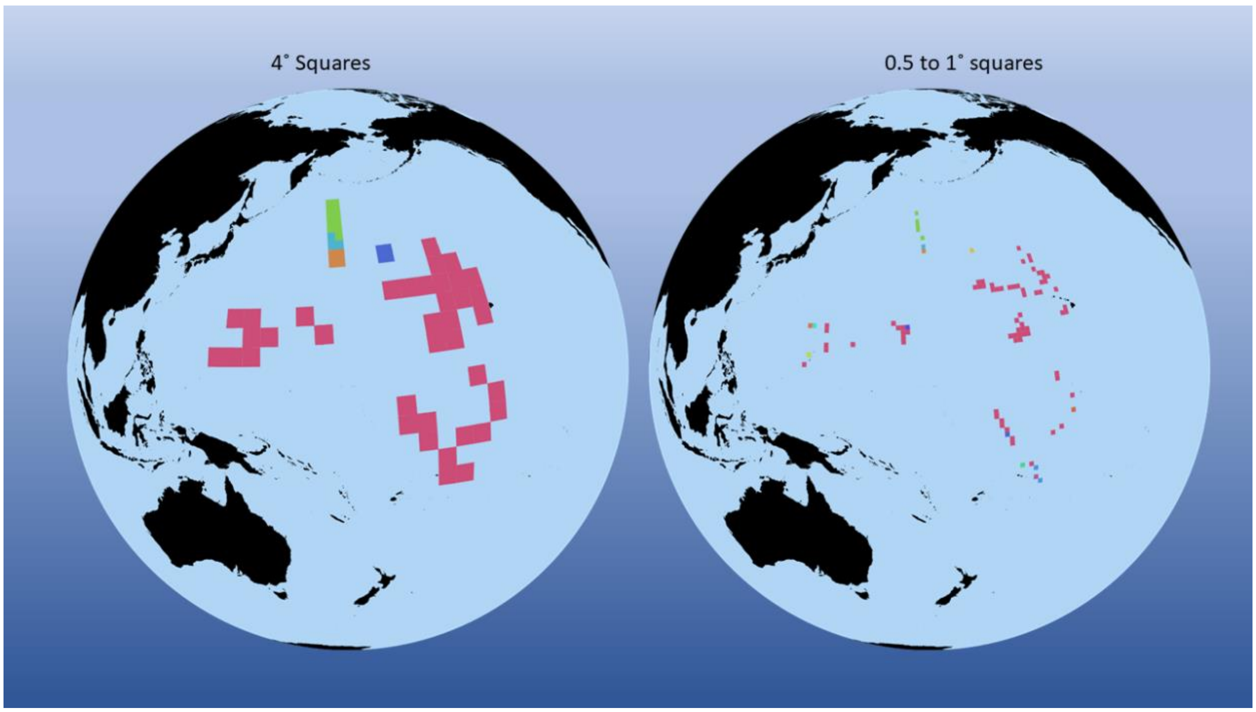

Figure 4.9.1.5. Output from Infomap Bioregions ver. 2 of the CAPSTONE and Emperor edited bathyal records dataset. When the network results are aggregated into 4˚squares, there are five bioregions, but when the results are aggregated at the level of 1˚ squares, the dive sites are assigned to 13 bioregions.

Hierarchical cluster analysis with the SIMPROF routine can be used to examine the subdivisions within the large Central Pacific cluster. Excluding clusters c and d which are north of the Main Gap and thus part of the North Pacific Province (Watling et al 2024), and cluster e, which seems to represent a transitional area between the two major Pacific provinces, most of the other cluster units are widespread, although several are represented by only a few dives. A major caveat is that many of the "major" clusters are represented by 5 – 7 dives, sometimes with large distances between one of the dives and the others in the cluster. As a result, the dominance of several taxa seems to determine the membership in one cluster or another. That is, there is considerable patchiness that is captured by the dives, but there are not yet a sufficient number of dives to help understand what is the causal factor. On the other hand, the network analysis shows that when taking a large enough view, all those patches contribute to the overall characterization of the Central Pacific fauna.

Also seen in the cluster analysis is the effect of depth on the overall taxonomic resolution for some groups, especially the sponges, which are not as well studied to date as are the octocorals. Therefore, some of the cluster analysis and network analysis results might be biased by the low resolution of several of the taxonomic categories, i.e., those identified to the level of genus (larger unresolved categories were mostly removed from the analysis). Even so, it seems doubtful that the Central Pacific Province, at bathyal depths, will be subdivided with better taxonomic resolution. On the other hand, there does seem to be some evidence that the Central Pacific Province extends beyond the limits of sampling in the CAPSTONE program. Several new species that have been and are being described from the area of the South China Sea are identical genetically to those from the area of the Hawaiian Ridge (e.g., Xu et al. 2024, Wang et al. 2024).

4.10 Prepare scientific reports for dissemination of results.

This TOR has been completed. Canada published a series of working papers about seamounts in the northeast Pacific Ocean to the North Pacific Fisheries Commission (NPFC) in 2021, 2022, and 2023. Most WG 47 members published primary papers or reports that address this TOR. See Related Publications on page 54 of this report.

5 Conclusions and Next Steps

The work of WG 47 has advanced our knowledge of the diversity, distribution, and associations of seamount taxa in the North Pacific Ocean, where seamounts are unique and abundant features yet relatively unknown. This working group gathered knowledge on seamount taxa with a particular focus on deep-sea corals, sponges, and fishes, and submitted some of their data to publicly accessible databases. The World Ocean Atlas data compiled by WG 32 on the Biodiversity of Biogenic Habitats was updated for use by members of WG 47 and the dataset was used to predict the distribution of benthic species on seamounts in the eastern part of the North Pacific Fisheries Commission's Convention Area. WG 47 convened a workshop on predicting the distributions of species associated with seamounts at PICES 2022 and a session on seamount biodiversity at PICES 2023. Several members used predictive habitat models to predict the distribution of benthic biodiversity. Indicators of seamount biodiversity included e-DNA and VME indicator density thresholds. Data have been collected for potential association analysis in the future and large-scale biogeographic patterns were identified with cluster analyses. This working group also produced maps of the distribution of seamount taxa and biodiversity indicators, including those of vulnerable marine ecosystems (VMEs), that could be used to monitor change. And members contributed to the co-authorship of more than 20 scientific publications (see Related publications in the next section). Because most WG 47 had an interest and expertise in the ecology of demersal or benthic fauna, most TOR were partially addressed with a focus on benthic and/or demersal taxa; therefore the ecology of pelagic species associated with seamounts were not addressed. Also, WG 47 members had insufficient time and capacity to address its term of reference to "Use available data to predict climate-induced changes in the distribution of seamount fauna."

Enhancing our community's ability to better document and/or predict where diverse biogenic habitats occur is an important precursor to understanding how these habitats support other elements of the ecosystem, including commercially valuable species.

A focus on seamounts is a relatively new research avenue for PICES with clear linkages to the activities of other PICES expert groups, including BIO Committee and FIS Committee, and future PICES activities related to seamount research would support the PICES-NPFC Framework for Enhanced Scientific Collaboration in the North Pacific Ocean (where NPFC = North Pacific Fisheries Commission). WG 47 members and some observers at its 2024 business meetings discussed the merits of establishing one or more PICES expert groups on the following topics:

- Use of available data to predict climate-induced changes in the distributions of seamount fauna.
- Identification of VMEs and areas likely to be VMEs in areas beyond national jurisdiction (ABNJ) of the North Pacific Ocean and/or assessing the relative risk of significant adverse impacts (SAI) to those VME areas.
- Improving our understanding of the life history of seamount taxa, with an emphasis on reproduction and connectivity, and a better integration of biology and physics

6 Related publications

Dautova, Tatiana N. (2025) Introduction to the Emperor Seamount Chain studies. Deep Sea Research Part II: Topical Studies in Oceanography, Volume 222, September 2025 105486, https://doi.org/10.1016/j.dsr2.2025.105486

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Appendix 1

WG 34 Terms of Reference

WG 34 term: 2015–2018
Extended 1 year to 2019
Parent Committee: FIS

The Secretariat will add TORs, membership, Annual Reports and PICES Press articles, but please add other items if applicable.