PICES-2020
Report of SCIENCE BOARD
OCTOBER 7/8 – 9/10,2020

Prepared by Science Board Chair, Dr. Vera Trainer, and the PICES Secretariat

Day 1 of Science Board meeting

Agenda item #1: Introductions, Adoption of Agenda

The meeting commenced at 18:00. Dr. Vera Trainer facilitated a brief round of attendee introductions, and reviewed call protocol for the meeting. Science Board adopted the agenda as set out (See Appendix A).

Attendees: Vera Trainer (SB Chair), Sonia Batten (PICES Exec Scty), Lori Waters (SB Support), Xianshi Jin (FIS), Guangshui Na (MEQ), Igor Shevchenko (RUSSIA), Tetsuo Fujii (GC), Sung Yong Kim (MONITOR), Janelle Curtis (NPFC), Mitsutaku Makino (HD), Carmel Lowe (GC, F&A Chair), Hal Batchelder (Deputy Exec Scty), Sukyung Kang (FUTURE), Steven Bograd (FUTURE), Akash Sastri (BIO), Jorn Schmidt, Chul Park (GC Chair), Alex Zavolokin, Jeanette Gann (TCODE), Emanuel Di Lorenzo, Enrique Curchitser (GC Vice-Chair), Matt Baker (NPRB).

Agenda item #2: Election of Science Board Vice-Chair

SB acclaimed Dr. Igor Shevchenko as Vice Chair of PICES Science Board.

Agenda item #3: Report from FUTURE SSC

Drs. Bograd and Kang reviewed the FUTURE SSC Agenda from the recent FUTURE SSC meeting held virtually October 4-7, 2020, and provided an overview of accomplishments towards FUTURE Science Program goals in 2020.

The FUTURE SSC thanked Drs. Ian Perry (Canada), Sinjae Yoo (Korea) and Toyomitsu Horii (Japan) who recently stepped down from the FUTURE SSC, and welcomed Dr. Jennifer Boldt (Canada), Dr. Hanna Na (Korea) and Tetsuo Fujii (Japan) replacing Ian Perry, Sinjae Yoo and Toyomitsu Horii, respectively. Each of the new members accepted liaison assignments and liaisons were revised to incorporate new PICES Expert Groups.

Dr. Bograd provided an overview of the SEES approach, the FUTURE Schematic, and new Expert Groups under FUTURE parenting. The SSC continues work on its FUTURE Product Matrix, analyzing completed PICES science to determine which questions are being answered with respect to the FUTURE Science Program. The results of this analysis will be presented as part of the FUTURE Phase II final report. The SSC recommended that new Expert Groups be requested to map their research into the FUTURE SEES product matrix, to assist future researchers in contextualizing PICES Science, and to assist FUTURE in identifying any knowledge gaps where additional EG's may be required to address those gaps.

FUTURE continues planning of its Open Science Meeting (OSM), and will provide an update when more details are known.

The SSC made the following requests of Science Board:

- Support WG-40 and WG-41 extensions to October 2021;
- Request $3000CAD publication support for WG-36;
- Endorse plan for completion of FUTURE Phase II Final Report (April, 2021);
    - Hire student/ intern on FUTURE funds to complete FUTURE Product Matrix;
    - Request new EG's to map activities and products on product matrix;
- Support online distribution of FUTURE Phase III Science and Implementation Plans (endorsed by SB at ISB-2020);
- Support online distribution of revised FUTURE Liaison table and FUTURE Schematic.

Science Board indicated its support for FUTURE Activities as set out and recommended the implementation of FUTURE Integrative Science Program, phase III, primarily focused on science related to the goals of the UN Decade of Ocean Science for Sustainability (UNDOS).

The SSC is in the process of determining requirements and TORs for new working groups, and plans to hold a workshop to develop plans for an inter-disciplinary Coastal SEES working group, co-parented with POC and facilitated with PICES Partners such as APN. The SSC initial proposal conceives this as an interdisciplinary group of partners and working groups who cooperate to better understand Social-Ecological-Environmental impacts of climate extremes in Pacific Coastal Systems. The HD Committee noted that it also supports this idea, and has a proposal for a Study Group, independent of the WG proposal, and wishes to work with FUTURE and POC to further develop the idea, partnerships, and Expert Group(s).

Dr. Bograd provided an update on its child EG's: WG's 35 and 36.

WG-35 has recently completed the NPESR synthesis report. The parent committee review has been completed and revisions accepted. The report is now with the Editorial board, and the final version of Synthesis is to be submitted for review by GC in November of 2020. WG-35 requested an extension to PICES-2021 to complete publications and propose a new WG for next phase of NPESR. WG-35 requests a full day meeting at next annual meeting.

WG 36 requested a six-month extension due to COVID-19-related delays. Dr. Batten noted that this does not require a formal extension. The group intends to complete its manuscript based on analyses of ecosystem thresholds for the west coast of Vancouver Island, and a review manuscript to quantify thresholds in ecological time series. WG-36 is requesting $3000CAD for Open Access publication costs. A journal has not yet been identified.

Agenda item #4: FUTURE: Next Integrative Science Program

The FUTURE Science Program is transitioning from phase II to phase III, to build on momentum begun in Phase II. Overall objectives and key questions of the FUTURE program are still relevant and reflective of the needs of PICES integrative science. Phase III of the FUTURE program will exploit recent accomplishments (the SEES approach), and will leverage and provide leadership to PICES scientific contributions to UNDOS. Specifics of the transition from FUTURE Phase II to Phase III include:

- Maintain momentum developed during FUTURE Phase II;
- Continue to work on the overall objectives and key questions of the FUTURE Program Phase II, as these are still relevant and reflective of the needs of PICES integrative science;
- Implement the new Phase III FUTURE program to exploit recent accomplishments (SEES approach), and leverage these to provide leadership to PICES UNDOS scientific activities;
- Evaluate Phase II progress towards FUTURE objectives, determine which objectives cannot be resolved or are now of lower priority, and identify new activities which are required to accomplish objectives. Identify these in the Phase II Final report;
- Continue to facilitate trans-disciplinary research and communication;
- Maintain PICES activities in traditional disciplines;
- Encourage and facilitate participation of early career scientists (for example, through the SEES Travel Award);
- Enhance inter-sessional and remote EG activities and cross-WG meetings at PICES Annual Meetings.

Science Board accepted the FUTURE SSC report.

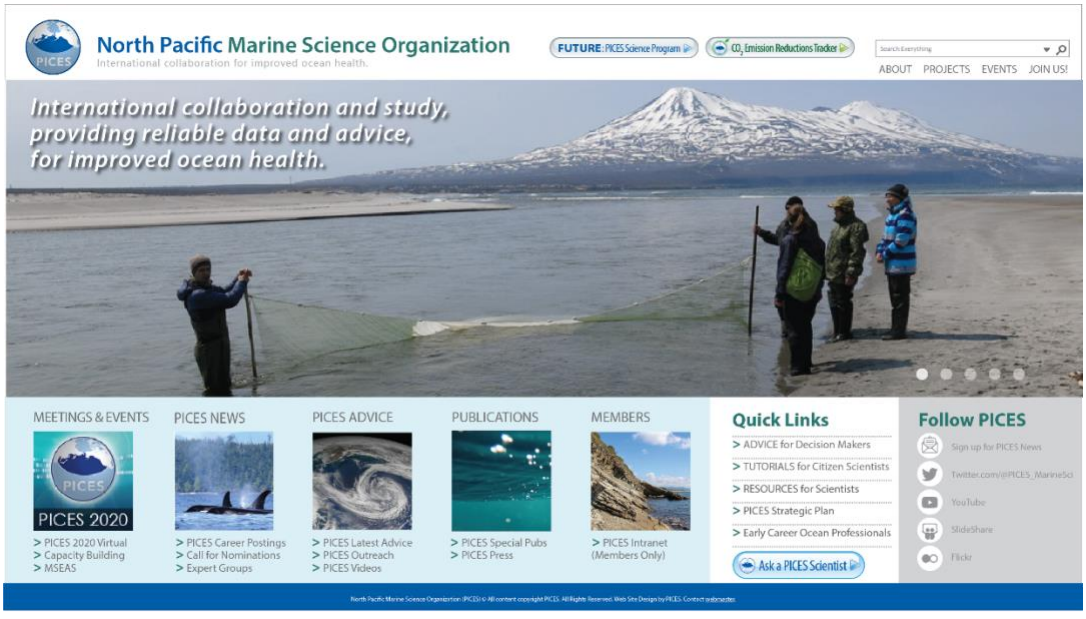
Science Board recommends that PICES expert groups hold at least one virtual intersessional meeting annually, to preserve momentum. This could be combined with shorter business meetings at the annual meeting.

Agenda item #5: PICES Science Contributions to the United Nations Decade of Ocean Science (UNDOS)

Drs. Bograd, Kang, and Trainer provided an overview of FUTURE SSC and PICES plans for PICES engagement in the UNDOS vision of "*The science we need for the ocean we want*." PICES and ICES both had input on the draft UNDOS Implementation Plan, and PICES will engage with partners in UNDOS at the Programme level. Dr. Bograd noted that there is a great deal of potential to accomplish UN Decade goals within our region, and he outlined the timing of upcoming document needs for UNDOS. FUTURE expects the first call for Decade Actions to come out in mid-October of 2020. The call will be open for three months, and committees within the decade organization will endorse specific proposals or plans after January of 2021. In the meantime, the UN General Assembly is negotiating the omnibus resolution to implement the UNDOS. To date, PICES and ICES have jointly begun to coordinate activities for UNDOS and have presented a joint strategic plan for UNDOS that was developed was presented to ICES and PICES governance bodies. Both organizations submitted joint comments on the UNDOS draft implementation plan, and both organizations have collaborated to form a joint study group to clarify structure and plans for upcoming UNDOS activities. The TORs of this group are currently under review by PICES GC and may be further refined to allow a broad range of partnerships, activities, and engagement across a spectrum of UNDOS Goals and cross-cutting themes.

Agenda item #6: Promoting PICES Science

Dr. Trainer provided an overview of PICES SB plans to create a landing page targeted to more general audiences and decision makers. She shared Lori Waters' concept (shown below) for the landing page design concept, aimed at making the PICES website attractive, and to give a better sense of the comprehensive nature of PICES Science. SG-ECOP members indicated that they wish to participate in the website work, and Dr. Curchitser suggested that TCODE may wish to collaborate to provide appropriate links to PICES North Pacific climate and ecosystem data. Science Board expressed support for updating PICES website.



Agenda item #7: Promoting Flexibility and Environmental Sustainability within PICES

Dr. Trainer provided an overview of PICES plans to promote environmental sustainability within PICES. SB recognizes that in-person meetings won't be completely replaced and are valuable, but recent lack of travel due to the pandemic has provided an opportunity to provide metrics for carbon savings, to help us determine PICES direction with respect to future hybrid virtual and in-person meetings. Dr. Trainer presented calculations of carbon emission savings from ISB-2020, AP-CREAMS inter-sessional meeting 2020, and PICES-2020, as shown below.

Carbon Savings 2020

Inter-sessional Science Board (ISB-2020) Carbon Emission savings:

- **Meeting stats:** 24 attendees representing 7 countries (on 3 continents).
- **Estimated total carbon emission savings:** 70,322.10279 kg CO_2
- **Equivalent to:** ▪ removing 15.28 passenger vehicles from the road for one year
- ▪ not burning 29,954L of gasoline, 35,146 Kg of coal, or 163 barrels of oil
- ▪ CO_2 taken up by 91.8 acres of forest in one year, or 1,163 tree seedlings grown for ten years

AP-CREAMS Inter-sessional Carbon Emission savings:

- **Meeting stats:** 14 attendees representing 5 countries (all from Asia except 1 participant).
- **Estimated total carbon emission savings:** 9457.338777 kg CO_2
- **Equivalent to:**
  - removing 2 passenger vehicles from the road for one year
  - not burning 4,028L of gasoline, 4727 Kg of coal, or 22 barrels of oil
  - CO_2 taken up by 12.4 acres of forest in one year, or 156 tree seedlings grown for ten years

PICES-2020

- **Meeting stats:** 475 average attendees representing >15 countries from >3 continents.
- **Estimated total carbon emission savings:** 689074.7292 kg CO_2
- **Equivalent to:**
  - removing 149 passenger vehicles from the road for one year
  - not burning 293,509.473 Litres of gasoline, 344397.2644 Kg of coal, or 1595 barrels of oil
  - CO_2 taken up by 900 acres of forest in one year, or 11,394 tree seedlings grown for ten years

PICES Estimated Cumulative Emission Savings 2020:

Cumulative total savings:
- ISB-2020 70.32210279 tonnes.
- AP-CREAMS 9.457338777 tonnes.
- PICES-2020 689.0747292 tonnes.

CUMULATIVE SAVINGS 768.8541708 Tonnes of CO_2

Dr. Trainer noted for Science Board that PICES cumulative emission savings of 768.8542 tonnes of CO_2 is equivalent to: removing 166 passenger vehicles off the road for one year; 3,070,350 Km driven by an average passenger vehicle; burning of 327,491 Litres of gasoline; burning of 384270 Kg of coal; burning of 10 tanker trucks of

gasoline; or burning of 1,780 barrels of oil. This savings can also be expressed by equivalents of carbon sequestered by: 12,713 tree seedlings grown for 10 years or 1,004 acres of U.S. forests in one year.

Because the savings are significant, Dr.Trainer stated that there will be further discussions and follow-up in the PICES community with respect to future hybrid meetings. SB reviewed the Survey (See Appendix B) to be sent to registered members from PICES-2020, asking how they wish to move forward with meetings. SB was supportive of the idea of continuing to move forward with calculating carbon savings. Suggestions from Science Board included that: PICES set a strategy of meeting net zero emissions by 2050, in accordance with the Paris Agreement; combining virtual meetings with shorter in-person meetings; intermixing or alternating in-person and virtual meetings. Secretariat staff agreed to add the suggestion of alternating in-person and virtual meetings to the Survey.

Agenda Item 8: NPFC update presentation

Dr. Janelle Curtis provided an update (see Appendix C) of PICES-NPFC cooperation, as required by the 2019 Framework for Scientific Cooperation. Recent activities include: a NPFC workshop on the influence of the environment on the Pacific Saury (*Cololabis saira*); NPFC has designated its representatives for participation in the PICES-ICES joint working group on the Small Pelagic Fish international symposium in Lisbon, Portugal; and the NPFC is planning a training course on VME indicator taxa identification for students.

The NPFC requested partner funding co-sponsorship from PICES in the amount of $15,000 for meeting and travel costs for experts. Drs. Batten and Batchelder provided additional details on PICES funding allocation for ECS. NPFC and SB representatives agreed to discuss the funding issue, and that SB revisit the request when it considers funding requests as a whole on day 3 of the SB meeting.

Agenda Item 9: Science Board Requests and Governing Council Decisions

Dr. Batten provided an overview of decisions taken by GC via correspondence during 2020. (See Appendix D).

Call review

Prior to adjourning the first day of the Science Board meeting, Dr. Trainer reviewed the call, and requested that Science Board review the briefing materials ahead of the session and workshop ranking, as this is a primary focus of day two of SB. Day one of SB adjourned at 20:47.

Day 2 of Science Board meeting

Agenda Item 10: ICES update presentation

Dr. Karp provided an overview of ICES (see below) and PICES-ICES joint achievements, historic and current activities. Many PICES people have participated in ICES activities, including joint symposia and conferences. The series of joint ECS conferences – the first of which was in 1999, and the next which will be held in 2023 – continue, with ICES hosting the next conference in the PICES/ICES rotation. Canada has agreed to host the conference which will emphasize UNDOS science. ICES/PICES activities also include joint workshops and strategic initiatives, both with a significant range of science activities. Pending joint working groups and initiatives include WG-ONCE (pending) and the Small Pelagic Fish Symposium. Emerging issues for ICES/PICES cooperation include: Arctic, Biodiversity beyond national jurisdiction (BBNJ) and continued UNDOS activities, which present significant opportunities for collaboration.

Dr. Karp noted that while portions of the arctic may be strictly ICES jurisdiction, ICES has agreements with respect to the Greenland Sea and the Central Arctic Ocean with PICES and PAME. The new Joint working group for Northern

Bering / Chukchi Sea was formed in part to address scientific needs for the arctic. ICES is also currently considering how it might engage in studies for other related areas including: Kara Sea, Laptev Sea, and the Northwest Atlantic.

Currently, there are issues with preventing unregulated high seas fisheries in the Central Arctic Ocean, and the recent moratorium Agreement for the time being is a step forward. The provisional scientific coordination group will be meeting next year, and the science that ICES and PICES will bring to the collaboration will be important to supporting arctic biodiversity.

ICES and PICES continue their partnership with respect to UNDOS, and planning and implementation efforts continue on the joint contribution to ensure a fruitful and productive collaboration. It is expected that the joint proposal will be presented to PICES and ICES governance bodies in the near future.

Planning continues for the joint ICES-PICES annual meeting / annual science conference in 2023. As the US will be the host of the PICES meeting, this provides the potential for the US to host both organizations. ICES and PICES will continue to collaborate to determine the best structure for a meeting of this type.

Science Board had no questions or comments and thanked Dr. Karp for his report.

ICES:

Global cooperation

We work together with other scientific organizations on topics of mutual interest. This cooperation takes the form of joint working groups, co-sponsored theme sessions at annual science meetings, and co-sponsored science symposia. A strategic planning framework has been established specifically for the cooperation with **the North Pacific Marine Science Organization (PICES)**, our sister organization in the North Pacific. Science cooperation agreements are also in place with more than 20 global and regional organizations including:

- **UN Intergovernmental Oceanographic Commission (IOC)**
- **Food and Agriculture Organization (FAO)**
- **Arctic Monitoring and Assessment Programme (AMAP)**
- **International Arctic Science Committee (IASC)**
- **BONUS programme (science for a better future of the Baltic Sea region)**
- **General Fisheries Commission in the Mediterranean (GFCM)**
- **Mediterranean Science Commission (CIESM)**

We hold an official observer status to **the United Nations General Assembly** as well as **the Arctic Council**.

In addition, we have contracts and agreements with public authorities and commissions we provide advice for, including:

- **European Commission (EC)**
- **Helsinki Commission (HELCOM)**
- **North Atlantic Salmon Commission (NASCO)**
- **North East Atlantic Fisheries Commission (NEAFC)**
- **OSPAR Commission (OSPAR).**

We contribute to the developments in marine science through our external project work and collaborate with a variety of organizations to achieve this. ICES involvement in external projects is decided based on our project policy and consultation with our Executive Committee (Bureau). For more information see

our **project policy.**

By participating in projects, we:

- provide scientific support for implementation of the Marine Strategy Framework Directive (MSFD)
- support development of the European Integrated Maritime Policy by developing interactions between partners (the research community, industry, regional authorities, civil society and other stakeholders) and delivering data/information to policy-makers
- develop fisheries management plans for the Natura 2000 sites (Marine Protected Areas)
- manage datasets
- underpin cooperation between marine research funding agencies

Agenda Item 11: Scientific / Technical Committee Reports

Science Board heard reports from all Scientific and Technical Expert Groups. Details of expert group highlights and requests since ISB-2019 can be found in expert group/Committee reports in Annual Report 2020 as well as on their homepages.

Science Board Recommended the following Plan:

- **S-CCME Implementation Plan for Phase 4 (2021 - 2022)**
  The plan was also supported by BIO, FIS, and POC.

Science Board forwards the following membership requests to GC:

- MEQ requests new members from Russia be appointed to MEQ.
- S-CCME requests a member from Russia be appointed to S-CCME. Alexei Somonov was proposed as a candidate.
- WG 43 requests an additional member from Russia
- WG-44 FIS requests additional members from Japan and Canada. Recommended candidates are Kohei Matsuno (Hokkaido University), Nadja Stenier (DFO) and Martin Nantel (DFO).
- AP-NPCOOS requests a member to be appointed from Japan (Dr. Hasegawa is proposed).

Agenda Item 12: Expert Group Updates

Dr. Batchelder provided an update on PICES Expert Groups. Science board reviewed the proposals and recommended the following:

Science Board recommends establishing Expert Groups as follows:

1. (FUTURE) Study Group: Early Career Ocean Professionals (SG-ECOP)
2. (FUTURE) Study Group: United Nations Decade of Ocean Science (SG-UNDOS)
3. (BIO) Working Group: Ecology of Seamounts
4. (BIO) Working Group: Towards best practices using imaging systems for monitoring plankton
5. (HD) Working Group: Science Communications

Science Board recommends deferring consideration of the following EG proposals until ISB-2021

1. IMCE WG: Ecosystem-based mariculture management
2. IMCE WG: Impacts of mariculture pathogens on coastal ecosystems

3. WG-CHANGE Correlating Habitats using Artificial Intelligence, Numerical models, and Gathered Empirical data
4. SG on Ocean Outcomes: Coastal community feedback to external Ocean stressors (HD)

Science Board recommends extension of the following existing Expert Groups:

1. **1-year extension for WG-37** (*Zooplankton Production Methodologies, Applications and Measurements in PICES Region)* to PICES-2021, to:
    a. Convene workshop at PICES 2021;
    b. Complete ToR # 4: Develop an interactive website for exchange of information on zooplankton production measurements for regional and/or global mapping. -Incomplete: requires ~2-3 months coordinated effort between WG members, data owners, and host site (NOAA Copepod)
2. **1-year extension for WG-38** to complete final report.
3. **1-year extension for WG-40 (***Climate and Ecosystem Predictability)* to PICES-2021, (supported by FUTURE-SSC) to
    a. Write a perspectives paper with guidelines for marine ecosystem prediction studies using physical climate/ocean prediction.
    b. Expand discussions on key questions, applications, and WG40 contributions in climate ecosystem predictability
    c. Help establish a new working group with a focus on extremes in coastal environments, to include broad PICES participation including members from WG36, WG41, S-HAB.
4. **1-year extension for WG-41 (***Marine Ecosystem Services)* to complete work on WG projects, with a new end date of October 2021 (supported by HD & FUTURE-SSC)
5. **1-year extension/shift of START DATE for WG-46**: Request to start WG term from 2020 (Supported by POC/BIO)

Agenda Item 13: PICES Code of Ethics

Dr. Batten provided an overview of the development of PICES Code of Ethics, and requested that Science Board review the draft text (see below).

PICES Code of Ethics - *DRAFT, Sept 2020*

PICES is committed to:

- Providing a welcoming and inclusive environment, and encourages all staff, members and guests to aspire to principles of integrity and respect in their interactions.

- 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 science with integrity. Members should strive to not misrepresent results, to not plagiarize and to appropriately acknowledge contributions of others.

- Creating and maintaining a respectful environment free from harassment and discrimination (harassment includes speech or behavior that is not welcome or is personally offensive, regardless of intent).

Practices required to achieve these commitments:

1. When finalised and approved, publish the Code of Ethics in PICES Press so that it reaches the wider membership and demonstrates our commitment to its adoption.

2. Post the Code of Ethics on the website, under "Roles and Responsibilities of Chairs and Members of PICES Groups" (we suggest within the Introduction) so that each new Chair is aware of the policy.

3. Strive for improved gender and career-stage balance within each Committee and Expert Group, while considering each Contracting Party's rights and need to nominate members with the necessary expertise to be effective. Consider incorporating the products and recommendations of the PICES-2020 Early Career Ocean Professionals (ECOP) who plan a workshop in conjunction with PICES-2020.

4. Track the improvements in balance over time, as much as possible, noting that that this would require the collection of potentially sensitive information on gender identity and/or career stage and such information must be voluntarily provided and dutifully protected.

    a. establish the baseline against which to track changes over time. Send out a survey to populate the current members database with voluntarily provided information on:

        - Gender identity (Female/Male/prefer not to answer)
        - Career stage (Early Career Ocean Professional/Mid-career/Senior Career Ocean Professional/Retired or Emeritus/prefer not to answer)

    b. Future registrations for annual meetings will ask for this information to be updated, or entered for new members.

5. Strive for inclusivity at PICES meetings by providing opportunities for members with physical attendance challenges to engage meaningfully in business meetings and Science Sessions using remote connectivity. There will be a cost to this which will be dependent on the venue. PICES-2020 virtual meeting, motivated by the current pandemic, will provide insights into how remote participation can help provide equity.

Call Review

Dr. Trainer briefly reviewed the call and the meeting was adjourned for the day.

Day 3 of Science Board meeting

Dr. Trainer welcomed Science Board and guests, and provided an introduction to new guests joining the call: Dr. Taewon Kim and George Balazs, Project Science Team Co-Chairs of PICES SEAturtle Special Project.

Agenda Item 14: Special Project Reports

Ciguatera Special Project

Dr. Makino provided an update on the Ciguatera Special Project. Due to COVID-19, there has not been significant progress this year. He provided an overview of the project purpose, goals, funding, and anticipated products. Details are available on the webpage for the Ciguatera Special Project. Science Board thanked Dr. Makino for his update.

SEAturtle Special Project

Dr. Taewon Kim, supported by Dr. Balazs, provided an update on the SEAturtle project, which has experienced delays due to COVID-19. The group has requested an extension of their research period from their project funder, as the start of the research has been delayed. Additional members have joined from Mexico, and the group is seeking additional members from China. Dr. Kim provided an overview of the project research and its goals, and showed some of the results to date. He noted that the project has also had a side benefit: during the project, researchers found a dead fin whale, and upon necropsy found 45 pieces of plastic in the intestine and baleen. Science Board thanked Drs. Kim and Balazs for their contribution.

Agenda Item 15: ECOPS mentorship framework

Dr. Erin Satterthwaite presented a proposal for an early career ocean professional (ECOP) study group to address continuity and legacy of PICES Science. She outlined how the group would address retention of institutional knowledge, provide new perspectives, enhance partnerships, and play a leading role throughout the entire ten-year term of UNDOS. The group intends to propose an ECOP study group to develop an engagement plan, which would aim to build a diverse community of PICES mentors, ECOPS, and emerging ECOPs. Dr. Satterthwaite invited SB to a workshop to take place in future to create an engagement plan. Science Board thanked her for her update.

Agenda Item 16: PICES-2021 Update

Dr. Batten provided an update that PICES-2021 is provisionally being hosted by China in Qingdao, but this is not yet confirmed. Science Board reviewed the sessions for PICES-2021, and ranked them. (See Appendix E).

Agenda Item 17: FUTURE Open Science Meeting

As this agenda content was covered during the FUTURE SSC report to SB, the meeting moved on to the next agenda item.

Agenda Item 18: PICES-sponsored conferences / symposia updates

Dr. Batten provided an overview of the following upcoming Symposia. (See Appendix F for additional detail).

Event	Location	Year	Month	Dates
International Symposium on Plastics in the Arctic and Sub-Arctic Regions	Reykjavik Iceland	2021	March	2 to 4
PICES Annual Meeting	Qingdao, China	2021	October	
MSEAS Symposium	Yokohama, Japan	2021	December	6 to 10
Small Pelagic Fish Symposium	Lisbon, Portugal	2022	Feb	21-24
FUTURE Open Science Meeting	TBD	2022	Mar/Apr	
4th Early Career Scientist meeting	St John's Newfoundland, Canada	2022	May?	1 to 4?
PICES Annual Meeting	Korea	2022	October	
5th International Symposium on the Effects of Climate Change on the Worlds Oceans	Bergen, Norway	2023	May?	
Joint ICES/PICES Annual meeting?	USA	2023	Oct?	
7th Zooplankton Production Symposium	Hobart, Australia	2024?	March?	

Agenda Item 19: PICES Capacity Building

Capacity building activities are on hold during the pandemic. SB briefly reviewed the briefing materials provided for this item as follow, and moved on to the next agenda item.

PICES Spring School: "What is the Deep Scattering Layer (DSL) in the coastal region?"

2020 PICES Spring School Synopsis and Schedule

- Cancelled due to Covid-19

SCOPE

"What is the Deep Scattering Layer (DSL) in the coastal region?"
We can easily to observe the deep scattering layer (DSL) by acoustic Doppler current profiler (ADCP) or quantitative echo sounder, but do we really know what the DSL is? Is it the thermocline, phytoplankton, zooplankton, fish or any other matter? In this summer school, students will identify the DSL by the various sampling gears. CTD (temperature, salinity and conductivity) and water sampling can define thermoclines, nutrients, oxygen maxima and subsurface chlorophyll maximum. Zooplankton net sampling can collect zooplankton patches in the subsurface layers around the DSL. Trawl net sampling can collect fishes and their larvae from the deep layers. Participants will have a chance to obtain experience in oceanographic observations and apply data analyses to understand the interactions between physical and biogeochemical environments and marine ecosystem in coastal regions.

Local Organizing Committee

- Naoki Yoshie (Ehime University, AP-NPCOOS, Chair of LOC)
- Toru Kobari (Kagoshima University, PICES WG37)
- Gen Kume (Kagoshima University)

Full information on the school is available on the PICES website:
https://meetings.pices.int/meetings/summer-schools/2020/Kagoshima/scope

ICES PICES ECS 2023

- Update on ECOP members for SSC

ClimEco7 Summer School

- IMBeR's "Climate and Ecosystems Summer School
- University of British Columbia (UBC), Vancouver, Canada, 9 - 13 August, 2021
- Intended audience: Post-graduate students and early career researchers from any oceans science discipline and any country in the world
- Application: http://mform.imr.no/view.php?id=110572
- Full details on summer school website: http://imber.info/activities-events/imber-climeco7-summer-school-interdisciplinary-ocean-science-for-sustainable-development-goals/

Agenda Item 20: PICES-2023

Dr. Batten provided a brief update regarding this joint PICES-ICES conference to be held in the USA in 2023, as mentioned in Dr. Karp's ICES update.

Agenda Item 21: PICES Publications

Dr. Batchelder provided an update on PICES recent publications.

Science Board recommended:

- That the following publication is to be produced in the PICES Scientific Report series in 2020, upon completion of the required review:
    - WG-32. Working Group on Biodiversity of Biogenic Habitats has completed its final report.
- That the following publications are to be produced in or submitted to primary journals in 2020 and shown on the PICES publication pages following publication:
- S-CC published paper: Sastri, A., J.R. Christian et al. Perspectives on in situ sensors for ocean acidification research, Frontiers in Marine Science (2019) 6:653. https://doi.org/10.3389/fmars.2019.000653
- S-HAB. Section on harmful Algal Blooms: two Journal Publications:
    - Trainer, V.L, Moore, SK, Hallegraeff, G., Kudela, RM, Clement, A., Mardones, JI, Cochlan, WP. 2020. Pelagic harmful algal blooms and climate change: Lessons from nature's experiments with extremes. Harmful Algae 91, 101591
    - Wells, ML, Karlson, B, Wulff, A, Kudela, R., Trick, C., Asnaghi, V, Berdalet, E., Cochlan, W, Davidson, K., De Rijcke, M., Dutkiewicz, S., Hallegraeff, G., Flynn, KJ, Legrand, C., Paerl, H., Silke, J., Suikkanen, S., Thompson, P., and Trainer, V.L. 2020. Future HAB science: Directions and challenges in a changing climate. Harmful Algae 91, 101632
- WG-40. Working Group on Climate and Ecosystem Productivity: ~16 submissions to a special issue of Frontiers in Marine Science (on North Pacific Climate and Ecosystem Predictability on Seasonal to Decadal Timescales) resulting from the 2019 Qingdao workshop and papers from the PICES-2019 Annual Meeting in Victoria. Editors: S. Minobe, A. Capotondi, F. Chai, M. Jacox, M Nonaka, and R. Rykaczewski. An overview of the special issue is to be put on the PICES Publication Page when the volume is completed.
- WG-34. Joint PICES/ISC Working Group on Ocean Conditions and the Distribution and Productivity of Highly Migratory Fish has two Journal Publications:
    - Muhling B., A., Brodie, S., Jacox, M., Snodgrass, O., Dewar, H., Tommasi, D., Edwards, C. A., Xu, Y., Snyder, S., & Childers, J. (2019) Dynamic habitat use of albacore and their primary prey species in the California Current System. CalCOFI Reports 60.
    - Runcie, R. M., Muhling, B. A., Hazen, E. L., Bograd, S. J., Garfield, T., & DiNardo, G. (2019). Environmental associations of Pacific bluefin tuna (Thunnus orientalis) catch in the California Current system. Fisheries Oceanography 28: 372-388

Agenda Item 22: ISB-2021 update

Dr. Trainer provided a very brief update on ISB-2021, which is to be held virtually via zoom as a series of three-hour meetings, similar to ISB-2020, in light of the continuing COVID-19 pandemic. Dates will be decided via Doodle poll of Science Board, and it is likely that the meeting will be held in the beginning of May, 2021

Agenda Item 23: Action Plans

Science Board discussed the intent and purpose of Action Plans, and agreed that the exercise of creating action plans is worthy of EG time. SB reviewed the Action Plan Template provided (See Appendix F). SB noted that not all groups find the exercise helpful to their activities. SB agreed to revisit Action Plans at ISB-2021.

Agenda Item 24: PICES Partner Organizations

Science Board members agreed to review the list of PICES partners and consider where additional partners will be necessary to achieve UNDOS goals. Science Board and Expert Group members are invited to continue to submit Partner Organization suggestions to the Secretariat so that the Partner Organizations can be integrated into PICES meetings on an ongoing basis. (See Appendix G for list of PICES Partner Organizations).

Call Review:

Dr. Trainer thanked Science Board members, guests, and Secretariat staff for their participation in the meeting, which then adjourned.

APPENDIX A: Agenda

Science Board Chair, Dr. Vera Trainer, will review video meeting etiquette and protocol, will call the meeting to order, welcome participants, and make introductions. The agenda will be reviewed and any adjustments/amendments will be made before the meeting commences.

Participants

Science Board	Vera Trainer	Science Board Chair	**vera.l.trainer@noaa.gov**
	Igor Shevchenko, rep. Russia	Science Board Vice-Chair	**igor.shevchenko@tinro-center.ru**
	Steven Bograd	FUTURE SSC Co-Chair	**steven.bograd@noaa.gov**
	Sukyung Kang	FUTURE SSC Co-Chair	**sukyungkang@korea.kr**
	Akash Sastri	BIO Chair	**Akash.Sastri@dfo-mpo.gc.ca**
	Xianshi Jin	FIS Chair	**jin@ysfri.ac.cn**
	Mitsutaku Makino	HD Chair	**mmakino@aori.u-tokyo.ac.jp**
	Guangshui Na	MEQ Chair	**gsna2010@163.com**
	Emanuele Di Lorenzo	POC Chair	**edl@gatech.edu**
	Sung Yong Kim	MONITOR Chair	**syongkim@kaist.ac.kr**
	Jeanette Gann	TCODE Chair	**jeanette.gann@noaa.gov**
Governing Council Members and Advisors	Chul Park	PICES Chair (TBC)	**chulpark@cnu.ac.kr**
	Dr. Laura Richards	PICES Past-Chair	**richards@pices.int**
	Dr. Carmel Lowe	F&A Chair	**carmel.lowe@dfo-mpo.gc.ca**
	Dr. Aleksei Baitaliuk	GC	**aleksei.baitaliuk@tinro-center.ru**
	Dr. Oleg A. Bulatov	GC	**obulatov@vniro.ru**
	Prof. Enrique N. Curchitser	GC	**enrique@marine.rutgers.edu**
	Dr. Tetsuo Fujii	GC	**tefujii@affrc.go.jp**
	Dr. Se-Jong Ju	GC	**sjju@kiost.ac.kr**
	Dr. Arran Ashley McPherson	GC	**Arran.McPherson@dfo-mpo.gc.ca**
	Prof. Fangli Qiao	GC	**qiaofl@fio.org.cn**
	Dr. Michael P Seki	GC	**michael.seki@noaa.gov**
	Mr. Hideki Uezono	GC	**hideki.uezono@mofa.go.jp**
	Mr. Antao Wang	GC	**wangantao@msn.com**
	Ms. Eun Won Yu	GC	**grace0907@korea.kr**
	Imai Kaori	Foreign Affairs, Japan	**kaori.imai@mofa.go.jp**
Invited Guests	William Karp	ICES	**bkarp@uw.edu**
	Erin Satterthwaite	FUTURE Earth	**satterthwaite@nceas.ucsb.edu**
	Jörn Schmidt	ICES	**joern.schmidt@ices.dk**

	Janelle Curtis	DFO Pacific Biological Station /NPFC	**Janelle.Curtis@dfo-mpo.gc.ca**
	Alex Zavolokin	NPFC	**azavolokin@npfc.int**
	Matt Baker	North Pacific Research Board	**Matthew.Baker@nprb.org**
PICES Secretariat	Sonia Batten	Executive Secretary	**Sonia.Batten@pices.int**
	Harold (Hal) Batchelder	Deputy Executive Secretary	**hbatch@pices.int**
	Alex Bychkov	Ex-officio	**bychkov@pices.int**
	Lori Waters	Science Board Support	**lori.waters@pices.int**

Agenda

Conference call #1: 180 Minutes

#	Item	Presenter	Time limit	Total Runtime	Details / Action, etc.
*	Conduct of call				
1	Welcome and meeting outline	Trainer	15	15	Dr. Trainer to call meeting to order, make introductions. SB to review agenda, note revisions, adopt agenda. Call etiquette review.
2	Election of Vice-Chair	Batchelder	5	20	Dr. Igor Shevchenko has served as SB Vice-Chair for one year, and has indicated his willingness to serve another year.
3	2020 report: FUTURE SSC	Kang, Bograd	Update: 10 WG 35: 5 WG 36: 5 Discussion: 10	30 35 40 50	- FUTURE update; highlight items requiring SB attention or decisions (10 mins) - Evaluation of Phase II Science, including: - progress towards objectives - new activities to accomplish objectives - update revised ECS award - update: product matrix - Provide FUTURE phase II final report - Provide WG updates: 35, 36 (5 mins ea.) - SB Discussion (10 mins)
4	Next integrative science program	Bograd, Kang, Trainer: present SB discussion /decision	15 10	65 75	- Phase III Science and Implementation Plans. - FUTURE recommendations for PICES contributions to UNDOS
SB to take a break when convenient.					
5	PICES Science contributions to the United Nations Decade of Ocean Science (UNDOS)	Bograd / Trainer	5 30	80 110	- SB to review plan - SB to recommend / not recommend plan - SG-UNDOS
6	Promoting PICES Science	Trainer	30	140	- PICES Science Communications Outreach
7	Promoting Flexibility and Environmental Sustainability within PICES	Trainer	15	155	- **Action:** SB to review carbon calculations - **Action:** SB to discuss carbon reduction / greener meetings - move business meetings to virtual?
8	NPFC *Appendix E*	Janelle Curtis PICES / NPFC	<5 mins	160	- 2019/20 NPFC /PICES Summary
9	SB / GC decisions	Batten	10	170	
*	Call review	Trainer	5	**175**	- Review conduct of call - note any required changes, suggestions, technical aspects

/End First Call.

Conference call #2: 180 Minutes

#	Item	Presenter	Time	Total Runtime	Details / Action, etc.
*	Conduct of Call				
10	ICES update	William Karp	5	5	
11	**Scientific / Technical Committee Mid-year reports. SB Chair direction for this agenda item:** • Presenters to focus on highlights, please use ppt template provided, no additional slides. • <5 mins, unless critical issues requiring SB attention. Please stay within total time allocation, allotting time to individual reports as required. **Committee reports for EG's:** Please note reporting arrangements, especially for Expert Groups that have more than one parent: • **SB** to report on **WG 39** • **BIO** to report on **S-MBM, WG 37** • **FIS** to report on **S-CCME, WG 43** • **HD** to report on **WG 41** • **MEQ** to report on **S-HAB, AP-NIS, WG 42** • **POC** to report on **S-CC, AP-CREAMS, WG 38, WG 40** • **MONITOR** to report on **AP-NPCOOS**				

Item	Presenter	Time	Total Runtime	Details / Action, etc.
SB - WG 39	Trainer	5	10	• WG 39 Report
BIO	Sastri	5	15	• WG 37 update on proposed schools: coastal ocean observatory science, and fisheries.
S-MBM	Sastri	5	20	
WG 37	Sastri	5	25	• WG-43 membership update
FIS	Jin	5	30	• HD - update on communication initiative HD update on knowledge map project WG 41 update on MES overview paper, MES survey, anticipated publications.
S-CCME	Di Lorenzo	5	35	
WG43	Jin	5	40	
HD	Makino	5	45	
WG41	Makino	5	50	• WG 41 update on funding request - details of inter-sessional workshop proposal.
MEQ	Na	5	55	
S-HAB	Na	5	60	
AP-NIS	Na	5	65	• AP-NIS - any update regarding a PICES/NOWPAP partnership on eDNA activities? WG-42 - any update on additional members?
WG42	Na	5	70	
POC	DiLorenzo	5	75	
S-CC	Di Lorenzo	5	80	• S-CC: Dr. Xianghui Guo appointed to this group to replace Dr. Minhan Dai?
AP-CREAMS	Di Lorenzo	5	85	
WG38	Di Lorenzo	5	90	• WG 38 - update on review paper disagreement?
WG40	Di Lorenzo	5	95	
MONITOR	Kim	5	100	• 105 mins presentations
AP-NPCOOS	Kim	5	105	• + 30 mins SB disc. = 135 mins.
TCODE	Gann	5	135	
SB Discussion	SB	30		

SB to take a break when convenient.

12	**Expert Group Updates**	Batchelder	35	175	• WG-39 Update on WG-39 joining WGICA? • WG-44: update on Co-chairs? • WG CHANGE (Deferred to PICES-2020) • SG-IMCE WG proposal 1 • SG-IMCE WG proposal 2 • WG-SciComms proposal • WG-ECOP proposal • WG-Seamounts • Requests for extensions if any
13	Code of Ethics	Batten	5	**180**	SB to review and make recommendation.

*	**Review Call**	Trainer			Review conduct of call

Conference call #3: 180 Minutes

#	Item	Presenter, # mins	Item time (mins)	Total Time (mins)	Details / Action, etc.
*	Conduct of Call		5	5	
14	Special Project Reports	SEAturtle update: Sastri Ciguatera intro: Makino	10 mins or less 10 mins or less	15 25	- SEAturtle: update, Akash Sastri, per Taewon Kim - Ciguatera - Project report, presenter: Makino
15	ECOPS mentorship framework	Trainer / Bograd	5		- SB / FUTURE update on ECOP / PICES mentorship framework
16	PICES-2021 Update & SB Session ranking	Batten - update SB rank sessions	20 30	50 80	- PICES-2021 Qingdao: Update - SB to review and rank session proposals for PICES-2021 - *spreadsheet to be provided.*
17	FUTURE OSM	Kang / Bograd	30	110	- Open Science Meeting Plans update
SB to take a break when convenient.					
18	PICES sponsored conferences symposia	Batten / Batchelder	5 5 5 5	115 120 125 130	- ECCW05 Norway: Defer to ISB-2021 - PICES → IYS Science update - ZPS: update on SCC members - MSEAS - Small Pelagic Fish (SPF)
19	Capacity Building *Appendix F*	Batchelder	5 5	135 140	- ICES PICES ECS 2023: Update from SB on ECOP members for SSC? - ClimEco7 Summer School: 9-13 August, 2021, UBC, Vancouver, Canada - PICES/AP-CREAMS Summer School on Ocean Turbulence
20	PICES-2022	Batten/Trainer	10	150	- Update: joint PICES/ICES Science Conference on 2022. This would require Expert Groups to give up much face-to face meeting time to be replaced with meetings by correspondence/conference call in the summer.
21	PICES - Latest Publications Update	Batchelder	5	155	- FishGIS Scientific report status - FishGIS final brochure status - WG-30 brochure / final report updates. - Other highlights
22	ISB-2021	Trainer / Secretariat	5	160	- ISB2021 – venue / date / format - overview
23	Action Plans	Trainer / Secretariat	5	165	- Brief overview ahead of ISB-2021
24	PICES Partner Organizations - *Appendix G*	Science Board	10	175	- SB members to review updated list, supply suggestions for additions.
*	Review Conduct of call	Trainer	5	180	

APPENDIX B: Survey of PICES-2020 participants regarding hybrid future meetings.

PICES-2020 - Follow Up Survey – DRAFT

(Note: would be distributed as a web survey, allowing users to select buttons, or fill in form fields.)

PICES has received significant feedback in recent years regarding the duration of the Annual meeting. In addition, PICES wishes to consider reducing its carbon environmental footprint in all future endeavours. Because of the COVID-19 pandemic we have made use of virtual business meetings and science sessions this year. As such, we would like to hear feedback from you, as PICES meeting attendees, to help us determine what our future Annual meetings will look like. We would like them to be as rewarding, non-exhausting, efficient, constructive, and as environmentally friendly and carbon-neutral as possible.

You may complete the survey anonymously but if you submit an email address it will be entered into a draw to win one of three complimentary registrations for PICES-2021

How many PICES meetings have you attended in person in the past?

- 1-3
- 4-6
- 7-10
- >10

On average, how long has it taken you to travel to a PICES meeting?

- ½ day
- 1 day
- > 1 day

What do you value about PICES meetings? (check all that apply)

- Learning about aspects of your own field of study
- Learning about aspects of new fields of study
- Meeting familiar colleagues
- Meeting new colleagues
- Opportunities for presentation
- Opportunities for collaboration
- Other _____

Which PICES-2020 sessions did you attend? (Choose all that apply).

- Expert Group Business meeting(s).
- Opening Ceremony
- Science Session(s)
- I did not attend the PICES 2020 Annual meeting

What feedback do you have for PICES regarding the Virtual sessions you attended? We are particularly interested in things that worked well, or that didn't work well for you.
(Open ended question - text box allowing participants to type their answers).

PICES is considering a number of options in the future for the format of its Annual meeting. Would you prefer:

- The entire PICES meeting to be held face-to-face (including business meetings, ceremonies, events, workshops, poster sessions and oral topic sessions).
- Business meetings to be held virtually in advance of the main meeting, but workshops and topic Sessions to be held as face-to-face meetings over a shorter period.
- The entire PICES meeting to be held virtually, via Zoom, Webex, or other similar platform (including business meetings, ceremonies, events, science sessions, etc.).

If you were planning future Annual meetings for PICES, what would you change to reduce their duration?(Open ended question - text box allowing participants to type their answers).
Please share any other feedback you have:

APPENDIX C: NPFC Update

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Report on the joint NPFC-PICES activities in 2019-2020

Summary
The intent of this document is to report on the recent joint activities between PICES and NPFC and plans for future collaborative work as required by the Framework for Enhanced Scientific Collaboration in the North Pacific. The Framework identified three broad areas of joint interest to PICES and the NPFC: (i) support for stock assessment for priority species; (ii) vulnerable marine ecosystems; and (iii) ecosystem approach to fisheries. In 2019-2020, NPFC and PICES had the following joint events or participated in each others' activities:

- Joint NPFC-PICES workshop on the influence of the environment on Pacific Saury;
- PICES-ICES joint Working Group on Small Pelagic Fish;
- PICES Working Group on Biodiversity of Biogenic Habitats;
- Joint PICES-NPAFC-NPFC workshop on Developing a collaborative, integrated ecosystem survey program to determine climate/ocean mechanisms affecting the productivity and distribution of salmon and associated pelagic fishes across the North Pacific Ocean.

NPFC members expressed interest in following the work of a proposed PICES Working Group on Biodiversity of Seamounts. NPFC invited PICES to hold a joint international course/workshop on VME indicator taxa identification in 2021.

1.0 Background

In 2019, the North Pacific Fisheries Commission (NPFC) and the North Pacific Marine Science Organization (PICES) endorsed the NPFC–PICES Framework for Enhanced Scientific Collaboration in the North Pacific. The Framework was developed by the joint PICES-NPFC Study Group for Scientific Cooperation in the North Pacific Ocean to enhance collaboration between the two organizations.

The Framework identified three broad areas of joint interest to PICES and the NPFC on which progress could be made over the next five years. These areas were (i) support for stock assessment for priority species; (ii) vulnerable marine ecosystems; and (iii) ecosystem approach to fisheries. The first two areas were ranked highest for both PICES and NPFC, and the third area was ranked lower.

The Framework identified various mechanisms for implementing enhanced collaboration between PICES and NPFC including workshops and joint working groups as the key ones in the near term, but also theme sessions at PICES annual meetings, representation at meetings and/or workshops, and coordination of science plans.

The NPFC and PICES are inter-governmental organizations with overlapping geographical areas and common scientific interests in the sub-Arctic regions of the North Pacific Ocean.

NPFC is a Regional Fisheries Management Organization (RFMO) which came into force on 19 July 2015 after ratification of the Convention on the Conservation and Management of the High Seas Fisheries Resources in the North Pacific Ocean. The objective of the Convention is to ensure the long-term conservation and sustainable use of the fisheries resources in the convention area while protecting the marine ecosystems of the North Pacific Ocean in which those resources occur. The fishery resources covered by the Convention are all fish, mollusks, crustaceans and other marine species caught by fishing vessels within the Convention area, excluding (i) sedentary species insofar as they

are subject to the sovereign rights of coastal states, and indicator species of vulnerable marine ecosystems as listed in, or adopted pursuant to the NPFC Convention, (ii) catadromous species, (iii) marine mammals, marine reptiles, and seabirds, and (iv) other marine species already covered by pre-existing international fisheries management instruments within the area of competence of such instruments. The Commission has several committees that provide information and advice to the Commission for decisions, and is supported by a Secretariat. These committees include the Scientific Committee, the Technical and Compliance Committee, and the Finance and Administration Committee.

PICES was established in 1992 (1) to promote and coordinate marine scientific research in order to advance scientific knowledge of the area concerned and of its living resources, including but not necessarily limited to research with respect to the ocean environment and its interactions with land and atmosphere, its role in and response to global weather and climate change, its flora, fauna and ecosystems, its uses and resources, and impacts upon it from human activities; and (2) to promote the collection and exchange of information and data related to marine scientific research in the area concerned. The Organization receives recommendations on the science program from the Science Board, which is supported by a number of permanent scientific and technical committees, along with an assemblage of "expert groups." The PICES Convention Area is defines as "the temperate and sub-Arctic region of the North Pacific Ocean and its adjacent seas, especially northward from 30 degrees North Latitude, hereinafter referred to as the "area concerned". Activities of the Organization, for scientific reasons, may extend farther southward in the North Pacific Ocean."

The present PICES members are Canada, Japan, People's Republic of China, Republic of Korea, the Russian Federation, and the United States of America, which are also members of NPFC (note: Chinese Taipei and Vanuatu are also members of NPFC).

2.0 Objective

The objective of this document is to report on the recent joint activities between PICES and NPFC and plans for future collaborative work as required by the Framework for Enhanced Scientific Collaboration in the North Pacific.

3.0 Joint NPFC-PICES activities in 2019-2020

In accordance with the Framework, NPFC and PICES

3.1 Support for Stock Assessments for priority species

On October 16, 2019 the joint NPFC-PICES workshop on the influence of the environment on Pacific Saury was held, in conjunction with the PICES 2019 Annual Meeting in Victoria, Canada. This workshop was the inaugural joint activity between PICES and NPFC to advance collaboration between the two organizations. Under the PICES-NPFC Framework, the theme area of stock assessment support was identified as a priority area for collaborative work. The objectives of this joint workshop were to:

- Present an overview of environmental conditions and spatio-temporal changes in Pacific Saury distributional areas,
- Identify periods with significantly different oceanographic conditions that could influence the population dynamics of Pacific Saury,
- Hind-, now- and fore-cast changes in habitat suitability for saury,
- Propose mechanisms for further research to understand the interaction of ecosystem changes on Pacific Saury distribution and population dynamics and associated consequences on stock assessment, and
- Discuss and identify approaches to incorporate environmental drivers in modeling the saury population dynamics to improve its stock assessment.

Eight presentations were given at the workshop including three talks from invited speakers: Dr. Kazuhiro Oshima, Dr. Chuanxiang Hua and Dr. Bai Li. The presentations addressed the following three topics: (1) the potential environmental

changes that have occurred in the area inhabited by Pacific Saury; (2) examination of projections and uncertainties in habitat suitability for Pacific Saury, and (3) mechanisms for further research on environmental impacts on Pacific Saury abundance. The workshop provided an opportunity to look at a broader picture and to address the issues which the NPFC Pacific Saury expert group does not address because of time constraints.

The workshop concluded with a discussion of the following future directions for research:

1. There should be further studies and analyses to build on the empirical relationships that have been identified to determine mechanistic processes controlling the distribution and abundance of Pacific Saury.
2. Environmental relationships (identified through mechanistic and empirical studies) should be explored in future stock assessments for Pacific Saury.
3. Research to link projections (under different climate change scenarios) and hindcasts of regional ocean models to projections of Pacific Saury abundance should be undertaken.
4. Analyses should consider the impacts of the environment on setting biological reference points and harvest control rules for Pacific Saury.

It was concluded that further collaboration with PICES would be good for moving forward on improving stock assessments for Pacific Saury as well as other species of interest to NPFC. The workshop participants endorsed continuing the discussions and collaborations between NPFC and PICES, with potential ideas of forming a joint PICES-NPFC Working Group and suggesting a broader topic session in the PICES 2020 annual meeting on the effects of the environment on small pelagic fishes that would have participation and engagement from a larger portion of the PICES community of researchers.

In 2019, PICES and ICES formed a joint Working Group on Small Pelagic Fish (WGSPF), and NPFC designated its representatives in the WGSPF, Dr. Toshihide Kitakado and Dr. Oleg Katugin.

The WGSPF aims to:

- Review recent progress on understanding how various drivers (environmental and/or anthropogenic) impact the population dynamics of SPF in different ecosystems and whether and how potential drivers shift with changes in ecosystem state.
- Create a networking environment for international and multidisciplinary collaboration to foster the establishment of similar study frameworks and comparative analyses of SPF across different social-ecological systems based on updated time-series data sets of climate indices, environmental factors and tipping points, fisheries biology, ecophysiological information (e.g. feeding, growth and survival), and inter-model comparisons.
- Identify, prioritize, and coordinate research most needed to advance our knowledge and capacity to predict the population dynamics of SPF at both short (seasonal to inter-annual) and long (decadal to centennial) time scales.
- Provide recommendations for strategies of marine ecosystem monitoring and fisheries management of SPF which will contribute to sustainable ecosystem-based fisheries management, through biophysical, ecosystem and/or socio-economic models.
- Organize a joint ICES/PICES symposium on SPF, tentatively scheduled for late 2021, that builds upon the 2017 symposium in Victoria, Canada, and showcases integrative analyses of this working group. Additionally, working group members will propose, coordinate, and convene topic sessions at PICES Annual Meetings and ICES Annual Science Conferences focused on key questions and recent advances in SPF science.

The WGSPF had a kick-off meeting in March 2020 to discuss plans and identify activities for the following three years. One of them is a workshop on research priorities for understanding the population dynamics of small pelagic fish in the North Pacific which will be held virtually in conjunction with the PICES-2020 annual meeting. The workshop is intended to discuss and prioritize research questions concerning the dynamics of small pelagic fish populations in the North Pacific. Participants will be encouraged to highlight key gaps in understanding and suggest actionable research activities that can be shared with the broader ICES, PICES, and other international communities. Small pelagic fish are of high importance to the NPFC as they comprise more than 90% of the total catch by NPFC Members in the Convention Area.

3.2 Vulnerable Marine Ecosystems (VMEs)

PICES Working Group on Biodiversity of Biogenic Habitats (WG32) has recently finalized its report summarizing key outcomes of the activities from 2015 to 2018. Even though NPFC formally did not participate in the working group, some NPFC scientists took part in its work, including both of WG32's co-chairs. WG32 members developed species distribution models (SDMs) for several major groupings of biogenic habitat-forming corals and sponges, in part to assess the primary drivers of suitable habitat for these taxa and to identify potential areas of high diversity of biogenic habitats. Some members and their collaborators introduced a new method for assessing the validity of VME indicator taxa (Gorgonians, Alcyonacea, Antipatharia and Scleractinia) and applied association analysis for identifying VME indicators on the basis of sea-floor visual imagery. Others reconstructed long-term climate-driven range shifts in biogenic habitats and associated fishes in the western North Pacific Ocean from tropical to subarctic zones. A key outcome of WG32's activities included the identification of large scale environmental and ecological predictors for the distribution and biodiversity of coral, sponge and associated taxa.

Members of the Working Group on Biodiversity of Biogenic Habitats (WG-32) recommended establishment of a Working Group on Biodiversity of Seamounts, with a focus on understanding the distribution of benthic, demersal, and pelagic species that are associated with seamounts. The proposed 3-year Working Group will advance the understanding of the distribution of the biodiversity of seamounts in the North Pacific Ocean. This effort would build on the contributions of WG-32 by mapping the distribution of seamount biodiversity and expands research in some of the unique and abundant ecosystems of the North Pacific Ocean for PICES. WG-32's focus on biogenic habitat provided a proof of concept on how to undertake collaborative biodiversity research in the North Pacific Ocean. Major applications of the science products developed by the Working Group on Biodiversity of Seamounts would be the provision of further technical guidance on the development and application of species distribution models, maps of known and predicted distributions of the benthic, demersal, and pelagic taxa associated with seamounts, and the development of seamount biodiversity indicators.

A proposal for the Working Group on Biodiversity of Seamounts has been submitted to PICES for consideration. NPFC members are strongly encouraged to participate in the new working group as the expected deliverables of the working group potentially can supplement the NPFC research towards protection of vulnerable marine ecosystems. Indeed, the proposed working group's co-chairs are both involved with NPFC's Scientific Committee.

NPFC invited PICES to hold a joint international course/workshop on VME indicator taxa identification. The course is aimed at capacity building and sharing knowledge on the identification of coral species in the North Pacific. It will include both theory and practice such as lectures on the taxonomy, physiology and geographical distribution of the VME indicator taxa and training on the identification of coral specimens. The course was originally scheduled for 2020 but is postponed to 2021.

3.3 Other collaborative activities

NPFC representatives took part in the joint PICES-NPAFC-NPFC workshop on Developing a collaborative, integrated ecosystem survey program to determine climate/ocean mechanisms affecting the productivity and distribution of salmon and associated pelagic fishes across the North Pacific Ocean in October 2019. The NPFC Science Manager presented a review on non-salmon species in the North Pacific with the aim to find out which NPFC species can be expected by NPFC to be caught in the pan-Pacific ecosystem research survey in 2021. Potential outputs for NPFC from joining the pan-Pacific survey could include improved knowledge about the distribution and migration of its priority species, validation and adjustment of models, new biological information on priority fishes and squids, and other data related to oceanography, fish diets, and zooplankton.

The workshop proposed a topic session at the 2020 PICES meeting to review the recent high seas expeditions and further develop a research program. The convenors of the topic session include representatives from NPAFC, PICES and NPFC.

APPENDIX D: Science Board Requests and Governing Council Decisions

2020 Intersessional Governing Council Decisions

(The following decisions were taken by correspondence during June and July 2020)

2020/S/1: Publications

i. The following publications are to be produced in the PICES Scientific Report series in 2020, upon completion of the required review:

a. WG-32. Working Group on Biodiversity of Biogenic Habitats has completed its final report.

ii. The following publications are to be produced in or submitted to primary journals in 2020 and noted on the PICES publication pages following publication:

a. S-CC, Section on Carbon and Climate has published the following paper: Sastri, A., J.R. Christian et al. Perspectives on in situ sensors for ocean acidification research, Frontiers in Marine Science (2019) 6:653. **https://doi.org/10.3389/fmars.2019.000653**

b. S-HAB. Section on harmful Algal Blooms has two Journal Publications:

1. Trainer, V.L, Moore, SK, Hallegraeff, G., Kudela, RM, Clement, A., Mardones, JI, Cochlan, WP. 2020. Pelagic harmful algal blooms and climate change: Lessons from nature's experiments with extremes. Harmful Algae 91, 101591

2. Wells, ML, Karlson, B, Wulff, A, Kudela, R., Trick, C., Asnaghi, V, Berdalet, E., Cochlan, W, Davidson, K., De Rijcke, M., Dutkiewicz, S., Hallegraeff, G., Flynn, KJ, Legrand, C., Paerl, H., Silke, J., Suikkanen, S., Thompson, P., and Trainer, V.L. 2020. Future HAB science: Directions and challenges in a changing climate. Harmful Algae 91, 101632

c. WG-40. Working Group on Climate and Ecosystem Productivity has at least 16 submissions to a special issue of Frontiers in Marine Science (on North Pacific Climate and Ecosystem Predictability on Seasonal to Decadal Timescales) resulting from the 2019 Qingdao workshop and papers from the PICES-2019 Annual Meeting in Victoria. Editors: S. Minobe, A. Capotondi, F. Chai, M. Jacox, M Nonaka, and R. Rykaczewski. An overview of the special issue is to be put on the PICES Publication Page when the volume is completed.

d. WG-34. Joint PICES/ISC Working Group on Ocean Conditions and the Distribution and Productivity of Highly Migratory Fish has two Journal Publications:

1. Muhling B., A., Brodie, S., Jacox, M., Snodgrass, O., Dewar, H., Tommasi, D., Edwards, C. A., Xu, Y., Snyder, S., & Childers, J. (2019) Dynamic habitat use of albacore and their primary prey species in the California Current System. CalCOFI Reports 60.

2. Runcie, R. M., Muhling, B. A., Hazen, E. L., Bograd, S. J., Garfield, T., & DiNardo, G. (2019). Environmental associations of Pacific bluefin tuna (*Thunnus*

orientalis) catch in the California Current system. Fisheries Oceanography 28: 372-388

2020/S/2 Current Expert Groups

The following changes to Expert Groups were approved:

i. AP-NPCOOS: Co-chair Dr. Jack Barth (USA) be replaced by Dr. S. Kim Juniper (Canada) and that co-chair Dr. Sung Yong Kim (Korea) be replaced by Dr. Naoki Yoshie (Japan).

ii MONITOR. The appointment of Dr. Clare Ostle (Marine Biological Association, UK) *as ex officio* Continuous Plankton Recorder Member to MONITOR, replacing Dr Sonia Batten.

iii WG 39. Joint PICES/ICES/PAME Working Group on an Integrated Ecosystem Assessment for the central Arctic Ocean. Approval of revised Terms of Reference did not take place at PICES 2019 and are approved here.

2020/S/3 New Expert Groups

The following new Expert Groups were approved and Council is requested to appoint members to this group:

i. WG GRAFY Joint ICES/PICES Working Group on Impacts of Warming on Growth Rates and Fisheries Yields.

ii WG ONCE PICES/ICES Working Group on Ocean Negative Carbon Emissions.

APPENDIX E: PICES 2021: Science Board Rankings

WORKSHOPS held over for 2021, not held virtually in 2020

- W1: (MEQ) The Expansion of Harmful Algal Blooms (HABs) from lower to higher latitudes
- W2: (BIO/FIS) Can we link zooplankton production to fisheries recruitment?
- W3: (FIS) 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
- W5: (FIS) Pelagic and forage species – predicting response and evaluating resiliency to environmental variability
- W7: (FUT/POC) The social-ecological-environmental dynamics of climate extremes in Pacific coastal systems (Possible Cosponsored by ONC)
- W8: (BIO/MEQ) Sea turtles and environmental stressors in the North Pacific

WORKSHOPS requested for 2021 (held as 2020 VIRTUAL WS) In order of SB ranking

1. W9: (FUT) Building a PICES early career professional network [Thursday, October 15, 2020/Virtual]

2. W6: (FIS) Research priorities for understanding the population dynamics of small pelagic fish in the North Pacific (Potential cosponsors: ICES, IOC, NPFC) [Wednesday, October 14, 2020/Virtual]

3. W4: (SB) How does the Pacific Arctic gateway affect the marine system in the Central Arctic Ocean (CAO)? [Tuesday, October 13, 2020/Virtual]

Notes: For the workshops held in 2020 as virtual workshops, SB suggests for 2021 that:

- W4 be combined with WG 39/44 WS.
- W6 be combined with W5.

2020 NEW workshop proposals for PICES-2021, in order of SB ranking

1. WS (AP-NPCOOS) Monitoring Essential Biodiversity Variables in the coastal zone. Supported by MONITOR, TCODE, BIO, FUTURE.

2. WS (WGs 39/44) Integrated Ecosystem Assessment (IEA) to understand the present and future of the Central Arctic Ocean (CAO) and Northern Bering and Chukchi Seas (NBS-CS)

3. WS (HD)Training WS on Sci.Communication (WG-Communication)

4. WS (FIS) "The Northern Bering Sea-Chukchi Sea Integrated Ecosystem Assessment: Recent Finding, Progress, and the way forward" be added to a potential waitlist, if scheduling permits addition of new workshop.

5. WS (S-MBM) Anthropogenic stressors, mechanisms and potential impacts on Marine Birds and Mammals" (in person*, virtual, or hybrid). Outcome: development of a Pathways of Effects style heuristic or conceptual model describing how stressors act on marine birds and mammals.

6. WS (WG-32, NPFC) Biodiversity of SeaMounts"Distributions of pelagic, demersal, and benthic species associated with seamounts in the North Pacific Ocean and factors influencing their distributions"*

Notes: For the above new workshop proposals, SB suggests for 2021 that:

- W4 be combined with WG 39/44 WS.
- WS FIS - Northern Bering-Chuckchi Sea be combined with 39/44
- WS-S-MBM be virtual.

PICES-2020 SB RANKING for PICES-2021

SESSIONS held over for 2021

- (SB) How does 30 years of research on changing North Pacific ecosystems inform the UN Decade of Ocean Science for Sustainable Development Goals (SDGs)? [Monday, Oct 26, 2020/Virtual] S1
- (POC) Global warming patterns and multiscale climate variability in the North Pacific S2
- (POC) Upper ocean energetics from mesoscale, submesoscale to small-scale turbulence in the North Pacific S4
- (HD) How the studies on human dimensions can contribute to meet the 7 societal needs of the Decade of Ocean Science? S3
- (HD) Marine Ecosystem Services – Connecting science to decision making S8
- (BIO/POC) Atmospheric nutrient deposition and microbial community responses, and predictions for the future in the North Pacific Ocean [Wed, October 29, 2020/Virtual] S5
- (FIS/POC) Environmental variability and small pelagic fishes in the North Pacific: exploring mechanistic and pragmatic methods for integrating ecosystem considerations into assessment and management S6
- (FUT) Managing for pathways of resilience in a changing climate: recent examples and emerging approaches S7
- (FUT/POC/TCODE) Applications of artificial intelligence to advance the understanding of North Pacific ecosystems S9
- (FUT/POC) Predictions of extreme events in the North Pacific and their incorporation into management strategies S12
- (MEQ) Impacts of climate change on aquaculture S10
- (MEQ/WG-42) Using environmental indicators to assess baselines, targets, and risk of plastic pollution in the North Pacific S11
- (MEQ) Using eDNA to assess and manage non-indigenous species in the North Pacific [Wed, Oct 28, 2020/Virtual] S13

- (FIS) Implementing a collaborative, integrated ecosystem high seas survey program to determine climate/ocean mechanisms affecting the productivity and distribution of salmon and associated pelagic fishes across the North Pacific Ocean [Wed, Oct 28, 2020/Virtual] S14
- (FIS/POC) Species migration and shifts responding to climate change: linking physics, plankton dynamics and fish ecology S15
- (S-HAB) ½-day Topic Session on "The effects of ocean acidification and climate change stressors on the growth and toxicity of harmful algal species" S17

PAPER SESSIONS HELD OVER

- BIO-P: Biological Oceanography Committee Paper Session
- FIS-P: Fisheries Science Committee Paper Session
- MEQ-P: Marine Environmental Quality Committee Paper Session
- POC-P: Physical Oceanography and Climate Committee Paper Session
- HD-P: Human Dimension Committee Paper Session
- GP: General Poster Session

NEW TOPIC SESSION REQUESTS - both given identical ranking by Science Board

- (AP-NIS / NOWPAP)1 day session, eDNA & NIS, sponsored by NOWPAP
- (S-CC) 1 day session. Connecting knowledge of ocean deoxygenation in coastal and offshore regions of the North Pacific.

PICES-2020 SB RANKING for PICES-2021

Business Meeting Requests for PICES-2021 - new requests in addition to those carried over from PICES-2020

Ranked as high priority by SB

- FUTURE-SSC: requests a 2 day Business Meeting at PICES-2021
- S-CCME: requests 1 day Business Meeting at PICES-2021
- S-HAB request for PICES-2021: S-HAB +MAFF CFP Project Science Meeting (1 day + 1day)

Below: ranked as medium priority by SB

- AP-NPCOOS Requests a 1/2 day business meeting at PICES-2021
- WG-37 Requests half day business meeting at PICES-2021, Pending term extension, (Virtual meeting ahead of PICES-2021 is fine).
- WG-39 Requests half day business meeting at PICES-2021
- WG-41 Requests a full day business meeting at PICES-2021
- WG-42 Requests one day business meeting at PICES-2021
- WG-43 Requests half day business meeting at PICES-2021
- WG-44 Requests one day business meeting at PICES-2021
- WG-45 Requests one day business meeting at PICES-2021

Travel Support Requests for PICES-2021 - carried over

- S-HAB request for Travel support for PICES-2021: for 1 invited speaker/participant for PICES 2021 Workshop: The expansion of harmful algal blooms (HABs) from lower to higher latitudes (E or W).

- S-HAB request for Travel support for PICES-2021: Travel support requested for 1 invited speaker/participant for PICES 2021 Topic Session: The effects of ocean acidification and climate change stressors on the growth and toxicity of harmful algal species (tentative speaker Dr. Dedmer van de Waal, Netherlands Institute of Ecology).

Travel Support Requests for PICES-2021 - new

- AP-NPCOOS Requests $2945 Travel Support for the invited Speaker for the workshop on Monitoring Essential Biodiversity Variables in the coastal zone.

- WG-39 Requests Travel Support for invited speaker / Costs for workshop, PICES-2021.$3000

CARRIED OVER PLENARY

(FUT) FUTURE plenary on PICES' role in the UN Decade S16

NEW PLENARY REQUEST

AP-NPCOOS proposes a plenary speaker for PICES-2021: ""best practices for coastal ocean observing systems" Proposed Speaker: Jay Pearlman. See Addenda #2.

Science Board Recommends that the new plenary speaker request be deferred for consideration at ISB-2021.

APPENDIX E: PICES-Sponsored Conferences / Symposia – updates.

ECCW05 Norway

- Local Host: Institute of Marine Research, Norway
- Venue: Bergen, Norway
- Proposed dates: 8-12 May 2023
- Principal local host contact: Geir Huse (**Geir.Huse@hi.no**)
- Theme and scope: to be defined over coming months.
- Format: Virtual or hybrid: to be defined over coming months.

- **For consideration by SB at ISB-2021:**
  SB to identify leadership team for this Conference:
  - **One** Symposium Convenor
  - **Two** Symposium Coordinators (recommend Sonia Batten and Hal Batchelder)
  - **3 – 5** scientists from PICES for the Scientific Steering Committee. At least one of these should be drawn from S-CCME

PICES / ICES Zooplankton Production Symposium (ZPS)

- Local Host: Anthony Richardson, CSIRO, Tasmania
- Venue: Hotel Grand Chancellor, Hobart
- Proposed dates: 13 - 18 March, 2022 - ***may be postponed to Spring of 2024.***
- Principal local host contact:

Marine Socio-Ecological Systems (MSEAS)

- Local Host Chair / Vice Chair: Toyomitsu Horii / Mitsutaku Makino
- Venue: Yokohama Port Opening Memorial Hall (Jack's Tower)
- Provisionally postponed to May 2021- ***may be further delayed.***
- Updates available on MSEAS **website**

ICES/PICES/FAO International Symposium on Small Pelagic Fish (SPF)

- Theme: "Small Pelagic Fish: New Frontiers in Science for Sustainable Management"
- Local Host: Susana Garrido
- Venue: Calouste Gulbenkian Foundation Congress Area, Lisbon, Portugal
- Proposed dates: February 21 - 25, 2022
- Principal local host contact: susana.garrido@ipma.pt

The emphasis of this group is on advancing knowledge about small pelagic fish, such as sardines and anchovies, in systems socioecological - for understanding and predicting fluctuations major fish _stocks_ and how to manage them as sustainable living marine resources. The symposium is intended to take place 20 - 24 Feb, 2022. 300 participants are expected. There will be 3 parallel sessions over 4 days and morning plenary sessions on 3 days (Monday to Wednesday).

APPENDIX F: Action Plan Template

<Insert Committee name here>
ACTION PLAN
2021 – 2024

<Insert Committee Abbreviation here, e.g. POC> **Mission Statement**

- REPLACE EXAMPLE TEXT BELOW (Originally from POC Mission Statement):
- Example: To promote and coordinate research and facilitates exchange of information and data on the impacts of ocean climate variability and change on living marine resources and human societies, on scales ranging from sub-seasonal to millenial and sub-mesocale to basin-scale.

Goal 1: Understand the functioning, resilience, and vulnerability of marine ecosystems.

- <Insert Actions for your committee here, relevant to the Goal as set out above>
- Insert Action here
- Insert Action here

Goal 2: Understand and quantify how marine ecosystems respond to human activities and natural forcing.

- <Insert Actions for your committee here, relevant to the Goal as set out above>
- Insert Action here
- Insert Action here

Goal 3: Provide scientific advice pertinent to North Pacific ecosystems.

- <Insert Actions for your committee here, relevant to the Goal as set out above>
- Insert Action here
- Insert Action here

Goal 4: Ensure that PICES products are relevant, timely, and broadly accessible.

- <Insert Actions for your committee here, relevant to the Goal as set out above>
- Insert Action here
- Insert Action here

Goal 5: Collaborate with organizations and scientific programs relevant to PICES.

- <Insert Actions for your committee here, relevant to the Goal as set out above>
- Insert Action here
- Insert Action here

Goal 6: Strengthen communication and engagement with users of PICES scientific products.

- <Insert Actions for your committee here, relevant to the Goal as set out above>
- Insert Action here
- Insert Action here

Goal 7: Advance methods and tools to improve and enhance scientific activities.

- <Insert Actions for your committee here, relevant to the Goal as set out above>
- Insert Action here
- Insert Action here

Goal 8: Foster collaboration among scientists within PICES.

- <Insert Actions for your committee here, relevant to the Goal as set out above>
- Insert Action here
- Insert Action here

Goal 9: Create education and training opportunities.

- <Insert Actions for your committee here, relevant to the Goal as set out above>
- Insert Action here
- Insert Action here

Goal 10: Provide an effective infrastructure to support PICES activities.

- <Insert Actions for your committee here, relevant to the Goal as set out above>
- Insert Action here

Insert Action here

APPENDIX G: PICES Partner Organizations

ISC (International Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean)

ISC has sent observers to PICES Annual Meetings since 2009. ISC and PICES share research interests in the relation between spatio-temporal patterns of variability and environmental signals, future climate scenarios, and end-to-end modeling. A joint ISC-PICES Study Group for *Scientific Cooperation of ISC and PICES* established in April 2015 to develop a framework for scientific cooperation in the North Pacific. The framework identified 3 broad research themes of mutual interest to ISC and PICES:

- Oceanographic conditions and the distribution and productivity of pelagic fish;
- Environmental interactions with fishers and fisheries (Section 2.2);
- Effects of climate change on the distribution and productivity of pelagic fish.

ISC/PICES collaborations include:

- ISC co-sponsored a FIS/TCODE Topic Session (S10) at PICES-2013: *Banking on recruitment curves: Returns on intellectual investment*. Invited speaker: Jon Brodziak (PIFSC, USA and ISC);
- PICES scientist (C.I. Zhang, Korea) presented a talk on "*Ecosystem-based assessment and management for sustainable fisheries*" at ISC13, Busan, Korea, July 17–22, 2013;
- ISC co-sponsored a 2-day workshop (W1) on "*Dynamics of pelagic fish in the North Pacific under climate change*" (W1) at PICES-2014, Yeosu, Korea;
- An ISC/PICES Study Group (SG-SCISC) workshop was held in Kona, HI, July 2015 to explore and prioritize scientific topics of interest to both ISC and PICES, and to develop the TOR and activities for a joint ISC-PICES working group. See the framework for scientific cooperation for a Working Group.
- A joint PICES/ISC Working Group on Ocean Conditions and the Distribution and Productivity of Highly Migratory Fish (WG 34) was established at PICES-2015;
- ISC co-sponsored a FIS Workshop (W4) at PICES-2016: *Methods relating oceanographic conditions to the distribution of highly migratory species* (Co-Convenors: Gerard DiNardo (ISC/USA), Chi-Lu Sun (ISC/Chinese Taipei);
- ISC co-sponsored the PICES International Symposium on "*Understanding changes in transitional areas of the Pacific",* April 24–26, 2018, La Paz, Mexico;
- ISC co-sponsored a FIS Topic Session (S12) on "*Applying ecosystem considerations in science advice for managing highly migratory species*"(Co-Convenor: Steve Teo (ISC USA)at PICES-2018.
- Dr. Gerard DiNardo represented ISC at PICES-2017; Dr. Hal Batchelder represented PICES at ISC17 in Vancouver, Canada.

Argo

Argo is an international project to collect information on the temperature and salinity of the upper part of the world's oceans. Argo uses robotic floats that spend most of their life drifting below the ocean surface. They make temperature and salinity measurements when they come up to the surface and after transmitting their data to satellites, they return to depth to drift for 10 days. Currently, there are roughly 3000 floats producing 100,000 temperature/salinity profiles per year. The floats go as deep as 2000m.

Among the many breakthroughs in observational technology and capabilities the Argo float observatory is one of the most impressive and successful examples (Freeland et al., 2010. Argo - A decade of progress, **doi:10.5270/OceanObs09.cwp. 32**). As Argo enters its second decade and chemical/biological sensor technology has improved significantly, it is becoming obvious that this observatory will be embraced by the ocean biogeochemistry community.

The primary goal of Argo, as enunciated in the original prospectus is to create a global network of instruments integrated with other elements of the climate observing system:

- to detect climate variability on seasonal to decadal time-scales. The targeted variability includes changes in the large-scale distribution of temperature and salinity and in the transport of these properties by large-scale ocean circulation;
- to deliver information needed for calibration of satellite measurements, and
- to provide data for initialization and constraint of climate models.

- Third Argo Science Workshop: The future of Argo (co-sponsored by PICES and several Chinese agencies/organizations), March 25–27, 2009, Hangzhou, China;
- Freeland, H. & Co-Authors (2010). "Argo - A Decade of Progress" in *Proceedings of OceanObs'09: Sustained Ocean Observations and Information for Society* (Vol. 2), Venice, Italy, 21-25 September 2009, Hall, J., D.E. Harrison & D. Stammer, Eds., ESA Publication WPP-306, doi:10.5270/OceanObs09.cwp.32
- Argo co-sponsored (with GOOS) MONITOR Topic Session (S7) on "*State of the art of real-time monitoring and its implication for the FUTURE oceanographic study*" co-convened by Jack Barth (U.S.A.), Dake Chen (China), David L. Mackas (Canada), Vyacheslav Lobanov (Russia), Young Jae Ro (Korea) and HiroyaSugisaki (Japan) at PICES-2009, Jeju, Korea.
- The International Argo Steering Team (Dr. Toshio Suga, Co-Chair of the Team) was the recipient of the 2018 POMA.

Argo usually sends a representative to PICES Annual Meetings. Dr. Tetjana Ross is representing Argo at PICES-2019.

FAO (Food and Agriculture Organization of the United Nations/Fisheries and Aquaculture Department)

The FAO Fisheries and Aquaculture Department usually sponsors large-scale PICES on symposia involving fish and fisheries:

- FAO and PICES co-sponsored (with GLOBEC and EUR-OCEANS) the Symposium on "*Coping with global change in marine social-ecological systems*", July 8–11, 2008, Rome, Italy;
- FAO and PICES co-sponsored (with IOC, FAO, SCOR, NOWPAP) the 15th International Conference on Harmful Algae, October 29–November 2, 2012, Changwon, Korea;
- PICES/ICES/FAO symposium on "Climate change effects on fish and fisheries: Forecasting impacts, assessing ecosystem responses, and evaluating management strategies" (April 25–29, 2010, Sendai, Japan);
- FAO was represented at the PICES/ICES Workshop on "Global assessment of the implications of climate change on the spatial distribution of fish and fisheries", May 22–24, 2013, St. Petersburg, Russia;
- PICES/ICES/FAO International Symposium on "*Drivers of dynamics of small pelagic fish resources*", March 6–11, 2017, Victoria, Canada (Dr. Manuel Barange, Director of the Fisheries and Aquaculture Policy and Resources Division, represented FAO);
- PICES/ICES/IOC/FAO 4th International Symposium on "*The effects of climate change on the world's oceans*" (June 4–8, 2018, Washington, DC, USA);
- S-CCME contributed Chapter 6, Climate change impacts, vulnerabilities and adaptations: North Pacific and Pacific Arctic marine fisheries, to an FAO Fisheries and Aquaculture Technical Paper 627 (2018) on "Impacts of climate change on fisheries and aquaculture. Synthesis of current knowledge, adaptation and mitigation" (an update of FAO Tech. Paper 530 (2009)).
- Dr. Yimin Ye represented FAO at PICES-2017.

Regional program of IMBeR

Ecosystem Studies of Sub-Arctic and Arctic Seas (ESSAS)

ESSAS objectives are to understand how climate variability and climate change affect the marine ecosystems of Subarctic and Arctic seas and their sustainability, and in turn, how changes in the marine ecosystems affect humans. ESSAS conducts research to compare, quantify, and predict the impact of climate variability and global change on the productivity and sustainability of Subarctic and Arctic marine ecosystems and their effect on humans. ESSAS has close ties to PICES and its Forecasting and Understanding Trends, Uncertainty and Response (FUTURE) project, and to the North Pacific Research Board (NPBR) in the Pacific and with International Council for the Exploration of the Sea (ICES) in the North Atlantic. ESSAS has connections and is collaborating in studies of interactions between Arctic and Sub-Arctic regions with Arctic-Subarctic Ocean Fluxes (ASOF), Arctic Ocean Sciences Board (AOSB), and Climate Variability and Predictability (CLIVAR) programs.

Symposia and inter-sessional workshops co-sponsored by PICES

- An ESSAS Symposium on "*Climate variability and sub-Arctic marine ecosystems*", May 16–20, 2005, Victoria, Canada;
- ESSAS and PICES held a joint a workshop to develop comparative studies of the sub-Arctic seas, June 12-14, 2006, St. Petersburg, Russia;
- The second ESSAS Open Science Meeting (also co-sponsored by ICES) on "*Comparative studies of climate effects on polar and sub-polar ocean ecosystems: Progress in observation and prediction*" (May 2011, Seattle, USA) by providing organizational support (including: maintaining the meeting website, handling major finances, on-line registration and abstract submission, compiling the book of abstracts, and arranging the logistics for the venue).
- An ESSAS Symposium on "Moving in, out and across the Subarctic and Arctic - shifting boundaries of water, ice, flora, fauna, people and institutions" June 12-16, 2017, Tromsø, Norway.

PICES Annual Meetings

- PICES and ESSAS initiated the Marine Ecosystem Model Inter-comparison Project (MEMIP) in 2008, in which the goal was to compare the performance of various lower trophic level marine ecosystem simulation models in predicting the abundance and distribution of coastal zooplankton functional groups. A series of joint MEMIP workshops were organized in conjunction with PICES Annual Meetings starting in 2008:
  - MONITOR/ESSAS workshop (W3) on "Status of marine ecosystems in the sub-arctic and arctic seas - Preliminary results of IPY field monitoring in 2007 and 2008", PICES-2008, Dalian, China;
  - CCCC/ESSAS workshop (W5) on "*Marine ecosystem model inter-comparisons*", PICES-2008, Dalian, China;
  - BIO workshop (W4) co-sponsored by ESSAS on "*Marine ecosystem model inter-comparisons (II)*", PICES-2009, Jeju, Korea;
- ESSAS/PICES workshop (W4) on "*Subarctic-Arctic interactions*" at PICES-2012, Hiroshima, Japan;

Publications

- Selected papers from the GLOBEC Symposium on "*Effects of climate variability on Sub-Arctic marine ecosystems*" (Guest Editors: G.L. Hunt Jr., K. Drinkwater, S.M. McKinnell, D.L Mackas) was published in Deep-Sea Research II, 2007, Vol. 54(23-26);
- A summary of the ESSAS 2011 Open Science Meeting on "*Comparative studies of climate effects on polar and sub-polar ocean ecosystems*" was published in the July 2011 issue (Vol. 19 No. 2) of PICES Press;
- Selected papers from ESSAS 2011 Open Science Meeting on "*Comparative studies of climate effects on polar and sub-polar ocean ecosystems*" (Guest Editors: K. Drinkwater,

G. Hunt, Jr., O. Astthorsson, and E. Head) was published in ICES Journal of Marine Science, 2012, Vol. 69(7).

ESSAS is regularly represented at PICES Annual Meetings. Dr. Franz Meuter is representing ESSAS at PICES-2019.

Large-scale Ocean Research Programs co-sponsored by IOC

WESTPAC (IOC Sub-Commission for the Western Pacific)

By bringing together, and in partnership with, governmental agencies and marine scientific communities, WESTPAC is committed to developing, coordinating and implementing marine scientific research, observations and services on four themes:
1) Understanding ocean processes and climate change in the Indo-Pacific (*e.g.*, through NEAR-GOOS);
2) ensuring marine biodiversity and seafood safety;
3) safeguarding the health of ocean ecosystems (*e.g.*, through projects/programs such as marine coastal and biodiversity conservation, coral reef under climate and anthropogenic perturbations, harmful algal blooms, remote sensing of coastal habitats, marine toxins and seafood safety); and
4) enhancing knowledge of emerging ocean science issues (*e.g.*, regular process for global reporting and assessment of the state of the marine environment, mapping of harmful jellyfish, Asian dust and its impact on the ocean ecosystem).

The main topics for cooperation between WESTPAC and PICES to date have been through ecosystem monitoring (NEAR-GOOS), harmful algal blooms, invasive species, and capacity building activities.

WESTPAC and PICES have co-sponsored:

- An International Workshop (also co-sponsored by KIOS, PKNU, NPEC, NFRDI, MOMAF, NOWPAP)on "*Remote sensing of marine environment in the Northwest Pacific region*", August 1–2, 2006, Busan, Korea;
- Dr. Vyacheslav Lobanov represented PICES at the 11th Session of IOC/WESTPAC Coordinating Committee for the North-East Asian Regional Global Ocean Observing System (January 2007, Bangkok, Thailand);
- PICES and IOC/WESTPAC HAB experts met (October 24–25, 2007, Seattle, USA and November 25–27, 2007, Tokyo, Japan) to discuss possible directions for HAB projects, what might be learned from past IOC/WESTPAC training courses, and potential collaborations to enhance the effectiveness of a HAB training program;
- Participation of PICES and WESTPAC experts in the 2nd Asian GEOHAB meeting (January 28–February 1, 2008, Nha Trang, Vietnam) to introduce activities of S-HAB and aPICES Seafood Safety/MAFF project;
- NOWPAP/PICES/WESTPAC training course on "*Remote sensing data analysis*", October 8–12, 2011, Vladivostok, Russia;
- PICES members (XianshiJin/FIS), Vyacheslav Lobanov (POC/AP-CREAMS), Lin Liu (SG-NPESR3), Xuelei Zhang (S-CCME), Douding Lu (S-HAB), FangliQiao (POC/FUTURE SSC/SG-CEP), Chan Joo Jang (POC, SG-CEP), Shang Chen (HD), and Mitsutaku Makino (HD) convened sessions at IOS/WESTPAC 10th Conference, on "Advancing Ocean Knowledge, Fostering Sustainable Development: from the Indo-Pacific to the Globe", April 17–20, 2017, Qingdao, China.

Capacity building events:

- As part of FUTURE's original Implementation Plan, WESTPAC was cited as one of the programs important for collaboration on human and coastal issues in the western North Pacific;
- PICES/ WESTPAC Workshop on "Rapid Assessment Survey methodologies for detecting non-indigenous marine species", July 19-21, 2011, Phuket, Thailand;
- PICES/MAFF Workshop on "*Introduction to Rapid Assessment Survey methodologies for detecting non-indigenous marine species*" (co-sponsored by FRA, NOWPAP and WESTPAC), February 8–9, 2012,

Nagasaki, Japan.

WESTPAC has sent observers periodically to PICES Annual Meetings since 2000.Dr. Kentaro Ando represented WESTPAC at PICES-2018.

IOCCP (International Ocean Carbon Coordinated Project) [this project is also sponsored by SCOR]

IOCCP, co-sponsored by SCOR and IOC-UNESCO, promotes the development of a global network of ocean carbon observations for research through technical communication and communications services, international agreements on standards and methods, and advocacy and links to global observing systems. This should lead to the joint development of global data products and synthesis activities documenting the ocean carbon cycle. PICES, through its earlier Working Groups, and now through the Section on *Carbon and Climate* (S-CC; 2006–present), has been a regional coordinator for these activities and provides a link to IOCCP.

GOOS has established three disciplinary panels: Biology and Ecosystems Panel (BioEco; PICES members are: **Sonia Batten**, and **Sanae Chiba**), Biogeochemistry Panel (IOCCP; **Masao Ishii**), and Physics Panel (OOPC; PICES is not represented on OOPC [Ocean Observations Panel for Climate]).

S-CC communication/coordination with SCOR/IOC-UNESCO IOCCP on ocean carbon activities
PICES, through its Working Groups on *CO_2 in the North Pacific* (WG 13; 1998–2001) and *Biogeochemical Data Integration and Synthesis* (WG 17; 2002–2005), and now through the Section on *Carbon and Climate* (S-CC; 2006–present) has been providing coordination for synthesis of ocean carbon research and the development of a network of ocean carbon observations in the North Pacific. The importance of ensuring effective two-way communication with other international scientific groups that have a responsibility for the coordination of ocean carbon research, such as the SCOR/IOC-UNESCO International Ocean Carbon Coordinated Project (IOCCP) and to the SOLAS/IMBeR Carbon (SIC) Research Working Group, has been explicitly included in the terms of reference for S-CC.

There are S-CC members on two of SIC's subgroups: Currently, Dr. **Masao Ishii** is on one of the SIC's 3 subgroups: subgroup 2 on *Interior Ocean Carbon*.

Dr. **Masao Ishii**, is also the Co-Chair of the IOCCP SSG; S-CC member, Dr. **Richard Feely**, is a member (member responsible for ocean acidification component) and Alex Kozyr, are also members of the IOCCP Scientific Steering Group.

IOCCP is normally represented as an observer at PICES Annual Meetings. Dr. Masao Ishii represented IOCCP at PICES-2018.

GlobalHAB/IPHAB (GlobalHAB and Intergovernmental Panel on Harmful Algal Blooms)

PICES communicates with various international HAB programs, including GlobalHAB (an initiative under the auspices of IOC and SCOR, and superseding GEOHAB (Global Ecology and Oceanography of Harmful Algal Blooms) program) and IPHAB (UNESCO-IOC Intergovernmental Panel on Harmful Algal Blooms) through the Section on *Ecology of Harmful Algal Blooms in the North Pacific*. Some of GlobalHAB's and IPHAB's goals will be to focus on climate change impacts on HABs and socio-economic impacts of HAB occurrences and S-HAB is well positioned from past activities to make a large contribution.

Climate change impacts on HABs:

- GEOHAB/PICES/ICES/SCOR co-sponsored a workshop on "*Harmful algal blooms in a changing world*", March 18–22, 2013, Friday Harbor, USA (Phase I);
- Outcome from the workshop was a paper on "*Harmful algal blooms and climate change: Learning from the past and present to forecast the future*" by M.L. Wells *et al*., 2015, *Harmful Algae*doi: 10.1016/j.hal.2015.07.009;

- PICES/FORMAS/SCOR/GEOHAB/NOAA Symposium co-organized by M.L. Wells on "*Harmful algal blooms and climate change*", May 19-22, 2015, Göteburg, Sweden (Phase II).

Socio-economic impacts of HAB occurrences:

- PICES Scientific Report No. 47 on "*Proceedings of the Workshop on Economic Impacts of Harmful Algal Blooms on Fisheries and Aquaculture*", edited by V.L. Trainer and T. Yoshida;
- GlobalHAB Second SSC meeting was held in Naples, Italy on 27–31 March 2017. Vera Trainer (partial funding from PICES) and Mark Wells (no funding from PICES) represented PICES at the meeting. *GlobalHAB—A New Program to Promote International Research, Observations and Modelling of Harmful Algal Blooms in Aquatic Systems*, was published in a special issue on International Cooperation in Harmful Algal Bloom Science in *Oceanography*, 30(1): 70–81 (Vera Trainer, co-author);
- GlobalHAB co-sponsored MEQ Workshop (W18) on "GlobalHAB: Evaluating, reducing and mitigating the cost of harmful algal blooms: A compendium of case studies", PICES-2019, Victoria, Canada.
- Dr. Trainer is an *ex officio* member of GlobalHAB SSC;
- Dr. Wells is Chair of the Editorial Board for the Best Practices Manual for Climate Change and HABs in IPHAB.

GOOS (Global Ocean Observing System)

GOOS is a program executed by IOC, but relies on coordinated contributions from organizations worldwide for its success. GOOS is a permanent global system for observations, modelling and analysis of marine and ocean variables to support operational ocean services worldwide. It provides accurate descriptions of the present state of the oceans, including living resources; continuous forecasts of the future conditions of the sea for as far ahead as possible, and the basis for forecasts of climate change.

PICES established a Study Group to develop a strategy for GOOS in 2005 whose purpose was to identify and describe the major observing systems in the PICES region and to provide recommendation and justification to MONITOR on whether or not PICES should propose a North Pacific GOOS pilot project to IGOOS.

Drs. David Checkley (AP-CREAMS), Sanae Chiba (MONITOR) and Masao Ishii (S-CC) attended the IOC's First Technical Expert Workshop for the GOOS Biology and Ecosystems, and GOOS Biogeochemistry Panels, November 13–15, 2013, Townsville, Australia. The goal of this workshop was to identify and develop approaches to observe non-physical Essential Ocean Variables as per the concept described in the Framework for Ocean Observations (FOO) (developed by Dr. Checkley who represented PICES on the Integrated Framework for Sustained Ocean Observations Task Team to in 2010 work on a framework, http://www.ioccp.org/foo).

- GOOS co-sponsored the workshop to discuss the Framework for Ocean Observing (FOO) held in conjunction with the above mentioned PICES/ICES/IOC Symposium the 2nd International Symposium on "*Effects of climate change on the world's oceans*", May 13–20, 2012, Yeosu, Korea. The report of the workshop can be found in the July 2012 issue of PICES Press, pp. 14-15;
- GOOS held a First Technical Expert Workshop for the GOOS Biology and Ecosystems, and GOOS Biogeochemistry Panels, November 13–15, 2013, Townsville, Australia;
- GOOS co-sponsored the 2nd PICES/ICES/IOC Symposium on "*Effects of climate change on the world's oceans*", May 13–20, 2012, Yeosu, Korea;
- Dr. Toshio Suga represented GOOS at PICES-2014;
- The GOOS Biology and Ecosystems Panel (PICES members, Dr. Checkley and Chiba) held its first (online) July 15, 2015;
- The first GOOS Biology and Ecosystems Panel meeting was held February 19-20, 2016 in New Orleans, USA;
- A second GOOS Biology and Ecosystems Panel meeting was held September 19–21, 2016 in Oostende, Belgium;
- Drs. Sanae Chiba and Sonia Batten (MONITOR) serve as members on the GOOS Biology and Ecosystems Panel;

- Dr. Batten attended a workshop on "*Implementation of multidisciplinary sustained ocean observations*" February 8–10, 2017, Miami, USA;
- PICES fully supported Dr. Batten in 2018 to attend SCOR WG 154 on Integration of Plankton-Observing Sensor Systems to Existing Global Sampling Programs (P-OBS);
- PICES was an Intellectual Sponsor for OceanObs'19, September 16–20, 2019, Honolulu, USA
- Dr. Sanae Chiba (MONITOR) and Dr. Minhan Dai (S-CC) were Co-Chairs of the OceanObs'19 Program Committee.

IODE (International Oceanographic Data Exchange) program

From the FUTURE Implementation Plan:

"There is a need to enhance the timely availability of physical and biological data for FUTURE through indices, inventories, compilations, and other appropriate means. The responsibilities of the PICES Technical Committee on Data Exchange include supporting the data management needs and recommending data management policies for the FUTURE Program. This should be done in close cooperation with National Oceanographic Data Centers (NODCs) of the region and with the IOC International Oceanographic Data Exchange (IODE) program."

The International Oceanographic Data and Information Exchange system of national data facilities was established in 1961 to "…Enhance marine research, exploration, and development by facilitating the exchange of oceanographic data and information between participating Member States." All PICES member countries are Member States of IODE. In order to strengthen relations with IODE, PICES began sending a TCODE representative to IODE annual sessions starting in 2009. TCODE maintains dialogue with the IODE and its programs such as the IODE Group of Experts, OBIS (Ocean Biogeographic Information System), ODP (Ocean Data Portal) and ODINWESTPAC (Ocean Data and Information Networks in Western Pacific region).

- Dr. Hernan Garcia represented IODE and Dr. Ward Appeltans (OBIS and IODE ODP) participated through WebEx at PICES-2012;
- Dr. Toru Suzuki attended a technical workshop of ODP Oostende, Belgium (February 27-29, 2012) and the IODE GE-BICH workshop in Oostende, Belgium (October, 2012);
- Dr. Suzuki and 3 other TCODE members attended the 22nd Session of IODE of IOC-UNESCO (Ensenada, Mexico, March 11–15, 2013);
- IODE co-sponsored TCODE workshop (W4) on "*Tools, approaches and challenges for accessing and integrating distributed datasets*" (cancelled at PICES-2013 due to US govt. shutdown but rescheduled for PICES-2014, but cancelled again);
- Drs. Toru Suzuki and Joon-Soo Lee attended IODE-XXIII and the Celebration Session and Scientific Conference on the occasion of the 10th Anniversary of the opening of the IODE Project Office (March 16–21, 2015, Bruges, Belgium);
- Drs. Lee and Suzuki attended a meeting of ODINWESTPAC (Oceanographic Data and Information Network for the Western Pacific region) at WESTPAC-X (May 12–15, 2015, Phuket, Thailand);
- Dr. Lee represented PICES at IODE-XXIV (March 27–31, 2017, Kuala Lumpur, Malaysia).

TCODE and IODE regularly attend each other's meetings/conferences. Dr. Yutaka Michida is an *ex officio* member of TCODE, representing IODE. TCODE is currently applying for Associate Data Unit membership in IODE.

IWC (International Whaling Commission)

The IWC was set up under the International Convention for the Regulation of Whaling, signed in 1946. Its purpose is to provide for the proper conservation of whale stocks and thus make possible the orderly development of the whaling industry. Canada was a member from 1949-1982. Dr. Hidehiro Kato (former Co-Chair AP-MBM) was a PICES observer (through its AP-MBM) at IWC annual meetings from 2003-2014, replaced by Dr. Tsutomu Tamura (Japan) as PICES liaison to IWC. Dr. Tsutomu Tamura has represented IWC since PICES-2015.

Dr. Tsutomu Tamura is representing IWA at PICES-2019.

CLIVAR (Climate and Ocean – Variability, Predictability, and Change)

The main area for cooperation between PICES and CLIVAR has been the impact of climate variability and change on marine ecosystems. CLIVAR is a core project of the World Climate Research Programme (WCRP) which has undergone re-organization, with new core panels and new research foci. CLIVAR has interacted with PICES through collaborations with WG 27 and WG 29. A Study Group on *Climate and Ecosystem Predictability* (SG-CEP) was established at PICES-2015 to develop terms of reference for establishing a joint PICES/CLIVAR Working Group on *Climate and Ecosystem Predictability*.

- CLIVAR co-sponsored a POC Topic Session on "*Challenges in understanding North Hemisphere climate variability and change*" (also co-sponsored by ICES), PICES-2012, Hiroshima, Japan;
- Dr. ShoshiroMinobe represented PICES at the CLIVAR SSG meeting (May 6–9, 2013, Kiel, Germany) to look at integrated research opportunities on the 2nd phase of CLIVAR activities on "Biophysical interactions and dynamics of upwelling systems" led by Dr. Kenneth Drinkwater;
- A joint CLIVAR/PICES Theme Session on "*Biophysical interactions and dynamics of upwelling systems*" (Convener: ShoshiroMinobe) was held at the 2nd International Symposium on "*Boundary Current dynamics*", July 8–13, 2013, Lijiang, China;
- Dr. Minobe attended the 1st Pan-CLIVAR meeting in July 17-18, 2014, The Hague, The Netherlands. Dr. Minobe convened a 2-day Workshop (W4) on "*Upwelling systems under future climate change*" (which stemmed from a CLIVAR/IMBER/SOLAS working group) at the 3rd PICES/ICES/IOC Symposium on "*Effects of climate change on the world's oceans*", March 21–27, 2015, Santos, Brazil;
- Dr. Enrique Curchitser (WG 27) is a member of CLIVAR WG on Ocean Model Development;
- Mr. Robin Brown (PICES Executive Secretary) visited the CLIVAR International Project Office in Qingdao, China in May 2015 for discussions, and attended a CLIVAR Workshop at the First Institute of Oceanography, where he outlined some potential venues for collaboration between CLIVAR and PICES.
- CLIVAR co-sponsored a POC Topic Session (S5) on "*Ocean circulation of the Western Pacific and its response to climate change*" at PICES-2015, Qingdao, China;
- PICES provided support for 4 early career scientists (1 from Korea, 1 from Russia and 2 from USA) to attend the CLIVAR Open Science Conference on "*Charting the course for climate and ocean research*", September 18-25, 2016, Qingdao, China.
- A joint PICES/CLIVAR Working Group on *Climate and Ecosystem Predictability* was established at ISB-2017;
- CLIVAR co-sponsored a POC/FUTURE Topic Session on "Ecological responses to variable climate changes and their applicability to ecosystem predictions" at PICS-2018, Yokohama, Japan.

Dr. Annalisa Bracco (International CLIVAR Project Office) is representing CLIVAR at PICES-2019.

Inter-American Tropical Tuna Commission (IATTC)

The IATTC is responsible for the conservation and management of tuna and other marine resources in the eastern Pacific Ocean. All PICES member countries, except Russia, are members of IATTC. Research of the IATTC is on stock assessment, biology and ecosystem, data collection and database, and bycatch and IDCP (International Dolphin Conservation Program).

IATTC, along with PICES, is a non-voting member of ISC. ISC provides stock assessment results and research and undertakes scientific collaboration with the Inter-American Tropical Tuna Commission (IATTC).

PICES Annual Meeting

- Dr. Robert Olson (IATTC) was an Invited Speaker at the BIO Workshop (W3) on "The feasibility of updating prey consumption by marine birds, marine mammals, and large predatory fish in PICES regions" at PICES-2012, Hiroshima, Japan;
- IATTC co-sponsored (with ISC) FIS Topic Session S12 on "*Applying ecosystem considerations in science advice for managing highly migratory species*" at PICES-2018, Yokohama, Japan.

Dr. Carolina Minte-Vera represented IATTC at PICES-2018.

APPENDIX H: Summary of PICES-2020 Requests to Science Board

The following was provided to Science Board as a summary of all requests for their review at PICES-2020. It is provided here for future reference and to ensure completeness of information in this report.

Table of Contents: PICES-2020 Science Board Meeting - ADDENDA #2

PICES-2021 Workshop Requests

- **Request for recommendation**: PICES-2021: 2-day Workshop on Biodiversity of SeaMounts - Recommendation requested by NPFC, WG-32. Research aligns with NPFC-PICES Framework for enhanced Scientific Collaboration in the North Pacific. *"Distributions of pelagic, demersal, and benthic species associated with seamounts in the North Pacific Ocean and factors influencing their distributions"**

- **HD Requests One-day workshop at PICES-2021:**Training WS on Sci.Communication (WG-Communication)

- **FIS requests** that the proposal for a 0.5 day (with Invited Speaker) **Workshop** for PICES 2021: "The Northern Bering Sea-Chukchi Sea Integrated Ecosystem Assessment: Recent Finding, Progress, and the way forward" be added to a potential waitlist, if scheduling permits addition of new workshop.

- **S-MBM PICES-2021 Requests PICES 2021 1-day Workshop:** Anthropogenic stressors, mechanisms and potential impacts on Marine Birds and Mammals" (in person*, virtual, or hybrid). Conveners: Yutaka Watanuki (Japan); Miran Kim (Korea); Patrick D. O'Hara (Canada). The main outcomes of the workshop will be the development of a Pathways of Effects style heuristic or conceptual model describing how stressors act on marine birds and mammals.

- **S-HAB request for PICES-2021:**1-day Workshop on "The expansion of harmful algal blooms (HABs) from lower to higher latitudes" at PICES-2020.

- **AP-NPCOOS Request a one-day workshop at PICES-2021 Monitoring Essential Biodiversity Variables in the coastal zone. (See Addenda #2) Supported by MONITOR, TCODE, BIO, FUTURE.**

- **AP-NPCOOS Requests an invited Speaker for the Workshop on Monitoring Essential Biodiversity Variables in the coastal zone.**

- **Wg-37 Requests PICES 2021 Workshop** (postponed from PICES 2020): Can we link zooplankton production to fisheries recruitment? Duration: 1 Day. Conveners: Hiu Liu (USA); Toru Kobari (Japan); Karyn Suchy (Canada); Russ Hopcroft (USA)

- **WG 39/WG 44 joint/ hybrid 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)**
  Duration: 1.0 day (0.5 day + 0.5 day); 2 sessions with focus on CAO and NBS-CS, 1 session for joint deliberation. **Co-conveners**; Sei-Ichi Saitoh, Japan, corresponding); Hyoung-Chul Shin, Republic of Korea; Libby Logerwell, USA;Yury Zuenko, Russia.
  Objectives: describe and discuss present ecosystem processes (sources, signals, significance) in the CAO and the NBS-CS based on achievements from existing and future research programs such as MOSAiC and SAS, NBS-CS programs, and Indigenous Knowledge. In addition, it will help to explore and develop future approaches for IEA and jointly organized monitoring in both regions.

- **WG-43 Workshop Update Workshop (FIS) at the 2021 PICES Annual Meeting "Pelagic and forage species – Predicting response and evaluating resiliency to environmental variability"**

PICES-2021 Plenary Requests

- **AP-NPCOOS proposes a plenary speaker for PICES-2021: "**"best practices for coastal ocean observing systems" Proposed Speaker: Jay Pearlman. See Addenda #2.

PICES-2021 Topic Session Requests

- **MEQ requests a half-day paper session**

- **MEQ requests a one day** eDNA Topic Session – carried over from PICES 2020

- **HD Request to SB: PICES-2021: Save the two postponed Topic Sessions**
    - HD for seven societal needs of UNDOS (HD Committee)
    - Marine Ecosystem Services – Connecting Science to Decision Making(WG-41)

- **S-HAB request for PICES-2021:** ½-day Topic Session on "The effects of ocean acidification and climate change stressors on the growth and toxicity of harmful algal species" at PICES-2020.

- **AP-NIS intends to host planned session** on eDNA and NIS at PICES 2021 in China with NOWPAP. 1 day session, sponsored by NOWPAP.

- **WG-40 requests a topic session (carried over to PICES-2021)** Predictions of extreme events in the North Pacific and their incorporation into management strategies.

- **WG-41** will convene a topic session that was postponed from PICES-2020: **Title:** Marine Ecosystem Services – Connecting Science to Decision Making. **Convenors:** Sarah Dudas (Canada) and Jingmei Li (China)

- **WG-42 Postponing approved topic session to 2021**: "Using environmental indicators to assess baselines, targets, and risk of plastic pollution in the North Pacific." (**WG-42 Requests 1 day Topic Session at PICES-2021:** Using environmental indicators to assess base- lines, targets, and risk of plastic pollution in the North Pacific (1 day).)

- **WG-43 Topic Session Update**: Topic Session (FIS) at the 2021 PICES Annual Meeting: "Environmental variability and small pelagic fishes in the North Pacific: Exploring mechanistic and pragmatic methods for integrating ecosystem considerations into assessment and management" at 2021 PICES Annual Meeting.

PICES-2021 Business Meeting Requests

- **S-CCME:** requests 1 day Business Meeting
- **S-HAB request for PICES-2021:** S-HAB +MAFF CFP Project Science Meeting (1 day + 1day)
- **AP-NPCOOS Requests** a 1/2 day business meeting
- **WG-37 Requests half day business meeting** at PICES-2021, Pending term extension, Virtual meeting ahead of PICES-2021 is fine.
- **WG-39 Requests half day business meeting** at PICES-2021
- **WG-41 Requests a full day business meeting** at PICES-2021
- **WG-42 Requests one day business meeting** at PICES-2021
- **WG-43 Requests half day business meeting** at PICES-2021
- **WG-44 Requests one day business meeting** at PICES-2021
- **WG-45 Requests one day business meeting** at PICES-2021

Inter-sessional Meeting Requests

- **WG-41 Requests PICES Secretariat host a virtual intersessional meeting** of the working group (tentatively in January 2021) – via WebEx

PICES-2021 Travel Support Requests

- **S-HAB request for Travel support for PICES-2021:** for 1 invited speaker/participant for PICES 2021 Workshop: The expansion of harmful algal blooms (HABs) from lower to higher latitudes (E or W).

- **S-HAB request for Travel support for PICES-2021:** Travel support requested for 1 invited speaker/participant for PICES **2021 Topic Session**: The effects of ocean acidification and climate change stressors on the growth and toxicity of harmful algal species (tentative speaker Dr. Dedmer van de Waal, Netherlands Institute of Ecology).

- **AP-NPCOOS Requests Travel Support** for the invited Speaker for the workshop on Monitoring Essential Biodiversity Variables in the coastal zone.

- **WG-39 Requests Travel Support** for invited speaker / Costs for workshop, PICES-2021.

Other Travel Support Requests

- **WG-39 Requests** Travel support WGICA physical meeting in ICES HQ : Fall 2021

- **S-HAB Requests Travel Support of $3000 CAD** for 1 PICES representative to travel to attend the IOC Intergovernmental Panel on HABs (IPHAB) in 2021.

- **AP-NIS Requests to SB: Travel support:** AP-NIS would like to request travel support for ECS or session/workshop convenor at ICMB-XI (Washington, DC, USA – May 2022 – delayed due to COVID).

- **AP-NIS would like to request** PICES support and provide travel support for up to 2 ECS from eastern Pacific to participate in NOWPAP-led training course on eDNA (Japan, exact date TBD due to COVID).

PICES-2022 Workshop Requests

- **TCODE is** planning to submit two **proposals in 2021** for two workshops for **PICES-2022:**

    1. A workshop to familiarize PICES community with the new TCODE PICES catalog service, and to walk participants through its use.

    2. A workshop to engage data managers and others into a discussion on what we can do to engage wider data sharing across international boundaries, in line with the U.N. Decade of Ocean Science theme: “Transparent and accessible oceans.”

Study Group and Working Group Proposals - Requests for Recommendations

- **Joint PICES/ICES Study Group:** on UNDOS
- **HD – Proposed New SG:** Early Career Ocean Professionals
- **HD – Proposed New SG Ocean Outcomes**: Coastal community feedback to external Ocean stressors
- **HD – Proposed New WG:** Science Communication
- **BIO / NPFC Request for recommendation:** Working Group on Biodiversity of SeaMounts.
- **BIO - Proposed new WG**: Towards best practices using imaging systems for monitoring plankton (See Addenda #2 for proposed membership update).

- **IMCE WG:** Ecosystem-based mariculture management
- **IMCE WG:** Impacts of mariculture pathogens on coastal ecosystems

Capacity Building and Summer School Requests

- **AP-NPCOOS** Plan to have a 2021 virtual summer school with reservation of the allocated budget of the cancelled 2020 spring school due to COVID19

- **MONITOR Requests support for AP-CREAMS Proposals for** Summer Schools:
    - 2021 summer school of ocean turbulence (on-site; spring 2021; China)
    - 2021 summer school of data analysis of satellite observations (on-site; fall 2021; Japan)

- **AP-CREAMS Summer School** – **Remote Sensing** - NOWPAP CEARAC - 5th NOWPAP Training Course on Remote Sensing Data Analysis: **Request: international travel fees and lecture fees – USD15000.** Toyama, Japan, Apr. 2021or online. Dr. Genki Terauchi, NOPWAP. Latest technique for analysis and interpretation of satellite data (assessment of eutrophication and other environmental issues).
    - 25-30 students
    - 5 days
    - **Students use their own travel funds**, limited support will be available
    - NOWPAP supports USD20000
    - **Request: international travel fees and lecture fees – USD15000**
    - PICES has supported all 4 previous training courses on satellite data analysis with NOPWAP since 2000-s

Capacity Building and Summer School Requests - (cont'd)

- **AP-CREAMS Summer School** – **Ocean Turbulence**, Qingdao, Ocean Turbulence: From Observing to Research. **Request: international travel fees and lecture fees – USD9000**
    - Qingdao, China, Aug. 2021
    - Dr. Fei Yu, IO CAS
    - Field measurements technique and data processing
    - 25-30 students
    - 5 days
    - **Students use their own travel funds**
    - Already got support from China NSF around USD10000
    - Submitted proposals to CAST, QNLM, MNR
    - **Request: international travel fees and lecture fees – USD9000**
    - This proposal was already supported by POC and PICES for 2019, postponed because of late confirmation of Chinese funds to 2020, and postponed again because of COVID-19.

- **S-CC Recommendation to BIO/POC (Requested by Sonia):** SOLAS summer session 2021:
  Request for travel fee support of young scientist (10 k$)

- **Co-sponsorship:** PICES-NPFC 2021 Joint course on VME Indicator Taxa ID. Co-sponsorship: $15,000.
  Travel support for 1-2 coral/sponge experts, Travel support for PICES capacity building.

Publication updates

- **HD Publication update:**
  Journal article in early 2022: "Network analysis within PICES Sciences and our way ahead for UNDOS"

- **MEQ Publication Update:**
    - WG-30 Brochure approved by Editorial Board Chair on Sept 21, 2020

- WG-30 Submitted Final Report to MEQ and Secretariat on Sept 11, 2020.

- **MONITOR publication update:**
  1. Confirmed EAST-II report revision (Oct. 1st 2020)
  2. Provided NPSERIII synthesis report's comments (May 2020) and expect to receive the revision (final version) by Oct. 2020

- **S-HAB Publications Update:**
  Two papers published in the special issue on "*Climate change and harmful algal blooms*" (C. J. Gobler, ed.) in Harmful Algae, Vol. 91.
  1. Future HAB science: Directions and challenges in a changing climate.
  2. Pelagic harmful algal blooms and climate change: Lessons from nature's experiments with extremes.

- **WG-32 Publication Update:**
  WG-32 Final report in editorial revision (PICES Scientific Report #57)

- **WG-37 Publication Update:**
  Evaluation of trade-offs in traditional methodologies for measuring metazooplankton growth rates: Assumptions, advantages and disadvantages for field applications. T. Kobari, A.R. Sastri, L. Yebra, H. Liu, R.R. Hopcroft Progress in Oceanography (2019) 178: https://doi.org/10.1016/j.pocean.2019.102137

- **WG-37 Publication Update:**
  Chapter Four: Advances in biochemical indices of zooplankton production. L. Yebra, T. Kobari, A.R. Sastri et al. Advances in Marine Biology (2017) 76: 157-240, https://doi.org/10.1016/bs.amb.2016.09.001

- **WG-39 Publications Update:**
  2020 ICES/PICES/PAME Working Group on Integrated Ecosystem Assessment (IEA) for the Central Arctic Ocean (WGICA). ICES Scientific Reports. 2:79. 144 pp. http://doi.org/10.17895/ices.pub.7454

- **WG-39 Publications Update:**
  WGICA IEA Report No.1 —Ecosystem Description (ICES CRR – Cooperative Research Report series) (in review)

- **WG-40 Publication Update:** A journal special issue is under development based on the intersessional workshop presentations and on the contributions to PICES Annual meeting 2019 Session 15. Journal: Frontiers in Marine Science. Research Topic: North Pacific Climate and Ecosystem Predictability on Seasonal to Decadal Timescales. Guest editors: Shoshiro Minobe, Antonietta Capotondi, Fei Chai, Mike Jacox, Masami Nonaka, Ryan Rykaczewski. Current status: 10 manuscripts submitted, 8 manuscripts already accepted, Manuscript deadline: 31 March 2021 *The guest editors will write a perspectives paper and an introductory paper.

- **WG-43 Publication update:**
  PICES Press, Vol. 28, No. 2
  Identifying research priorities for understanding the dynamics of small pelagic fish Ryan Rykaczewski, Myron Peck, Ignacio A. Catalán, and Akinori Takasuka https://meetings.pices.int/publications/pices-press/volume28/PPJul2020.pdf%20#page=40

Publication requests to SB

- **HD Publication update:**
  Journal article in early 2022: "Network analysis within PICES Sciences and our way ahead for UNDOS"
  Does SB need to recommend publication?

- **S-HAB Requests Approval for proposed publication:**
  Trainer, V.L., Davidson, K. (Ed) 2020. GlobalHAB: Evaluating, Reducing and Mitigating the Cost of Harmful Algal Blooms, a Compendium of Case Studies. PICES Sci. Rep. 2020.
    - This is a series of 7 chapters resulting from the GlobalHAB workshop on HABs and Economics that was held at PICES-2019.
    - The Chapters are currently undergoing Technical Edit by Rosalie at the PICES Secretariat.

- **WG-37 Request?** WG-37 Scientific Report Manuscript to be submitted to Secretariat in December 2020.
  Does SB need to recommend publication of this Sci Rpt?

- **WG-39 Requests to SB:** Approval for two proposed publications**:**

  1. WGICA Ecosystem Overview (EO) Report (First draft in November 2020 and final 2021):EO provide a description of the ecosystems, identify the main human pressures, and explain how these affect key ecosystem components. Short report with 16 pages.

  2. WGICA IEA Report No.2 "Human activities, climate and vulnerability assessment of the CAO Ecosystem" (final 2021-2022) (ICES CRR)

- **WG-42 Publication Request: Approval for proposed publications + Request for $17,750 USD:**
  - ***Environmental Pollution*** **journal encouraged submission of 5 companion review articles:**
    - Sea surface and water column – Wonjoon Shim
    - Shoreline – Amy Uhrin
    - Sediment and seafloor – Shuhei Tanaka
    - Biota ingestion – Matthew Savoca
    - Biota entanglement – Jennifer Lynch
      5 review articles to submit to Environmental Pollution.
  - **The journal charges $3550 per paper for the open access option.**
  - **Total charge to make all 5 articles open access would be $17,750 USD**

- **WG-40 Publication - Request to SB required?: J**ournal special issue is under development based on the intersessional workshop presentations and on the contributions to PICES Annual meeting 2019 Session 15. Journal: Frontiers in Marine Science. Research Topic: North Pacific Climate and Ecosystem Predictability on Seasonal to Decadal Timescales. Does SB need to recommend publication?
- **WG-43 Review Paper - submitted and in revision**. Details?
  Does SB need to recommend publication?

Expert Group Requests for Extensions

- **BIO:** Request from **WG46** to extend start of term to 2020 (POC)

- **HD requests** One year extension of WG41 MES to complete work on WG projects, with a new end date of October 2021

- **WG 37 Requests 1 year extension** to PICES-2021, to:
- Convene workshop at PICES 2021
  2. Complete ToR # 4: Develop an interactive website for exchange of information on zooplankton production measurements for regional and/or global mapping. -Incomplete: requires ~2-3 months coordinated effort between WG members, data owners, and host site (NOAA Copepod)

- **WG-38 Requests a one year extension** to Oct 2021 to finish preparing final report.

- **WG-40 requests a one-year extension** through PICES-2021 to:
  1. Write a perspectives paper with guidelines for marine ecosystem prediction studies using physical climate/ocean prediction. This paper could be used as reference for operational and research centers, for individual researchers, and for

near future discussion in PICES, WCRP and UN Ocean Decade planning.
2. Expand discussions on key questions, applications, and WG40 contributions in climate ecosystem predictability
3. Help start a new working group, likely with a focus on extremes in coastal environments, to include broad PICES participation including members from WG36, WG41, S-HAB

TORs / Action Plans

- **WG42 updated its TOR,** changing 'meso and microplastic' to 'across different size categories'.
- **AP-NPCOOS Revised ToR** by adding 'summer school to build capacity in COOS
- **TCODE Activity Plan Update:** TCODE has recently updated its activity plan to clarify some points within the mission statement and to add more specific strategies to some of the goals. Additionally, TCODE has updated its work plan for the next year.
- **S-CCME** has finalized it's Phase 4 (2021-2025) Implementation Plan. We request Committee endorsement and provision to Science Board for approval.

Membership Updates

- **SB to advise GC** that Dr. Shevchenko will serve second term as SB Vice-Chair?

- **FIS Membership update:**
  - Dr. Xiujuan Shan is a new Committee member replacing Dr. Jie Kong and representing China.
  - Dr. Tetsuo Fujii is a new Committee member replacing Dr. Toyomitsu Horii and representing Japan.
  - Dr. Jin will continue as Chair for a second term.
  - Dr. King will continue as Vice-Chair for a second term.

- **TCODE Membership Updates:**
  - Peter Chandler has agreed to serve as Vice Chair for one more year, however, TCODE will need to elect a new vice chair next year. (PICES-2021)

- **S-CCME Membership update:**
  - Dr. Jackie King is stepping down as Co-Chair.
  - Dr. Kirstin Holsman (USA) is the new Co-Chair.

- **AP-NIS Membership Update:**
  - New member : Dr. Satoshi Watanabe replacing Dr. Tatsuya Yurimoto, Japan

- **S-CC: Membership update:**
  - **Stepping down:**Dong-Jin Kang [Korea], Minhan Dai [China]
  - **S-CC new members:** Geun-Ha Park [Korea], Xianghui Guo [China], Wiley Evans [Canada], Samantha Siedlecki [USA]

- **WG-42 Membership Update:**
  - **New member: Dr. Sarah Dudas, Canada**

Membership Requests

- **FIS requests** a member from Russia be appointed to **S-CCME**. Alexei Somonov was proposed as a candidate.
- **FIS** requests an additional member from Russia be appointed to **WG 43.**
- **FIS requests** an additional member from Japan and Canada be appointed to WG 44. Recommended candidates are: Kohei Matsuno (Hokkaido University), Nadja Stenier (DFO) and Martin Nantel (DFO).
- **MEQ requests** members from Russia.

- **AP-NPCOOS Requests** a member to be recommended from Japan (Dr. Hasegawa)
- **TCODE:**A representative from China (Wan Fangfang) who stands in for TCODE member Jinkun Yang when he is unavailable, has shown great initiative and engagement in the activities of TCODE. If/when an availability becomes possible, it would be good to keep her in mind.
- **WG-43 (SPF) Requests to SB:** recommendations for another member from Russia
- **S-CCME.** We request a **Russian member** from **FIS, BIO, and/or POC,** as there are currently no Russian members in S-CCME.

Other Requests / Updates / Reminders

- **FIS approves the S-CCME Implementation Plan** for Phase 4 (2021-2022), and **requests that Science Board recommend** the S-CCME Implementation Plan.

- **TCODE would like to request** that any new working groups add into their terms of reference (TOR), a clause to ensure data management plans and contact with TCODE on any potential data holdings as a result of the groups activities.

- **AP-NIS Recommendations for SB:** NOWPAP would like to work closely with PICES on eDNA activities.

- **AP-NIS Recommendations for SB:** Dr. Thomas W. Therriault suggested that PICES think about updating its website to indicate COVID status, or at least acknowledge PICES is thinking about this and how it might impact meetings/events until at least the end of the year.

- **SB to recommend Code of Ethics**

- **SB to recommend:** .e. do any FUTURE activities require recommendations from SB?
    - FUTURE Phase 3 Science Plan?
    - FUTURE and UNDOS activities?
    - FUTURE OSM?

- **Any SB recommendation** re: Greener meetings?

- **POC recommendations:**
  1. Synergies with S-CC, WG-46 and United Nation UNDOS GEOS Programme: Joint session on “The ecological impacts of Ocean CDR." Include Ocean Solutions in S-CC new directions

  2. APN is actively seeking to engage and fund PICES on activities related to their core mission goals, specifically in the Pacific Sector.Possible Actions (and proposals to APN):Joint PICES/APN Fellows Program; New APN/PICES WG for UN Ocean Decade to span work between North and South Pacific (e.g. climate extremes).

  3. PICES and CLIVAR have now developed a significant and successful partnership. New strategic plan allows CLIVAR to expand this further. Possible Actions: Topics identified by WG-40 for possible continuing collaboration (e.g. climate extreme and impacts on ecosystem and coastal systems); Get involved in CLIVAR WK ‘From global to coastal: Cultivating new solutions and partnerships for an enhanced Ocean Observing System in a decade of accelerating change’ (2021 (virtual), 2022 Trieste, Italy) – Led by IORP.

Suggestions for PICES Partnerships

- **IS** Committee supports pursuing the development of a PICES-PSC (Pacific Salmon Commission) Framework for collaborative research opportunities
- **HD** suggests: ICES SIHD (Alan Haynie); IMBeR (esp. HD-WG); LOICZ; IOC-UNESCO, WESTPAC; Future Earth Ocean KAN; FAO, IMO, UNEP, etc.
- **MEQ** suggests: Coastal and Estuarine Research Federation (CERF); International Center for Environmental Management of Enclosed Coastal Seas (EMECS);
- **TCODE** suggests that an ICES/PICES working group dedicated to addressing the U.N. Decade theme 'Transparent and Accessible Oceans', would be a beneficial partnership.
- **WG-41** suggests: Arctic Council – Protection of the Arctic Marine Environment (PAME) working group; Food and Agriculture Organization (FAO) of the UN Fisheries and Aquaculture Department; IMBER.
- **WG-43** Suggestions for PICES Partnerships: We seek inclusion of SPF scientists and interested groups from equatorial and southern hemisphere regions