



## North Pacific Fisheries Commission

### NPFC–PICES Framework for Enhanced Scientific Collaboration in the North Pacific

#### Executive Summary

The North Pacific Fisheries Commission (NPFC) and the North Pacific Marine Science Organization (PICES) are inter-governmental organizations with overlapping geographical areas and common scientific interests in the sub-Arctic regions of the North Pacific Ocean. The joint PICES-NPFC Study Group for Scientific Cooperation in the North Pacific Ocean (PICES-NPFC SG) developed a framework that strives to enhance collaboration between the two organizations.

This 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. There were other areas that were discussed, but it was recommended not to pursue these areas due to being a lower priority when the framework was developed or they were not aligned with the organization's research plans and priorities. Some areas (e.g., climate change) were incorporated into the three high priority areas above. As areas of interest and priorities change over time, the joint areas for collaboration may be updated.

The framework identifies 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.

Following approval and implementation from both organizations, routine monitoring of the progress of activities will be completed jointly by the Secretariats of PICES and NPFC and reported to the PICES Science Board and the NPFC Scientific Committee on an annual basis during their respective annual meetings.

#### 1.0 Background

The North Pacific Fisheries Commission (NPFC) and the North Pacific Marine Science Organization (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 (Figure 1) 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 Administrative Committee.

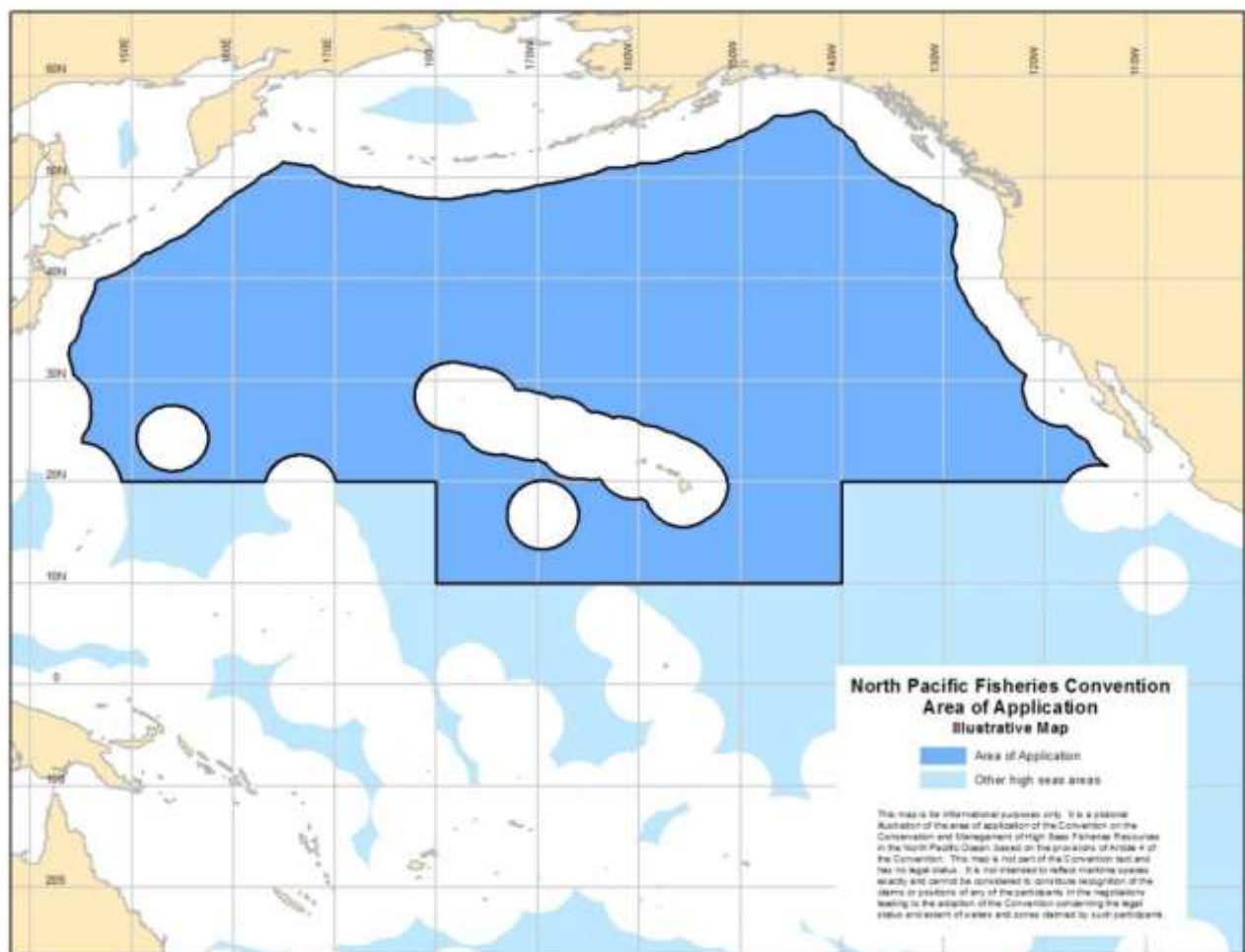


Figure 1: Illustrative Map of the NPFC Convention Area

PICES was established in 1992 to:

- 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;
- 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.”

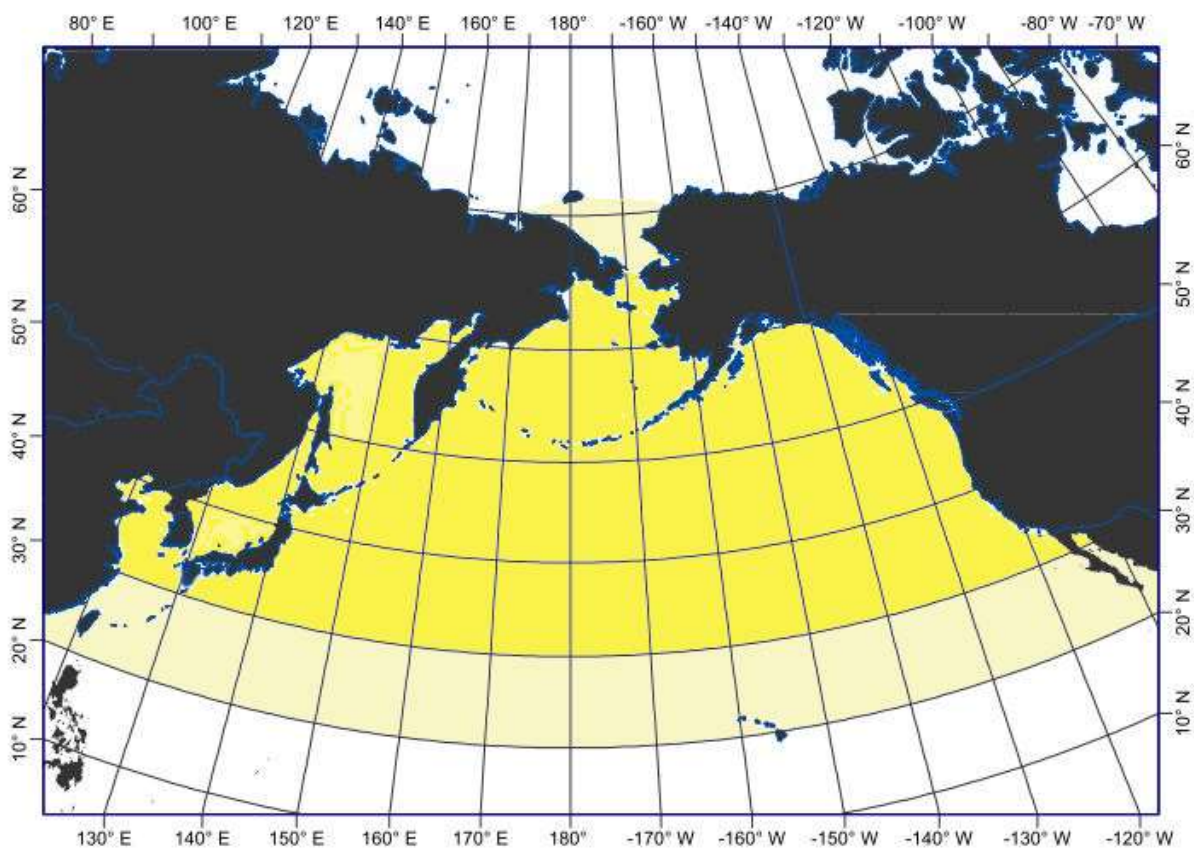


Figure 2: Illustrative Map of the PICES Convention Area

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).

Following a number of informal conversations between the two organizations, it was recognized that there was an opportunity to share and build upon each organization's expertise and activities through enhanced collaboration in order to more efficiently and effectively meet work plans and priorities. As a result, the joint PICES-NPFC Study Group for Scientific Cooperation in the North Pacific Ocean (PICES-NPFC SG) was established in 2017 to determine if there were scientific areas of mutual interest on which both organizations can collaborate, and if so, to identify mechanisms to jointly implement activities that produce desired products and outcomes for each organization.

Membership of the PICES-NPFC SG comprised of Eddy Kennedy (Co-Chair), Yong Chen, Lisha Guan, Changan Xu, Wei Yu, Daisuke Hasegawa, Kazuaki Tadokoro, Eunjung Kim, Todd Miller, and Robin Brown representing PICES, and Vladimir Kulik (Co-Chair), Toshihide Iwasaki, Seok-Gwan Choi, Tatiana Semenova, Chih-Hao Hsieh, Kari Fenske, and Aleksandr Zavolokin representing NPFC.

The PICES-NPFC SG was formed in October 2017, but was delayed in initiating discussions among members. There were some on-line discussions, and progress was provided to the Scientific Committee of the NPFC in April 2018. As well, PICES participated in the NPFC/FAO Workshop on the Protection of Vulnerable Marine Ecosystems in the North Pacific Fisheries Commission Area: applying global experiences to regional assessments that took place from 12-15 March 2018. In this workshop, PICES provided expert input and shared information and experiences that were pertinent to achieving the workshop objectives, such as the usefulness of species distribution models for predicting the occurrence of VMEs which was advanced in PICES WG 32. Also, NPFC contributed to and participated in the PICES International symposium "Understanding Changes in Transitional Areas of the Pacific" which was held in La Paz, Mexico from 24-26 April 2018. An NPFC expert presented recent situations with Pacific saury stock assessment and considered some marine environmental factors which are and could be included in stock assessment models.

The SG met face-to-face at PICES-2018 in Yokohama, Japan to develop a framework for collaboration that included identifying and prioritizing areas of joint interest on which to collaborate, as well as various implementation mechanisms for these activities. Most of the members of the PICES-NPFC SG were present at this meeting as well as the following observers: Anya Dunham

(Canada), Janelle Curtis (Canada), Hyewon Moon (Korea), Ric Brodeur (USA) and Jackson Chu (Canada).

The framework was drafted at the face-to-face meeting and the co-chairs presented progress to the PICES Science Board at PICES-2018. The PICES-NPFC SG committed to continue to finalize the report by email correspondence during the Winter 2018/19, and present the Framework to the NPFC Science Committee in April 2019 and the PICES Science Board in May 2019.

### 1.1 NPFC Science Priorities

The NPFC Scientific Committee provides scientific advice and recommendations to the Commission. The primary functions of the Scientific Committee are to (i) regularly plan, conduct, and review the scientific stock assessments of the relevant fisheries resources in the Convention Area; (ii) assess the impacts of the fishing activities on fisheries resources and species belonging to the same ecosystem or dependent upon or associated with the target stocks; (iii) develop a process to identify VMEs and areas of features where VMEs occur or are likely to occur; (iv) review effectiveness of management measures and make recommendations to meet Convention objectives; and (v) develop rules and standards for the collection and sharing of data on fisheries resources and associated ecosystems.

In response to these functions, the NPFC developed a 2017-2021 Research Plan which outlines priority research themes, including the rationale and more specific areas of work. These theme areas include (i) stock assessments for target fisheries and bycatch species, (ii) ecosystem approach to fisheries, (iii) vulnerable marine ecosystems, and (iv) data collection, management and security.

Accurate stock assessments are critical in helping to ensure the long-term conservation and sustainable use of fisheries resources in the Convention Area. In NPFC, stock assessments for both pelagic fish (e.g., Pacific saury and chub mackerel) and bottom fish (e.g., North Pacific armorhead, and splendid alfonsino) should strive to understand the current status and trends in production of populations of priority species as well as factors that may affect future trends. Areas of work include developing baseline assessments, reaching consensus on data standards used in stock assessments, and developing a standardized method to provide advice to the Commission.

Making progress on adopting an ecosystem approach to fisheries addresses several articles in the Convention. For example, the Convention makes reference to (i) adopting and implementing measures in accordance with the precautionary approach and an ecosystem approach to fisheries, (ii) adopting management strategies for any fisheries resources and for species belonging to the

same ecosystem or dependent upon or associated with the target stocks, and (iii) assessing the impacts of fishing activities on fisheries resources and species belonging to the same ecosystem or dependent upon or associated with the target stocks. Areas of work identified include vulnerable marine ecosystems and understanding ecological interactions among species.

## 1.2 PICES Science Plan

PICES engages scientists in trans-disciplinary, multi-national collaborations to further collective understanding of the North Pacific's natural systems and enhance ecological and social resilience of marine systems. As part of its vision, PICES aspires to be a leading contributor to global marine science, sought as a valued collaborator to solve current and future management issues as they emerge, and to be recognized as the premier organization for current research and understanding of North Pacific marine ecosystems. The scientific leadership for the organization is through the Governing Council and Science Board which are supported by the Secretariat. The scientific work of PICES is conducted primarily by expert groups, which consist of (i) working groups, (ii) study groups with a one to three year duration to achieve the results described in their terms of reference, as well as (iii) advisory panels and (iv) sections which provide longer-lived expert groups to maintain specific expertise within PICES. The Scientific and Technical Committees are responsible for the planning and direction of the major disciplinary themes, and for providing general supervision to the expert groups.

The PICES Strategic Plan (April 2016), outlines six specific goals to meet its vision and advance scientific knowledge. These goals are:

1. Foster collaboration among scientists within PICES and with other multinational organizations, particularly with those that have common goals.
2. Understand the status and trends of marine ecosystems in the North Pacific, and improve assessment of the vulnerability and resilience of these ecosystems to pressures from climate and human activities.
3. Understand and quantify how marine ecosystems respond to natural forcing and human activities.
4. Advance methods and tools (e.g., oceanographic models, ecosystem indicators, etc.) to enable new knowledge and improved advice over seasonal to decadal timescales in support of ecosystem based management.
5. Provide relevant scientific information pertinent to North Pacific ecosystems that is timely and broadly accessible.
6. Engage with early career scientists to sustain a vibrant and cutting edge PICES scientific community.

PICES activities are further guided by its current 10-year integrated research program FUTURE: Forecasting and Understanding Trends Uncertainty and Responses of North Pacific Marine Ecosystems. FUTURE is an integrative science program with a goal to understand and communicate the future of North Pacific ecosystems and the potential impacts from human use. More specifically, the program seeks to understand how marine ecosystems in the North Pacific respond to climate change and human activities, to forecast ecosystems status based on contemporary understanding of how nature functions, and to communicate new insights to its members, governments, stakeholders, and the public.

### 1.3 Contributions to Other Science Initiatives

Future collaborations between PICES and NPFC would contribute to other international science initiatives. One in particular is the UN Decade of Ocean Science for Sustainable Development. This initiative came into being at the seventy-second session of the United Nations General Assembly (UNGA) within Part XI of the Omnibus Resolution for Oceans and the law of the sea relating to Marine Science. The resolution stated that the UN Decade of Ocean Science for Sustainable Development will be for the 10-year period beginning on 1 January 2021, within existing structures and available resources, and calls upon the Intergovernmental Oceanographic Commission to prepare an implementation plan for the Decade in consultation with Member states, specialized agencies, funds, programs, and bodies of the United Nations, as well as other intergovernmental organizations, non-governmental organizations and relevant stakeholders. The endorsement by UNGA of the Decade highlights the need and role of ocean science data and information exchange for sustainable development. With the two main goals of (i) generating the scientific knowledge and underpinning infrastructure and partnerships needed for sustainable development of the oceans, and (ii) providing ocean science, data, and information to inform policies for a well-functioning ocean in support of Agenda 2030, this PICES-NPFC Framework for Collaboration is well aligned with contributing to UN Decade of Ocean Science for Sustainable Development. In 2019, there may be relevant regional workshops where both PICES and NPFC can participate to not only support the goals of the Decade but also to advance the areas of scientific collaboration identified in this framework.

## 2.0 Objectives

The objectives of this framework is to address the Terms of Reference of the PICES-NPFC SG which are:

1. Review the scientific interests and objectives of each organization;

2. Identify potential areas and specific topics for scientific cooperation;
3. Identify potential collaborative methods (such as representation at each other's meetings, holding of joint workshops or symposia, development of a Memorandum of Understanding (MOU) between the organizations or other formal agreements, establishment of joint working groups);
4. Clarify practical steps to advance the cooperative activities identified above;
5. Provide advice on how information produced by PICES can be shared and applied in NPFC;
6. Make a specific proposal to each organization for further consideration.

Specifically for NPFC, some key objectives are to reduce duplication of effort, increase leveraging of time and resources with PICES, and to acquire impartial scientific information and advice to support policy and decision making within the North Pacific Convention area. PICES also share these objectives as well as the objective to be more relevant to Regional Fisheries Management Organizations (RFMOs), such as NPFC, by providing the needed objective scientific advice for decision making. Further, for both organizations, the intent is for productive, mutually beneficial collaborative initiatives, which is to say that the areas for collaboration need to make sense for both organizations. To support the success of this Framework for Enhanced Collaboration, efforts will be focused on areas that are high priority for both organizations to advance over the next five years.

### **3.0 Scientific Areas of Joint Interest**

The PICES-NPFC SG identified several topics of joint interest, but came to consensus on three priority areas that are ranked according to making progress over the next five years. For each area identified, discussions focused on whether each organization viewed the area to be a priority and the specific interests in the area for each organization. Determining whether the research area was a priority for future collaborative work involved consideration of several criteria including:

- Aligns with organization's goals and objectives and existing research plans and priorities
- Potential outputs/benefits from the work area well-defined and relevant
- The timelines for when scientific results and advice are required
- The level of impact and likelihood that the project outputs will be utilized
- Likelihood of success (i.e., are the project objectives likely to be achieved)

Table 1 in the Appendix summarizes all scientific areas for collaborations that were identified, the three areas that were recommended for joint activities, and potential activities that can be implemented over the next five years for each area. Below the three priority areas of joint interest are discussed in more detail.



### **3.1 Support for Stock Assessments for priority species**

Stock assessments for target fisheries and bycatch species have the highest priority among the research areas of the NPFC. There are six fish species and two squid species which were recognized by the Scientific Committee as priority species: Pacific saury (*Cololabis saira*), Chub mackerel (*Scomber japonicus*), Spotted mackerel (*Scomber australasicus*), Japanese sardine (*Sardinops melanostictus*), North Pacific armorhead (*Pentaceros wheeleri*), Splendid alfonso (*Beryx splendens*), Neon flying squid (*Ommastrephes bartramii*), and Japanese flying squid (*Todarodes pacificus*). The highest priority belongs now to the species with decreasing catch (i.e., Pacific saury and North Pacific armorhead) and increasing catches (i.e., Chub mackerel and Japanese sardine). These species are also relevant for many PICES Committees and Working Groups since these squid and fish species are suspected to be very sensitive to environmental changes, in particular during early life history stages. Given that many of the priority species are short lived and their abundance fluctuates significantly year to year, recruitment rate may not be determined by the number of spawners in any deterministic one-way interaction. Rather, oceanography and climate are suggested to be main drivers not only for distribution patterns at different spatial scales but also for survival success. PICES participants have a long history of developing and validating saury, mackerel, sardine and squid distribution models, collecting ecosystem time series observations (ETSO), and using simulation studies to predict the consequences of changes / variability in key environmental parameters on populations in space and time. Thus, the common question to be resolved is what methodologies are most appropriate to incorporate environmental variables, which may affect stock status and distribution estimates, into stock assessments.

### **3.2 Vulnerable Marine Ecosystems (VMEs)**

Internationally, steps have been taken to protect marine biodiversity of vulnerable marine ecosystems (VMEs). According to the [International Guidelines for the Management of Deep Sea Fisheries in the High Seas](#) (FAO 2009), the criteria for identifying VMEs are: uniqueness or rarity, functional significance of the habitat, fragility, life-history traits that make recovery difficult, and structural complexity. PICES and NPFC share a common objective of promoting marine research that helps ensure the long-term conservation and sustainable use of the fisheries resources while protecting the marine ecosystems in which these resources occur. There are several areas of possible collaboration between NPFC and PICES on VMEs. Focused research topics may include:

- (1) Increasing scientific knowledge of biodiversity associated with known seamounts in the North Pacific, including identification of endemic species and distribution patterns of vulnerable taxa;

- (2) Increasing scientific understanding of the functional relationships within the ecosystem, with a special focus on the complex dependency of fishing resources and benthic species within VMEs;
- (3) Identification of suspected VMEs in the Convention Area through predictive modeling and empirical observations (visual survey tools, fishery-independent data, where possible, or landed bycatch).

These and other research projects on VMEs will (1) contribute towards PICES FUTURE goals to understand how marine ecosystems in the North Pacific respond to climate change and human activities, (2) support decision making regarding significant adverse impacts (SAIs) of bottom fisheries on VMEs, exploratory fisheries and encounter protocol, and (3) aid implementation of NPFC Conservation and Management Measures for bottom fisheries and protection of VMEs in the NW and NE Pacific Ocean.

### **3.3 Ecosystem Approach to fisheries**

The NPFC is willing to adopt, where necessary, conservation and management measures for species belonging to the same ecosystem or dependent upon or associated with the target stocks. Based upon this, the NPFC's Scientific Committee shall assess the impacts of fishing activities on both the targeted fisheries resources as well as species belonging to the same ecosystem or dependent upon or associated with the target stocks. However, to date, with the exception of certain VME studies, no ecosystem considerations have been incorporated within science advice on fisheries. PICES integrates Scientific Programs undertaken by the member nations and affiliates of PICES to understand how marine ecosystems in the North Pacific respond to climate change and human activities, to forecast ecosystem status based on a contemporary understanding of how nature functions. There are four active PICES Working Groups (i.e., (i) Third North Pacific Ecosystem Status Report; (ii) Common Ecosystem Reference Points across PICES Member Countries; (iii) Climate and Ecosystem Predictability; and (iv) Marine Ecosystem Services) which could make a tremendous contribution in providing advice on the state of the art ecosystem modeling techniques and methods to estimate "health" of the North Pacific in particular in the areas where NPFC's priority species occur and co-occur. Realizing that there is an endless scope for research direction in this area, the short-term goal for this collaboration would be to develop a research plan to enable ecosystem considerations to be incorporated into a fisheries management approach.

### **4.0 Collaboration Mechanisms**

There are many potential mechanisms for enhancing collaboration and making progress in the priority areas identified in Table 1. Some of these, which have been identified in other Frameworks for joint collaboration with PICES, include:

- Workshops
- Joint working groups
- Theme sessions at PICES annual meetings
- Representation at meetings and/or workshops
- Coordination of science plans

In the short term, the preferred mechanism is workshops as a venue to identify knowledge gaps and discuss opportunities and research needs to address these gaps. From these workshops, further recommendations could be made on joint activities (e.g., joint working groups) to enhance collaboration on specific activities. In addition, the workshop could define a terms of reference for a joint working group.

#### 4.1 Workshops

PICES and NPFC have been co-sponsoring and participating in each other's workshops throughout their mutual history. New and emerging issues often demand innovative and multidisciplinary approaches. The ability to deal with and resolve new concepts is likely to be enhanced by the bringing together of PICES and NPFC expertise in co-sponsored workshops. NPFC held a joint workshop with FAO in March 2018 on *the Protection of Vulnerable Marine Ecosystems in the North Pacific Fisheries Commission Area: applying global experiences to regional assessments* where PICES experts were invited to provide expert input to the discussions. The workshop made recommendations for future work, and these recommendations may be used to establish joint research activities or working groups that can focus on specific objectives. Moreover, there is a joint PICES-NPFC workshop (W11) on *The influence of environmental changes on the potential for species distributional shifts and subsequent consequences for estimating abundance of Pacific saury* to be held at the 2019 PICES Annual Meeting. This workshop was proposed by the PICES-NPFC SG on Enhanced Scientific Collaboration in the North Pacific.

#### 4.2 Joint Working Groups

Joint working groups represent one of the most effective mechanisms for collaboration and cooperation when there is a need to focus on a specific topic with specific deliverables defined by a terms of reference. In general, joint working groups would be formed following one or a series of meetings and/or workshops that are organized on a common theme. Thus, effective planning is a crucial element of successfully establishing a new and productive working group. Typically in PICES, a working group has a typical duration of three years. Under this PICES-NPFC Framework, it is recommended that joint Working Groups can be of any duration that is necessary to complete the Terms of Reference, but not longer than three years, except on a case-by-case basis where extensions are required.

#### 4.3 Theme sessions at PICES annual meetings

Joint topic sessions at PICES annual meetings could be a potential mechanism for collaboration between PICES and NPFC. There are numerous past examples of sessions that PICES has co-convened with other organizations where the benefits of sharing research findings and expertise have been demonstrated, such as joint sessions with ICES (International Council for the Exploration of the Seas), NOWAP (Northwest Pacific Action Plan), and ISC (International Scientific Committee for Tuna and Tuna-like species in the North Pacific Ocean). Convening topics sessions at NPFC Scientific Committee annual meetings is not a mechanism used by NPFC for the review of the science. This is done via Small Scientific Committees (SSCs) and technical working groups focused on specific areas.

#### 4.4 Representation at meetings and/or workshops

Both PICES and NPFC have a history of having representatives from other organizations participate in meeting and workshops where they can report on their organization's activities of interest. It is recommended that both organizations consider inviting one or more representatives from the other organization to participate in the Scientific Committee (for NPFC) and Science Board (for PICES) to update the bodies on the research activities ongoing and research priorities for the future. Many of the science experts that participate in the NPFC SSCs and Scientific Committee are also members of PICES expert groups, thus representation within each organization is already strong.

#### 4.5 Coordination of science plans

To further promote collaboration in many of the activities identified in Table 1, PICES and NPFC could include share elements in their respective science/research plans.

### **5.0 Monitoring and Reporting**

Following the approval and implementation of this framework by the respective bodies of PICES and NPFC (i.e., the Science Board and the Scientific Committee), this Framework will continue for a period of five years at which time it will be reviewed to assess the progress on the areas identified in Table 1, and to identify new areas for collaborations. The review should also assess the collaboration mechanisms by identifying which ones were employed, the utility of those mechanisms in achieving desired results, and identify new mechanisms for future joint collaboration.

On an annual basis, there will be a progress report prepared by the Secretariat for each organization

that is available for members. This progress report should be common for both, be a summary of all joint activities between PICES and NPFC (including status of each activities and actions required to progress on objectives), and be prepared in collaboration by both Secretariats. Further, this progress report will be presented annually at the PICES Science Board and the NPFC Scientific Committee annual meetings as part of a standing item on their agendas. If modifications / alterations are required to joint activities to enable enhanced productivity and success, these recommendations will be approved by both the PICES SB and/or NPFC SC (via correspondence if necessary).

For any joint activity that is completed, the co-conveners will prepare a summary report of the activity and it will be available for all members of both organizations.

## **6.0 Other Considerations**

When identifying recommendations for activities under the joint areas for scientific collaboration, other considerations need to be evaluated, including costs to the organizations in terms of financial as well as human capital and time. Some recommendations to alleviate these costs include:

- Using existing travel opportunities to established events, such as PICES and NPFC annual meetings. Economic efficiencies are realized even if the duration at a location must be extended by a day or two.
- Utilize on-line correspondence to the maximum extent to achieve deliverables, to prepare for face-to-face meetings, and to finalize reports.
- Minimize the number of annual meetings and create efficiencies within existing meeting as much as possible.

It is recognized that in certain cases where the work effort is intense (e.g., over a three day period) to get the desired result, it is more effective to host a separate meeting with the additional financial and human capital costs, since the ultimate goal is to deliver on an objective. When additional costs are required, additional approvals also are likely required via the Governing Council for PICES and the Commission for NPFC.

TABLE 1: Recommended joint PICES-NPFC research areas and associated rank, interest, potential activities, and priority within next five years

<b>Research Area</b>	<b>PICES Rank</b>	<b>NPFC Rank</b>	<b>PICES Interest</b>	<b>NPFC Interest</b>	<b>Potential Activities</b>	<b>Priority (5 years)</b>
Support for Stock Assessments for priority species - How to include environmental variables that may affect stock status and distribution - Higher order modelling approaches that consider variability of multiple parameters	High	High	Methodologies incorporating multiple variables, such as ecosystem time-series observations under North Pacific Ecosystem Status Reports (NPESR)	Methodologies that can enhance estimation of stock status; provide scientific justification for breaks in time series based on regime shifts in indices; science advice on how to best incorporate available information	Joint workshop at PICES 2019 to identify specific areas on which to focus considering priority areas, data availability, desired outcomes, etc.; Joint WG(s) to address activities identified in the joint workshop; Sharing scientific results when they become available	High
Vulnerable Marine Ecosystems (VMEs)	High	High	Understanding biogenic habitat structure and function and importance to ecosystem services; WGs (e.g., WG 32)	Science support required for analysis of known and suspected VMEs in convention area; Use of SDM and HSM, particularly in unfished areas, to support	FAO-NPFC VME workshop in March 2018, with invited expert support from PICES, identified several recommendations for further science activities to advance assessment	High

			<p>have completed work in these areas;</p> <p>Have participated in workshops with NPFC; future considerations on biodiversity of seamounts.</p>	<p>identifying where VMEs are located and to aid in identifying potential new areas for fishing;</p> <p>VMEs assessment part of Conservation and Management Measures (CMMs) for bottom fisheries and protection of VMEs;</p> <p>Small Scientific Committee (SSC) established on VMEs.</p>	<p>and analysis of VMEs in the North Pacific;</p> <p>Sharing scientific results when they become available;</p>	
<p>Ecosystem Approach to Fisheries</p> <p>- Scope to be defined but it was agreed to make progress in this area in incremental steps, for example the advice on fishing effort would include target stock status as well as impact of fishing effort on other key stocks, impacts of environmental</p>	Med-high	Med	<p>Incorporate environmental variables and biological linkages within ecosystem models;</p> <p>Effort ongoing on advancing ecosystem models to understand</p>	<p>Commitment to formulate a research plan to enable ecosystem considerations to be incorporated into a fisheries management approach;</p> <p>Support UN and FAO interests and commitments;</p>	<p>Joint workshop or session in 2020 or later to discuss options for advancing this area.</p> <p>Sharing scientific results when they become available;</p>	Medium

<p>variability on future target stock abundance, impacts of management decisions on human systems, etc.</p> <ul style="list-style-type: none"> <li>- There is high potential that activities under “Support for Stock Assessment” will address some of the initial objectives under this area.</li> </ul>			<p>impacts of stressors to ecosystem structure and function rather than assessing stock status;</p>			
<p>Climate change</p> <ul style="list-style-type: none"> <li>- Factors effecting distributional changes of fish stocks due to changes in the environmental parameters including teleconnections with factors outside of the CA of the NPFC such as melting ice</li> <li>- Impact of ocean acidification</li> </ul>	High	Med	<p>Impacts on species / habitats; oceanographic process changes; some activities completed or ongoing (e.g., POC and BIO).</p>	<p>Shifting of fishing areas due to habitat changes; impacts on targeted stocks and distribution; impact of ocean acidification on corals</p>	<p>Ranked medium-high as a priority, but it was decided to incorporate relevant project areas under the other three areas above.</p>	Medium-High
<p>Data management (collection and sharing and security)</p>	High (for sharing scientific	Low	<p>For PICES to provide advice, access to data and products is</p>	<p>Raw data is not accessible to external parties, and only used for the stock</p>	<p>Decided this was not an area where joint work was required. Important to encourage sharing of</p>	



		results)		required (similar to published NPAFC data).	assessments by Members of the NPFC; available data products are accessible on the website depending on the membership in different subsidiary bodies.	scientific results.	
Ocean Acidification (OA)						Decided this was an important consideration but not immediately relevant to NPFC priority fish species. Move area to be considered under VMEs.	
Management Strategy Evaluation (MSE)		Med	Med		NPFC has started activities on the MSE-based management approach for its priority species (BRP/HCR/MSE workshop in March 2019) and it may be something that NPFC would have interest in	Decided this was not an area that would be a priority for joint work over the next 5 years	

				pursuing through collaborative work with PICES, but not in the short term		
Microplastics	Med	Low			Decided this was not an area where joint work was required over the next 5 years	
Human activities pressures and impacts	Med	Med-low		Impacts of spatial management areas on other activities; engagement with other stakeholders	Recognized that the human dimension aspects of work needed to be considered in management actions, but it was decided that this area was not a priority over the next 5 years.	
Enhanced communications					Decided it was not a stand alone area, but needed to be incorporated within all areas for collaboration.	