GC Appendix A

2021 Governing Council Decisions

The following Governing Council Decisions were taken at the PICES-2021 Virtual Governing Council Meeting, held November1-3 2021.

2021/A/1: Annual Contributions.

i. Council re-iterated the importance for all Contracting Parties to pay the Annual Fee by the January 1 deadline and confirmed that, for planning of their funding requests for annual contributions, Contracting Parties should continue to use the guideline generally accepted at PICES-1999 (Decision 1999/A/2(ii)), which states that the annual contributions will increase at the rate of inflation in Canada.

ii. Council instructs the Executive Secretary to send letters to all Contracting Parties requesting payments of Annual Fees as soon as practical following the Annual Meeting.

2021/A/2: Voluntary Contributions for the Intern Program and Capacity Building

i. Council instructs the Executive Secretary to invite Contracting Parties to provide voluntary contributions to the Trust Fund to support the Intern Program and capacity building activities in 2022 and beyond.
ii. Council noted that owing to the COVID-19 pandemic Russia is now unable to send an intern in spring 2022 and requested a one-year postponement.

2021/A/3. Auditor's Report.

iii. Council accepted the audited accounts for FY 2020.
iv. Council instructs the Executive Secretary to sign a new 3-year contract (for FY2021-2023) with the current auditor Hughesman, Morris and Liversedge.

2021/A/4: Budgetary Considerations

i. Council approved the proposed FY 2022 budget of $1,142,000 and set the annual fees for 2022 at $148,900. This total is comprised of the Regular Annual Fee of $140,900 and an additional temporary Extraordinary Contribution of $8,000 to address the pension plan liability. A transfer from the Working Capital Fund to the General Fund of $248,600 on Jan 1st 2022 will be required to balance the budget.

ii. To address the pension plan liability, Council recommends that each Contracting Party make an additional $8000 Extraordinary Contribution for FY2022 and that the Extraordinary Contribution shall continue until pension plan liability is extinguished. Parties are requested to confirm their intention to provide this contribution in 2021 no later than the end of February 2022 to complete budget planning. The temporary fee portion will not be subject to inflation adjustment in subsequent years and will terminate when the pension plan liability is discharged.

iii. Working Capital Fund changes:

a) Council instructs that the Encumbered Fund "4th Effects of Climate Change on the World's Oceans – 2018" be renamed as the "5th Effects of Climate Change on the World's Ocean - 2023" and its residual funds used to support the Symposium planned for 2023.

b) Council instructs that the Encumbered USA Reserve Fund be renamed as the ICES-PICES-2023-USA Reserve Fund.

2021/A/5. Financial Reserve Planning.

Council requests that the Executive Secretary continue to report the Working Capital Fund reserve each year as a proportion of a Contracting Party's annual fee with the goal of maintaining a reserve of about twice a single Contracting Party's annual contribution. Furthermore, Council requests that the Executive Secretary continue to explore different reserve strategies and potential mechanisms to maintain the reserve, and report to the Finance and Administration Committee at PICES-2022.

2021/A/6: Future PICES Annual Meetings and 2022 Inter-sessional Science Board meeting

i. Council approved the current registration fee structure for PICES-2022:

Type of registration fee	CAD $
Regular	325
Early	250
Student	50
Spousal/guest	50

ii. Council invites Russia to explore the possibility of hosting PICES-2024 and inform the Secretariat on this matter by March 31, 2022.

iii. Council accepted the recommendation of the Finance and Administration Committee to be mindful of reducing carbon emissions from PICES activities as much as possible and so supports the request by Science Board for virtual Intersessional Science Board meetings each year (unless there is another in-person event it can be held in conjunction with that involves many Science Board members).

2021/A/7: Code of Ethics for the Operations of PICES

Council adopted the Code of Ethics presented by the Finance and Administration Committee and requested the Executive Secretary to add it to the list of PICES policies and include it in the Chair's Handbook, noting there that "The policy has been drawn up in the spirit of respect and inclusivity and is an expectation rather than a Rule of Procedure. It does not replace, or supersede, the

rules/guidelines/conflict of interest policies or procedures in an individual's place of employment or study. PICES participants who feel that they have been the recipient of a breach of the Code during a PICES event should raise this with their National Delegate who can inform Council". Council noted that the policy should be reviewed every 5 years to ensure the wording is still adequate.

PICES Ethics Policy: *PICES is committed to:*

• Providing a welcoming and inclusive environment, that encourages all staff, members and guests to aspire to principles of integrity and respect in their interactions and to maintain a respectful environment free from harassment and discrimination (harassment includes speech or behavior that is not welcome or is personally offensive, regardless of intent).

• Respecting the human rights, and worth of all persons regardless of age, physical appearance, gender expression, sexual orientation, ethnicity, religion or other group identity or political beliefs.

• Conducting the work of the Organization with integrity. Members should strive to encourage diverse voices and the full participation of all, not to misrepresent results, to not plagiarize and to appropriately acknowledge contributions of others.

2021/A/8: PICES Chair Award

Council encourages members to consider nominations for the 2022 PICES Chair award. The deadline for nominations is July 30, 2022 and supporting documentation should be sent to the Executive Secretary.

2021/A/9: Seeking UN Observer status for PICES

Council requested a deeper understanding of the role of a UN Observer and instructs the Executive Secretary to work with the Chair to compile relevant information and provide a report at PICES-2022 where the proposal will be further discussed.

2021/A/10: External Review of the Organization

Council considered the need to commission a review of PICES to ensure that it is evolving in line with global marine science priorities and to give confidence to Contracting Parties that their resources are effectively used. Council agreed to form a Study Group (SG-External Review) comprising the Chair, Executive Secretary and one member from each Contracting Party to draft Terms of Reference for an external review of the Organization and provide them to Council.

2021/A/11: Science Products

Council reviewed the publication metrics presented, and discussed additional scientific products and the potential for advice. In order to consider the needs of Contracting Parties for other outputs and services Council instructed the Executive Secretary to:

- Review the expected outputs and deliverables from recently approved Expert Groups (such as AP-SciCom, WG49 [WG-Extremes]) and the UNDOS Program SMARTNET.
- Explore with each Contracting Party their needs for specific products and preferences.
- Compile a report on the above, as well as the feasibility and resource implications for the Secretariat to deliver the preferred services.
- The report to be presented to the Finance and Administration Committee at PICES-2022 for discussion and further recommendations.

2021/S/1 *This Decision taken inter-sessionally and reported separately*

2021/S/2 *This Decision taken inter-sessionally and reported separately*

2021/S/3 *This Decision taken inter-sessionally and reported separately*

2021/S/4 *This Decision taken inter-sessionally and reported separately*

2021/S/5: Special Project BECI

Council approved continued development of the NPAFC/BECI program, and that NPAFC/BECI be requested to submit a full proposal for consideration as a PICES Special Project.

2021/S/6: Letter of Recognition for Individual's Service to PICES

Council reviewed the recommendation from Science Board that all Expert Group members be able to request a letter of recognition, signed by the Chair and Executive Secretary, indicating their participation in the organization that could be provided to their supervisor. Council instructs Science Board to work with the Secretariat to prepare a letter template and procedure guidelines at ISB-2022 that can be reviewed by Council.

2021/S/7: Participation at EXPO2025

Council requests that Science Board and the Secretariat continue to explore options for PICES participation at EXPO2025 and provide recommendations on the feasibility and costs of a PICES display and/or an academic event either separately from, or in conjunction with, PICES-2025.

2021/S/8: Amendment to Rules 13 and 15 of the Rules of Procedure

Council approved modifications to Rules of procedure 13 and 15 to reflect current practices, so that the wording of:

Rule 13iv will now read "An *Advisory Panel* is a group of scientists established by the Science Board, with approval by the Council, to coordinate and/or provide scientific advice on the activities of Scientific Committees and/or the Scientific Program", and "A *Working Group* is a group of scientists, generally established by a Scientific Committee or Scientific Program, for a period of

typically three years, to undertake specific terms of reference and to report to the Organization on their findings."

Rule 15iii will now read "shall establish at least one Chair according to Rule 17"

2021/S/9: Chair and membership changes for Science Board, Standing Committees and Expert Groups:

i. Dr Sukyung Kang will serve as Science Board Chair-Elect and her term official term as Science Board Chair will begin at the conclusion of PICES-2022
ii. Dr. Igor Shevchenko (Russia) was re-elected for a third 1-year term as Vice-Chair of Science Board
iii. Dr Guangshui Na was re-elected for a 2nd term as Chair of the MEQ Committee
iv. Dr Andrew Ross was re-elected for a 2nd term as Vice-Chair of the MEQ Committee
v. Dr Fangfang Wan was elected for a 1st term as Vice-Chair of TCODE, replacing Mr Peter Chandler
vi. Dr Jennifer Jackson was elected for a 1st term as Vice-Chair of the POC Committee replacing Dr Yuri Zuenko

2020/S/10 Current Expert Groups.

Council approved the following changes to existing Expert Groups:

i. The SG-SciCom: Study Group on Science Communications will be disbanded on completion of their final report
ii. SG-ECOP: Study Group on Early Career Ocean Professionals will be disbanded on completion of their final report
iii. WG35: Working Group on Third North Pacific Ecosystem Status Report (WG-NPESR3) will be disbanded on completion of their final report
iv. WG36: Working Group on Common Ecosystem Reference Points across PICES Member Countries will be disbanded on completion of their final report
v. WG37: Working Group on Zooplankton Production Methodologies, Applications and Measurements in PICES Regions will be disbanded on completion of their final report
vi. WG38: Working Group on Mesoscale and Sub-mesoscale Processes will be disbanded on completion of their final report
vii. WG40: Working Group on Climate and Ecosystem Predictability will be disbanded on completion of their final report
viii. WG41: Working Group on Marine Ecosystem Services will be disbanded on completion of their final report
ix. A 6-month extension of SG-UNDOS: Study Group on United Nations Decade of Ocean Science to Feb 2022 to (a) complete development of SMARTNET Implementation Plan and (b) develop a proposal for a follow-on PICES Expert Group.
x. A 1-year extension of WG39: Joint PICES/ICES/PAME Working Group on an Integrated Ecosystem Assessment for the Central Arctic Ocean to PICES-2022 to complete its Terms of Reference and create a proposal to address future research in this area.
xi. A 1-year extension of WG42: Indicators of Marine Plastic Pollution to PICES-2022, to finalize the final and synthesis reports, and to create a plan and proposal to address future research needs in this area.

xii. A 2-year Extension of WG43: Joint PICES/ICES Working Group on Small Pelagic Fish (FIS) to PICES-2023, to complete two manuscripts for peer-reviewed journals, to facilitate completion of the SPF Symposium planning organized by the WG (now delayed to November 2022) and to publish the results/products resulting from the symposium.

2021/S/11 New Expert Groups.

Council approved the establishment of the following new Expert Groups, with Terms of Reference as described in GC Appendix B:

i. Joint PICES-Pacific Salmon Commission Study Group on Scientific Cooperation in the North Pacific Ocean, SG-SCPSC
ii. Working Group on Climate Extremes and Coastal Impacts in the Pacific, WG49, with a five-year term.
iii. Working Group on Sub-mesoscale Processes and Ecosystems, WG50.

Council approved the establishment of the following new Advisory Panels, pending modification of their Terms of Reference as presented in GC Appendix B. Council also emphasises that ToRs be modified to reflect changes in the co-parent Science Program when they occur, which may be earlier than 5 years from establishment:

iv. Advisory Panel on Science Communications, AP-SciCom. Modify the Terms of Reference to exclude the creation of a new award.
v. Advisory Panel on Early Career Ocean Professionals, AP-ECOP. Modify the Terms of Reference to align the definition of ECOP with the PICES ECS definition.

2021/S/12: Changes to Expert Group work plans.

Council approved the revised Terms of Reference for the Section on Carbon and Climate (S-CC) (GC Appendix C) and term renewal from 2022-2027.

2021/S/13: Publications

The following publications are to be added to the PICES website as PICES products when completed:

i. Hallegraeff, G.M., Anderson, D.M., Belin, C. et al. Perceived global increase in algal blooms is attributable to intensified monitoring and emerging bloom impacts. Nature Commun, Earth Environ 2, 117 (2021). https://doi.org/10.1038/s43247-021-00178-8

ii. Council additionally approved US$2500 for Open Access fees for Jennifer L. Boldt, Elliott L. Hazen, Mary E. Hunsicker, Caihong Fu, R. Ian Perry, Xiujuan Shan. Quantifying ecosystem responses to environmental and human pressures in the marine ecosystem off the west coast of Vancouver Island. Ecological Indicators,Vol. 132, 2021. https://doi.org/10.1016/j.ecolind.2021.108232. (WG36)

iii. Peck, MA, J Alheit, A Bertrand, IA Catalán, S Garrido, M Moyano, RR Rykaczewski, A Takasuka, and CD van der Lingen. 2021. Small pelagic fish in the new millennium: a bottom-up

view of global research effort. Progress in Oceanography 191:102494, doi:10.1016/j.pocean.2020.102494. (WG43)

iv. Carsten Hvingel, Bernard Sainte-Marie, Gordon H Kruse, Cold-water shellfish as harvestable resources and important ecosystem players, ICES Journal of Marine Science, Volume 78, Issue 2, March 2021, Pages 479–490. https://doi.org/10.1093/icesjms/fsab005 (FIS)

v. Final Report of WG37 to be published as a PICES Scientific Report.

2020/S/14: PICES 2022

i. The following scientific sessions are to be convened at PICES-2022:

- **½ Day Session:** Marine Ecosystem Services – Connecting Science to Decision Making and/or
- **1 Day Session:** Realizing scalable artificial intelligence in marine science and/or Machine Learning for the North Pacific Environment
  Convenors of these two sessions are asked to explore combining or collaborating with each other for these sessions.

- **1 Day Session:** Application and best practice of imaging technologies for plankton and ecosystem monitoring.
- **1 Day Session:** Environmental variability and small pelagic fishes in the North Pacific: exploring mechanistic and pragmatic methods for integrating ecosystem considerations into assessment and management.
- **1 Day Session:** Forecasting and projecting climate variability and change on northern hemisphere marine ecosystems using coupled next generation biophysical models.
- **1 Day Session:** Recognizing the importance of zooplankton to fisheries research.
- **½ Day Session:** The effects of ocean acidification and climate change stressors on the ecophysiology and toxicity of harmful algal species.

- Conditional on new information and novel papers from the PICES-2020 session, a **1 Day Session**: Using eDNA to assess and manage non-indigenous species in the North Pacific.

ii. The following workshops are to be convened at PICES-2022:

- **2-day Workshop:** Distributions of pelagic, demersal, and benthic species associated with seamounts in the North Pacific Ocean and factors influencing their distributions.
- **1-day Workshop**: Integrated Ecosystem Assessment (IEA) to understand the present and future of the Central Arctic Ocean (CAO) and Northern Bering and Chukchi Seas (NBS-CS).
  (Convenors requested to consider including other partners (such as PAME) and the Executive Secretary to follow up with ICES to determine if they wish to co-sponsor this workshop).
- **1-day Workshop**: SMARTNET: Promoting PICES and ICES Leadership in the UN Decade of Ocean Science for Sustainable Development.
  (Convenors requested to consider collaborating with APN and other organizations that might enhance the opportunity for inclusion/diversity)
- **1-day Workshop**: Establishing a North Pacific ECOP node of the global ECOP program to increase inter-regional early career engagement and partnerships during the Ocean Decade.
  (Convenors requested to explore the opportunity to collaborate with proposed SMARTNET workshop, and possibly integrate the two.)

- **1-day Workshop**: Integrating biological research, fisheries science and management of broadly distributed flatfish species across the North Pacific Ocean in the face of climate and environmental variability.
  (Convenors requested to review PICES Expert Groups to identify additional collaboration for this workshop).
- **1-day Workshop**: Bridging Multiple Ways of Knowing within an Integrated Ecosystem Assessment to understand the social and ecological changes in the Northern Bering and Chukchi Seas.
- **1-day Workshop**: Anthropogenic stressors, mechanisms and potential impacts on Marine Birds, Mammals, and Sea Turtles.
- **1-day Workshop**: Science Communication Training Workshop 2022: Learn how to Share our PICES Science with the World in an engaging way.
- **1-day Workshop**: The Expansion of Harmful Algal Blooms (HABs) from lower to higher latitudes.
- **1-day Workshop**: Openly Discoverable, Accessible, and Reusable Data and Information in the U.N. Decade. *(Convenors requested to collaborate with SMARTNET and ECOP workshops).*

iii. The following Business Meetings are to be held at PICES-2022 but it is recommended that Expert Groups hold virtual business meetings wherever possible:
  - **½-day** Business meetings for WG47, AP-NPCOOS, AP-CREAMS
  - **1-day** Business meetings for WG43, WG44, WG45, WG49, S-CCME,
  - **2-day** Business meeting for FUTURE SSC
  - Scientific and Executive Committees will also hold business meetings at PICES-2022 (duration as needed; 0.75 day for Scientific Committees, 2 days for SB, 1-day for F&A, 2 days for GC)

2021/S/15: Intersessional meetings, workshops and Symposia

Council approved the following intersessional events, to be held virtually, with hosting support of the Secretariat if needed:

- 1-day *VIRTUAL Intersessional Workshop***:** S-CCME/SICCME Virtual Workshop on Integrated Climate Modeling to identify thresholds, limits, and tipping points in marine ecosystems: current progress and future needs. S-CCME also to hold a 1-day virtual business meeting in conjunction with the workshop.

- 2 half day S-CCME meetings to review and summarize observed and projected ecosystem tipping points and thresholds in marine systems using case studies from S-CCME member projects.

- Science Board will hold a 3-day Inter-sessional meeting in Apr-May 2022

- FUTURE-SSC will hold a 3-day Inter-Sessional meeting in Apr-May 2022

- WG39 Inter-sessional meeting. Spring Meeting of the ICES/PICES/PAME Working Group on Integrated Ecosystem Assessment for the Central Arctic Ocean (WGICA). Mid-April, 2022 (date TBC), Sponsors: ICES, PAME, PICES.

- WG49 will hold a virtual one-day business meeting (date TBC).

2021/S/16: Requests for support

Council approved registration fee support for an ECS to attend and present at Ocean Sciences Meeting, February 2022 (now entirely virtual)

2021/S/17: Capacity Building Activities

The following activities were approved at PICES-2019 or PICES-2020 but are included here to note the change in format to reflect the COVID-19 pandemic impacts. Support was deferred and has not been increased.

Requesting Group	**Request**	**Cost**
AP-CREAMS (MONITOR)	2021 summer school of data analysis of satellite observations (webinar) - Nov 30-Dec 2; Dec 14-Dec 16 Virtual.	No funding request *originally submitted as an in-person event at PICES-2019
AP-CREAMS	Summer school on Ocean turbulence (Prof. Yu Fei, Qingdao, China, Summer 2022)	$9000USD *originally approved at 2020 SB/GC, but deferred.
AP-NPCOOS	Ocean big data virtual summer school (Aug. 2022) Pre-recorded lectures relevant to data sets contributed from individual member countries; ONC hosts the datasets and virtual machine. Online materials to present analytic methods and tools. Real-time tutorial groups	$15,000 CAD *approved as in-person event at 2019 SB/GC and deferred.

GC Appendix B
New Expert Group Proposals

Proposed SG-PSC- Joint PICES-PSC Study Group on Scientific Cooperation in the North Pacific Ocean

Acronym: SG-SCPSC

Parent Committee: SB

PICES Co-Chair: Jackie King

PSC Co-Chair:

Background:

The North Pacific Marine Science Organization (PICES) and Pacific Salmon Commission (PSC) are Intergovernmental Organizations with a shared interest in Pacific salmon productivity and overlapping geographic areas of focus. A more formal relationship would be mutually beneficial; PICES could provide access to relevant marine ecosystem science through platforms such as workshops and topic sessions at Annual meetings and the PSC can provide a salmon research focus and access to salmon data for PICES scientists. Improvements in our understanding of climate change and marine factors affecting Pacific Salmon population dynamics can lead to advancements in population modeling and stock assessment research. The improved collaboration should allow PICES and PSC scientists to add value to their science, provide synergies on regional and global issues, and enhance the visibility of both Organizations.

The collaboration would contribute to the success of both Organizations by:

- enhancing the current understanding of Pacific Salmon status and trends, climate change impacts and associated management implications;
- promoting the collection of, and access to, data, models and other information; and
- identifying gaps in knowledge and needs that should be addressed.

At the PICES 2020 Annual Meeting, the FIS Committee recommended pursuing the development of a PICES–PSC Framework for collaborative research opportunities. To undertake this development, a Study Group is proposed. At its 36th Annual Meeting in February 2021, the PSC supported the PICES concept to form a Joint Study Group.

Statement of Purpose:

The purpose of a joint PICES-PSC Study Group on *Scientific Cooperation in the North Pacific* is to develop a framework of enhanced collaboration between the two Organizations to achieve a greater understanding of coastal and high seas ecosystem structure and variability, and its effect on the dynamics and production of Pacific Salmon populations. The Study Group will review each organization's scientific needs and identify where similar key questions or scientific issues might be explored jointly by both organizations specified as follows.

Terms of Reference:

The following are the Terms of Reference (TOR) of the joint ISC-PICES Study Group (hereafter, SG):

1. Review existing and planned scientific activities of each organization;
2. Develop a list of potential priority areas of cooperation;
3. Identify potential collaborative mechanisms such as reciprocal consultations, representation at each other's meetings, joint workshops and symposia, and joint Working Groups;
4. Propose practical steps for cooperation between the organizations in the near future;
5. Draft the Framework for Collaborative Research Opportunities or Memorandum of Understanding between PICES and PSC and its duration (e.g. open-ended or for a renewable 5 years).

Process and Timelines:

The PSC has endorsed the SG and nominated members. This SG is proposed to PICES for approval and membership designation at the 2021 (October) Annual Meeting. The SG will conduct the majority of the work described in the TOR through email correspondence (November – September 2022), and with a virtual meeting (summer 2022 if required). The Framework and recommendations will be submitted in September 2022 to the PICES Secretariat for consideration by Science Board and Governing Council at the PICES October 2022 Annual Meeting, and to the PSC for consideration at its October 2022 Meeting.

Proposed Membership:

PICES Members

Canada Jackie King Pacific Biological Station, Fisheries and Oceans Canada, Nanaimo, British Columbia Canada, V9T 6N7 jackie.king@dfo-mpo.gc.ca	**China** Declines membership	**Japan** Satoshi Honda Fisheries Resources Institute, Japan Fisheries Research and Education Agency 2-4-1Nakanoshima-nijo, Toyohira-ku, Sapporo, Hokkaido Japan 062-0922 honda_satoshi21@fra.go.jp
Korea	**Russia**	**USA** Ed Farley Alaska Fisheries Science Center, NOAA Fisheries, Juneau, Alaska USA, 99801 ed.farley@noaa.gov

PSC Members

John Field Pacific Salmon Commission 600-1155 Robson St. Vancouver, BC V6E1B5 field@psc.org	Catherine Michielsens Pacific Salmon Commission 600-1155 Robson St. Vancouver, BC V6E1B5 michielsens@psc.org	Shannon Balfry Fisheries and Oceans Canada 401 Burrard Street Vancouver, BC V6C 3S4 Shannon.balfry@dfo-mpo.gc.ca

Diana Dobson Fisheries and Oceans Canada 3225 Stephenson Point Rd. Nanaimo, BC V9T 1K3 Diana.Dobson@dfo-mpo.gc.ca	Bill Templin Alaska Dept. of Fish and Game PO Box 115526 Juneau, AK 99811-5526 Bill.templin@alaska.gov	Scott Rumsey NOAA Fisheries Regional Directorate Portland, OR 97232 Scott.Rumsey@noaa.gov

Proposal for a Working Group on

'Climate Extremes and Coastal Impacts in the Pacific'

Parent Committees: FUTURE (possibly POC, BIO, HD)

Requested Term: October 2021 – October 2026

GOALS

(1) Increase our understanding of climate extreme events with a focus on their drivers, predictability, and the impacts on coastal communities and marine ecosystem services.

(2) Facilitate partnerships between PICES, the Asia Pacific Network (APN), CLIVAR, WCRP and other organizations in the Pacific.

(3) Contribute to PICES activities supporting the UN Decade of Ocean Science for Sustainable Development, including the SMARTNET, CoastPredict, and GEOS Programs.

MOTIVATION

There is recognition of increased risk of **more frequent and more severe extreme events within the Pacific domain**. For example, a series of Marine Heat Waves (MHW) has occurred in the eastern North Pacific over the past 5 years, with substantial ecological and socioeconomic impacts on the west coast of North America. The 2015 MHW resulted in one of the largest harmful algal blooms ever recorded, leading to lost shellfish harvest, marine mammal deaths and lasting impacts on coastal communities (McCabe et al. 2015). In the western North Pacific Ocean near Japan, another long-term MHW occurred in the Oyashio region from 2010 to 2016, with significant impacts on local communities through changes in fish species available for catch (Miyama et al. 2021). There is a clear need to better understand the physical drivers and assess the predictability of MHWs and other extreme events, such as heavy rainfall, typhoons, and coastal inundation, and to be more prepared to resolve the socioeconomic impacts resulting from these events. Coastal communities around the Pacific Rim, which are highly reliant on coastal ecosystem services, are particularly vulnerable to these extreme events and in need of a suite of potential solutions to these climate-driven changes.

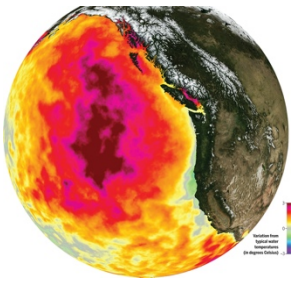

Fig 1: Marine Heat Wave in the eastern North Pacific.

The PICES FUTURE Science Program has implemented a **Social-Ecological-Environmental Systems framework** to facilitate transdisciplinary exchange of information within the organization. When applied to 'crisis' case studies, this framework proved effective in understanding large-scale ecosystem change and resulting impacts on coastal communities (Bograd et al., 2019). The FUTURE Science Program has also taken a central role in planning PICES' **leadership and engagement within the UN Decade of Ocean Science for Sustainable Development** (UNDOS). FUTURE's *Phase III* Science and Implementation Plan positions PICES to provide the scientific and organizational infrastructure to implement the activities of UNDOS in the Pacific. A key objective of these efforts is to identify and facilitate **engagement of partner**

organizations to implement joint UNDOS activities that will enhance communication and outreach to diverse stakeholders. Several key partner organizations participated in recent PICES meetings in which ideas for collaborative work, including within the context of UNDOS, were discussed. In particular, we have identified significant interest in and high potential for collaboration around the theme of 'Climate Extremes and Coastal Impacts in the Pacific' with APN and CLIVAR.

WORKSHOP DECISIONS

PICES held a Workshop on June 23rd, 2021, to strategize on developing an Expert Group proposal on 'Climate Extremes and Coastal Impacts'. There was general agreement among the ~40 participants on several key points:

1. We will develop a single transdisciplinary PICES Working Group proposal for Science Board/Governing Council consideration at PICES-2021 (WG-EXTREMES).

2. We will begin reaching out to partner organizations, stakeholders, and other communities (including indigenous communities) to ensure early participation.

3. The first year of the WG-EXTREMES will have a focus on continued scoping for additional partnerships, as this is a major undertaking and will require additional time and effort amongst partner organizations, stakeholders, and other communities. To facilitate progress on the issue of climate extremes, we prefer to begin the work as a Working Group rather than a Study Group.

4. We will frame the Working Group proposal in the context of contributions to the UN Decade of Ocean Science (including the SMARTNET and GEOS Programs), with anticipation of continued work on climate extreme events beyond the timeframe of WG-EXTREMES.

5. We strongly encourage Early Career Ocean Professionals (ECOPs) to take a leading role in proposal development and eventual implementation of the WG.

WG PROPOSAL

We propose a PICES Working Group to address multi-disciplinary aspects of climate extreme events, including their physical drivers, attribution to climate change, predictability on seasonal to interannual time scales, and impacts on coastal marine ecosystems and the coastal communities that are reliant on their ecosystem services. The principal objectives will be to (a) gain a better understanding of the drivers and impacts of extremes under changing climate conditions, (b) assess the predictability of different climate extreme events, and (c) explore potential solutions to mitigate their societal impacts. We seek to engage partner organizations in this Working Group, including APN and CLIVAR, to expand the scope and impact of the work, in support of PICES' engagement in UNDOS, in particular the Decade-endorsed ICES-PICES SMARTNET Program. We seek to leverage the organizational infrastructure of PICES as well as the APN network and its history of capacity development across Pacific developing countries.

We would also work closely with the PICES Study Groups on Early Career Ocean Professionals (SG-ECOP) and on Science Communications (SG-SCICOMM), or subsequent Expert Groups, with the aim of training

ECOPs in multi-disciplinary ocean research, organization of multi-partner collaborations, and communication of WG activities and products to diverse stakeholders. The partnerships fostered by this WG will bring together diverse networks to increase the overall capacity to conduct ocean science research in support of sustainable development and to foster the range of skills necessary to support broad and overarching marine science goals. This Working Group will facilitate transformative science and address several UNDOS key societal objectives as well as incorporate strategies to facilitate UNDOS cross-cutting inclusivity themes relating to gender equality, early career ocean professional engagement, and significant involvement of Indigenous communities and developing nations in the planning and implementation of joint activities.

TERMS of REFERENCE

1. Develop a census of historical climate extreme events around the Pacific Rim to describe their characteristics, identify potential climate and ocean drivers, and catalog the ecological and socioeconomic consequences.
2. Focus on case studies (e.g., MHWs) for full exploration: drivers, predictability, ecological and societal impacts, and dissemination of information for actionable solutions.
3. Assess the predictability of climate extremes and establish leading indicators to mitigate impacts on coastal communities.
4. Develop models to predict how existing ecosystem services may be affected by climate extremes and what effects those would have on different human communities.
5. Identify a set of social, economic, and cultural indicators that account for the suite of human dimension impacts from climate extremes.
6. Work with experts in science communications and participants in the UN Decade of Ocean Science (e.g., SMARTNET) to develop and disseminate information and products related to the drivers, predictability and impacts of climate extremes.
7. Identify and engage partners in the prioritization of activities and deliverables.

PROPOSED INTERNAL and EXTERNAL ORGANIZATIONAL PARTNERS

CLIVAR (Pacific Panel); WCRP (lighthouse activities “explaining and predicting earth system change,” “my climate risk,” and “WCRP academy”); APN

Joint PICES-APN Study Group on Scientific Cooperation in the Pacific Ocean

PICES Expert Group on Early Career Ocean Professionals (ECOPs): to provide WG leadership

PICES Expert Group on Science Communications: to assist communication of WG activities and products to the PICES community, the broader scientific community and the general public

PICES Expert Group on UN Decade of Ocean Sciences: to coordinate with SMARTNET and other Decade activities

PROPOSED MEMBERSHIP

1. Seek to maintain regional, expertise (natural and social sciences), gender and career-stage balance, including involvement of ECOPs.
2. Seek representation from the Indigenous community.
3. Seek representatives from the partner organizations (CLIVAR, WCRP, APN).
4. Include members who participated in the June 2021 Workshop on Climate Extremes.
5. Given cross-disciplinary and cross-organizational nature of WG, anticipate relatively large membership and an extended lifetime.

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Proposed Working Group on Sub-mesoscale Processes and Marine Ecosystems

Background

To improve the understanding on the ocean physical processes that relate to living marine resources is one of the main goals of POC. To this end, much effort has been made towards the ocean mesoscale dynamics and its impact on the marine ecosystem, while the sub-mesoscale processes, of one or two orders smaller in spatial scale, have received comparatively few attentions. The sub-mesoscale process is a ubiquitous phenomenon over the entire ocean and has been a front edge of oceanography during past decade. The PICES Working Group 38 (WG38) on Mesoscale and Sub-mesoscale Processes ended this year. While WG 38 has done a detailed and thorough work on the mesoscale processes on the North Pacific, the sub-mesoscale processes were not focused on sufficiently and completely due to the large volume of mesoscale studies. It is therefore timely to transition from mesoscale to sub-mesoscale at this moment on the basis of the results of WG38.

Motivation and Goals

Sub-mesoscale processes are relevant to ocean primary productivity because they support large vertical velocity with timescale similar to the phytoplankton growth, which will ultimately influence the upper trophic levels and food chain. This new group aims to *"improving our essential knowledge on the sub-mesoscale processes by integrating the sub-mesoscale-permitting observation dataset, developing and evaluating the high-resolution coupled model in the North Pacific, particularly in the coastal areas and others with important living resources".* The establishment of this group helps address the FUTURE goal on the variability of marine ecosystem under natural and anthropogenic forcings across scales. The working group will also develop tight collaboration with national and international work groups and promote more studies on this topic.

Proposed Terms of Reference (TOR)

Below we detail the Working Group goals in a set of terms of reference.

1. **Review the recent progress on the submesoscale observation techniques and model skills in the North Pacific**
   Thanks to the advance of computer and instrument technology, the observation and simulation of submesoscale processes have made a huge progress during past decades. The WG will carry on a thorough review on previous submesoscale studies in the North Pacific by regions. Particular interest will be paid on different submesoscale dynamics that dominate in different regional seas and in the open ocean such as the western boundary current (Kuroshio) and its extension, eastern boundary current and associated upwelling, the North Pacific Transition Zone as well as the equatorial areas etc.
2. **Review the current studies on the ocean submesoscales and their role in the marine ecosystem in the North Pacific**
   The impacts of submesoscales on the local marine system is one of the main focuses in this work group. Comparing with the Atlantic Ocean, less has been done in the Pacific. In view of this, we will review the role of submesoscale dynamics in regulating the marine ecosystem not only in the Pacific

but also over the other world oceans. We will identify which and how the submesoscale processes influence the local primary productivity and other living creatures such as zooplankton, fish and even sea birds.

3. **Identify how and which submesoscale processes interact with local marine ecosystem in the regional areas**
   The results of the TOR 1 and 2 will be very instructive to our submesoscale-ecosystem studies in the North Pacific. We will identify the major submesoscale process in the regional areas of the North Pacific using the existing numerical simulations (e.g., MITgcm *llc4320*) and/or building our own regional high-resolution models. Combined with the observed data like nutrients, chlorophyll and/or coupled biological model, we will be able to determine the role of submesoscale processes in the local ecosystem and clarify the bio-physical interaction across scales.
4. **Evaluate the integrated effects of submesoscale physics on the ocean primary production in the North Pacific**
   The integrated effects of submesoscale processes that the WG proposes to evaluate include both the overall long-term variability of primary production and regional ecosystem structure change under the climate forcings during past decades and future projections. This goal also serves as an effort towards the UN decades of Ocean Sciences for sustainable development and the UN SDG 14 (Life below water).
5. **Promote the national research on ocean submesoscales and the international collaboration with worldwide experts**
   As mentioned above, the submesoscale studies have received much less attention even in PICES countries. The WG will engage in the activities to promote the national research on ocean submesoscales as well as international collaboration with renowned research groups in this field. By means of this new impetus, we anticipate expanding the influence of our WG and PICES and attracting more scientists to join in. We have summoned an onsite and online submesoscale workshop in June this year.

Examples of Submesoscale impacts on marine ecosystem

Submesoscale processes modulating the phytoplankton growth rate

One important feature of submesoscale processes that makes them particularly relevant to phytoplankton growth is that they drive strong local vertical velocities at fronts and filaments. The upwelling velocities may drive enhanced nutrient fluxes into the euphotic zone, while the downwelling may take the phytoplankton away from light exposure into the dark ocean interior (e.g., Levy et al., 2012; Mahadevan, 2016; Zhong and Bracco, 2013). The net effect remains unclear though many studies have shown good correspondence between submesoscale fronts and chlorophyll maximum (Figure 1). Since the temporal scales of submesoscale currents are often of the same order to those of phytoplankton growth time scales, it is thus expected that the coupling between the submesoscale dynamics and phytoplankton growth may be subject to large regional variability.

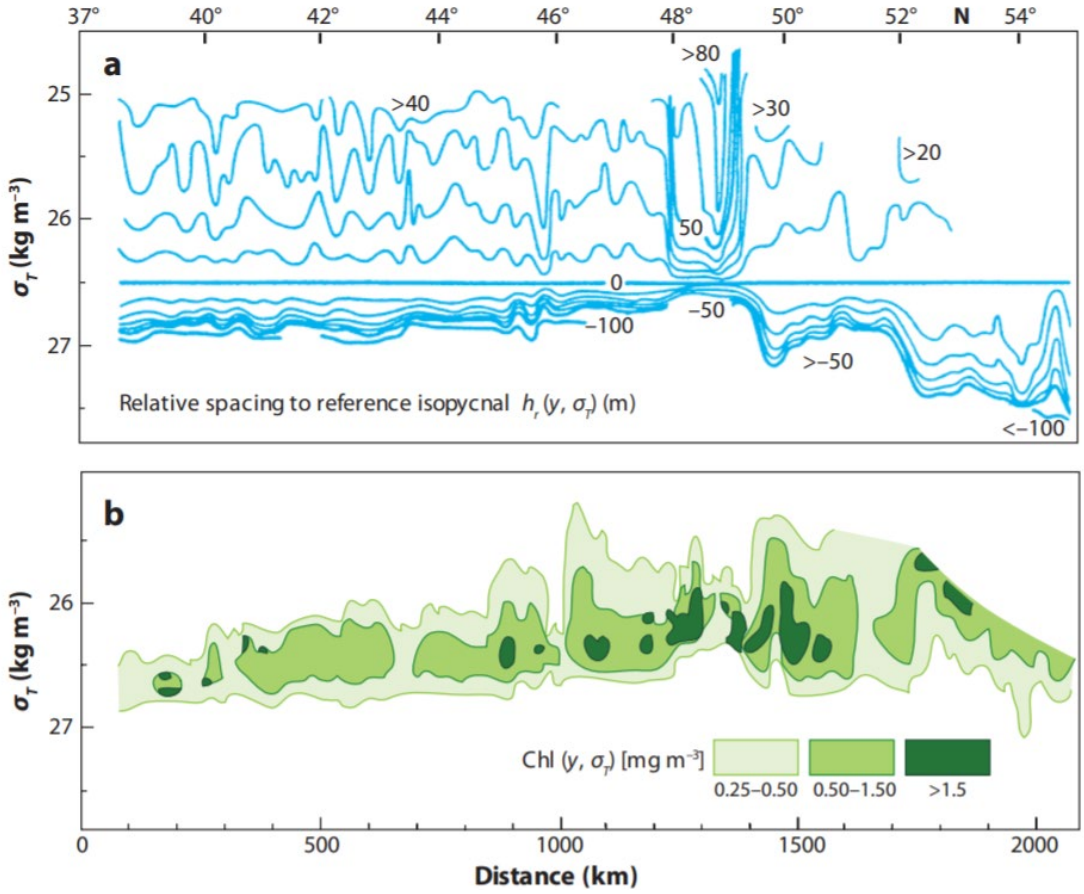

Figure 1: Isopycnal distributions along a section from the Azores toward Cape Farvel, Greenland of (a) the spacing of isopycnals relative to 26.5 kg m^{-3}, and (b) the chlorophyll concentration. High chlorophyll concentrations are observed in submesoscale fronts. This figure is taken from Klein et al. (2009).

Submesoscale processes redistributing the phytoplankton patches

The surface distribution of phytoplankton or other passive tracers is strongly regulated by the submesoscale currents. The elongated filaments or patches with complex structure are often identified in the satellite images (e.g., Zhong et al., 2012). The submesoscale stirring usually occurs in the eddy active regions, where the mesoscale eddies distort the large-scale phytoplankton landscape into submesoscale patches delineated by sharp gradients (e.g., McWilliams, 2016; Levy et al., 2018).

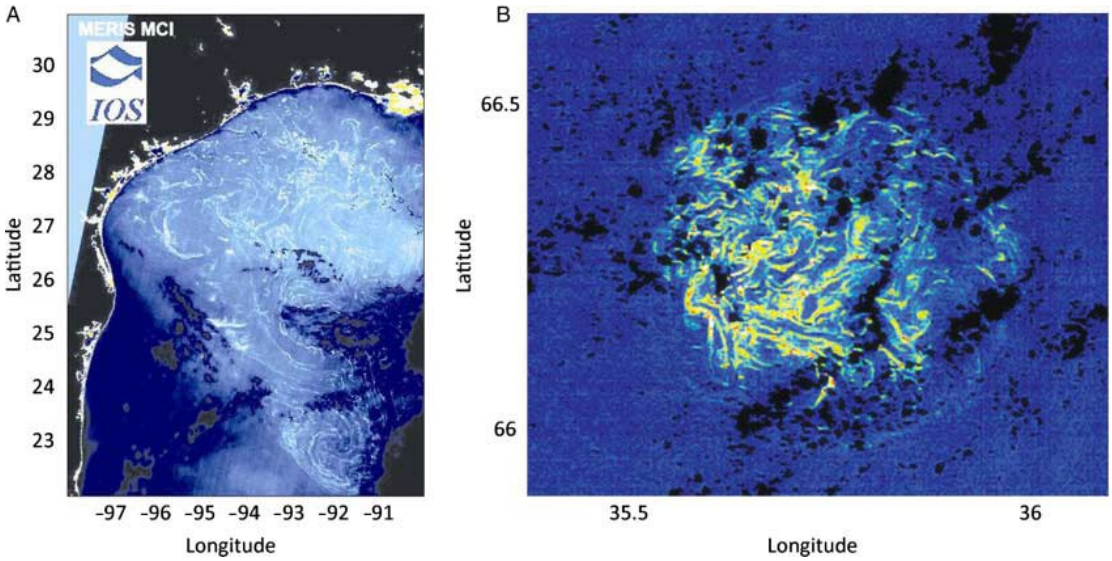

Figure 2: Ocean color satellite images of Sargassum. (A) Sargassum lines in a MERIS maximum chlorophyll index (MCI) image on 2 June 2005 (courtesy European Space Agency,). (B) A patch observed by the same satellite in the North Atlantic on 4 September 2008 (courtesy European Space Agency,). The center of the patch is located at 35°45'N and 66°21'W, and its diameter is

approximately 45 km. This figure is taken from Zhong et al. (2012).

Proposed Membership

PICES Co-Chairs: Yisen Zhong & Bo Qiu

Yisen Zhong (China): Associate professor at the School of Oceanography, Shanghai Jiao Tong University. Primary research focus is on mesoscale and submesoscale physical processes and dynamics in the ocean, particularly in the western Pacific. His research efforts mainly rely on high-resolution regional ocean numerical models (including physical-biological coupled models), and also use satellite and ship-based observation data.

Bo Qiu (USA): Professor of oceanography in SOEST, University of Hawaii. His scientific interests include large-scale ocean circulation variability, mid-latitude air-sea interaction, geophysical fluid dynamics, and satellite oceanography. Recently he was honored with the Henry Stommel Research Medal by the AMS for his seminal contributions using observations, models, and theory to understand the dynamics of the North Pacific Ocean circulation and its role in the climate system.

Suggested PICES Members

1. Sung Yong Kim (Korea)
2. Yusuke Uchiyama (Japan)
3. Annalisa Bracco (USA)
4. Fangli Qiao (China)

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Proposed AP-SciCom: Advisory Panel on Science Communications

Proposed Parent Committees: Science Board, FUTURE

Assumptions:

- Effective Science Communications are critical to PICES successful delivery of its mission.
- Clear and targeted messaging will enhance uptake of PICES Science, will demonstrate its value to a broader community outside of PICES scientific community, and may provide increased opportunities for collaboration, support, and funding.
- PICES Science is full of compelling stories, and important work. It is imperative that these stories reach a broad and appropriate audience. To do so, a framework for collection, creation, and regular dissemination of PICES Science content must be developed by a dedicated Science Communications Expert Group. It can then be implemented by PICES Expert Groups and the Secretariat as appropriate. Capacity building within the organization is a key element that will ensure that PICES is able to communicate its scientific achievements and recommendations broadly and be equipped to evolve its communication plan.

Proposed Terms of Reference:

PICES Strategic Communications Planning and Implementation:

- Create and maintain a PICES Strategic Science Communication Plan to share the findings and importance of PICES Science. Include short and long term communication goals to reach target audiences and specify a timeline for delivery.
- Review and develop best practices for Science Communications and provide recommendations for media

and messaging within PICES.
- Determine and document measures of success of PICES Science Communications.
- Review PICES brand and communication tools, especially the PICES website. Develop a plan for improvement, updates and long-term maintenance.
- Develop and practice a scheme to more effectively and regularly share the scientific results and achievements of PICES Expert Groups via the website, social media, and other available tools.

PICES Science Communications Training and Capacity Building:

- Develop an annual Science Communication Training Plan, including workshops, sessions, and symposia related to Science Communications.
- Develop a Science Communications Training section of the PICES website to share Science Communication resources, opportunities, and potentially Science Communication case studies.
- Create a PICES Science Communications Award, to be awarded by the Advisory Panel on Science Communications, to encourage all expert groups to share the results of their PICES work in a clear and compelling fashion.

Proposed membership (*Proposed leadership)

Canada: **Ms. Tammy Norgard** *Department of Fisheries and Oceans* Pacific Biological Station 3190 Hammond Bay Rd Nanaimo, B.C. Canada V9T6N7 250-756-7005 tammy.norgard@dfo-mpo.gc.ca	Korea: **Dr. Bum Soo Park** *Marine Ecosystem Research Center* Korea Institute of Ocean Science and Technology 385 Haeyang-ro, Yeongdo-gu, Busan, Republic of Korea 49111 82-51-664-3336 parkbs@kiost.ac.kr **Dr. Jongwoo Park** *Ocean Climate & Ecology Research Division* National Institute of Fisheries Science (NIFS. MOF) 216 Gijanghaean-ro, Gijang-eup, Gijang-gun, Busan, Republic of Korea 46083 (82-51) 720-2261 cyanopark@korea.kr
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Proposed AP-ECOP: Advisory Panel on Early Career Ocean Professionals

Acronym: AP-ECOP

Parent Committee(s): Science Board & FUTURE

Rationale & Goals of AP-ECOP

To remain vibrant and relevant over the long-term, professional organizations must attract, integrate and retain diverse perspectives, especially of early career professionals. The connection between organizations and early career professionals is mutually beneficial. Engaging ECOPs in PICES promotes diversity, initially generationally, but eventually by incorporating a greater number of disciplines and sectors and by developing and strengthening relationships with countries and organizations located in different ocean basins; provides expertise in new research techniques and greater emphasis on science communication, outreach, and enhances organizational capacity. Complementary to this, ECOPs benefit by engaging in knowledge sharing, training, and mentorship and getting direct experience in relevant professional skills such as international collaborations, intergovernmental engagement, science communication, and conference organization, as well as employment, funding, or other professional opportunities. A survey conducted by the previous SG-ECOP demonstrated how willing and keen both ECOPs and later career ocean professionals (LCOPs) were towards the institution of a mentorship program and towards greater inclusion and engagement of ECOPs within PICES organizational development, scientific agenda, communication strategy and multi-stakeholder partnerships.

The goal of the proposed Advisory Panel is to facilitate the incorporation and engagement of diverse early career ocean professionals (ECOPs), across regions, sectors, disciplines, and other axes of diversity into the PICES scientific activities and organizational structure, including expert groups and the Secretariat. This includes identifying opportunities for participation, recruiting diverse ECOPs, and sustaining their engagement. The AP will support and direct ECOP engagement within PICES and the North Pacific, as well as encourage ECOP participation in organizations, programs, and activities of interest to the PICES community, such as associated with the UN Decade of Ocean Science for Sustainable Development (e.g., SMARTNet).

Proposed Terms of Reference

1. **Explore opportunities for ECOP representation in PICES through enhanced demographic data collection & assessment.** The AP will continue to assess opportunities to enhance representation in PICES expert groups and organizational structures and ensure that there is cross fertilization among the existing Expert Groups, such as the proposed Science Communication Advisory Panel. This could include identifying reasonable, quantitative benchmarks for ECOP participation, both within PICES as a whole and in specific expert groups, decision-making bodies, and other key organizational structures and improving demographic information to track the demographics of the PICES annual meeting & community.

2. **Recruit diverse ECOPs through revitalized communications & existing networks.** The AP will actively work to recruit diverse ECOPs, from different regions, sectors, and disciplines, into PICES by revitalizing communication and connecting with existing networks. This could include supporting with the PICES website, developing an ECOP section on the PICES website, and asking existing PICES members & national members of expert groups to actively invite ECOPs to the annual meeting and expert group meetings.
3. **Engage ECOPs through professional opportunities in expert groups, programs, & other aspects of PICES structure.** Incorporate ECOPs into all levels of PICES including participation in expert groups and the Secretariat and ultimately leadership roles within the organization. For example, this could include post-docs or interns that support Expert Groups or the Secretariat. In addition, ECOPs could see which Expert Groups (EGs) align with their areas of interest, join the EG meetings, and contact the EG chair.
4. **Foster inter-generational exchange through mentorship programs and activities.** The AP will continue to foster inter-generational exchange and mentorship between experienced PICES members, ECOPs, and emerging ECOPs (e.g. youth), such as by encouraging later career ocean professionals (LCOPs) to mentor ECOPs that are eager to participate in expert groups and other organizational bodies.
5. **Collaborate with partners to develop and advance inclusive engagement in the North Pacific and internationally.** The AP will work with other international, regional, and national organizations, initiatives and/or countries to further ECOP engagement, especially those related to mentorship, diverse engagement, and early career professional recruitment, retention, and participation. This could include developing a North Pacific ECOP network to connect within and across regions globally and within the context of international processes, like the UN Decade of Ocean Science for Sustainable Development (2021-2030), and across the associated programs (e.g., SMARTNet, GEOS, ECOP).

Proposed/recommended chair(s):

We would like to propose 4 chairs (ideally two from West and East Pacific) that will rotate after 2 years with staggered service (e.g., to start co-chairs 1E/2W serves 2022-2024, co-chairs 3E/4W serves 2023-2025, co-chairs 5E/6W serves 2024-2026). This structure will allow for increased coordination and productivity while bridging gaps in learning curves and allowing for some flexibility in the event that a co-chair has to leave their term early due to unforeseen circumstances (i.e. job changes occur at a higher frequency at the early career stage).

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Cameron Freshwater (Canada) - cameron.freshwater@dfo-mpo.gc.ca
Alex Davis (Canada) - acdavis@ualberta.ca
co-chair 4- TBD

Proposed/recommended full members:

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GC Appendix C
Revised terms of Reference for S-CC

1. Coordinate and encourage ongoing and planned national and international syntheses of research studies regarding biogeochemical cycles of carbon, oxygen, and nutrient in the North Pacific and, where necessary and appropriate, for the larger Pacific basin;

2. Ensure effective two-way communication with other international scientific groups that have a responsibility for the coordination of ocean carbon-related biogeochemical studies, such as the International Ocean Carbon Coordination Project (IOCCP), Ship of Opportunity Project (SOOP/VOS), GO-SHIP/CO_2 Repeat Hydrography and the SOLAS/IMBER implementation group for carbon research;

3. Review the existing information on biogeochemical cycles of carbon, oxygen, and nutrient in the North Pacific, including anthropogenic carbon, the biological pump, impacts of ocean acidification and deoxygenation on marine biota, and possible feedbacks to atmospheric greenhouse gases; identify gaps in our knowledge, and make prioritized recommendations for future research;

4. Periodically review the status of the methodology of measurements for ocean carbon system, oxygen and nutrients, including the preparation of standards and reference materials, and sensor development, and advise on inter-calibration and quality control procedures;

5. Identify suitable data sets on the oceanic biogeochemical system including carbon, oxygen and nutrient in the Pacific region as they become available, and recommend the mechanisms of data and information exchange;

6. Carry out and publish basin-scale syntheses of biogeochemical cycles of carbon, oxygen, and nutrient in the North Pacific, including new data whenever appropriate, and encourage scientific interpretation of these evolving data sets;

7. Organize symposia, workshops, or Annual Meeting sessions on the biogeochemical cycles of carbon, oxygen, and nutrient, ocean acidification, ocean deoxygenation, and other climate studies in the North Pacific.

8. Enhance cross-disciplinal collaboration between climate, ocean biogeochemistry and biology/fisheries for the issues such as biological effect of ocean acidification and/or deoxygenation.