

NPAFC-PICES Framework for Enhanced Scientific Cooperation in the North Pacific Ocean

28 April 2014

Executive Summary

The joint NPAFC-PICES Study Group on *Scientific Cooperation in the North Pacific Ocean* (SG-SC-NP) agreed on the need for a formal framework to guide, develop, implement, and monitor activities between PICES and NPAFC in the area of science cooperation.

The framework identifies two major scientific topics of joint interest to NPAFC and PICES, but does not prioritize these topics, nor provide a time table for their investigation:

- Effects of climate change on the dynamics and production of Pacific salmon populations; and
- Oceanographic properties and the growth and survival of Pacific salmon;

The framework describes various collaborative mechanisms that can be followed, including joint working groups, joint workshops and symposia, theme sessions at PICES annual meetings, and joint strategic initiatives. The framework will be discussed by PICES at their inter-sessional meeting of the Science Board in April 2014 and at the May 2014 meeting of NPAFC. Final approval by PICES is required at their October 2014 Annual Meeting.

The SG-SC-NP recommends that the framework for enhanced collaboration be implemented immediately after approval by both Organizations, and that two persons from each Organization provide annual updates to the PICES Science Board and NPAFC CSRS concerning the implementation of this framework.

1.0 Background

The NPAFC (North Pacific Anadromous Fish Commission) and PICES (North Pacific Marine Science Organization) are inter-governmental organizations with overlapping geographical areas and common interests in the sub-Arctic regions of the North Pacific Ocean. Both organizations have responsibilities to promote and coordinate marine scientific research and to promote collection and exchange of information and data related to subarctic marine ecosystems.

In recognition of shared interests and a desire by both organizations to facilitate and enhance cooperation between them, a Memorandum of Understanding (MOU) was signed in 1998 that provides for a general framework for mutual cooperation (*Appendix 1*). Consistent with the MOU, the two organizations have a long history of cooperative efforts (*Appendix 2*).

In an effort to enhance collaboration between the two organizations to achieve better and/or more rapid understanding of natural and anthropogenic variability in North Pacific marine ecosystems, the joint NPAFC-PICES Study Group on *Scientific Cooperation in the North Pacific Ocean* (SG-SC-NP) was established in 2013 to review each organization's scientific needs and identify where similar key questions or scientific issues might be explored jointly by both organizations.

The following are the terms of the reference of the joint NPAFC-PICES Study Group (hereafter, SG):

1. Review existing and planned scientific activities of each organization
2. Develop a list potential areas of cooperation
3. Convene a meeting/workshop for the following purposes
 - a. improve understanding of the science activities of each organization
 - b. review scientific topics from TOR (1) to identify areas of common interest
 - c. develop a framework for cooperation between NPAFC and PICES that lists categories of joint activities and the rationale for each, including the benefits to each organization from the joint activity, and identify priorities for joint activities within categories
 - d. recommend processes for implementing TOR (3c)
 - e. recommend approaches to develop a strategic plan for cooperation and mechanisms to periodically update that plan
4. The Co-Chairpersons will prepare a final Study Group report for distribution by the NPAFC-PICES Secretariats by spring 2014.

Membership of the SG comprised James Irvine (Chairperson, Working Group on Stock Assessment), Nancy Davis (NPAFC Secretariat), Shigehiko Urawa (Chairperson, Science Sub-Committee), and Alexander Zavolokin (Science Sub-Committee) from NPAFC and Elizabeth Logerwell (FIS Committee Chairman), Skip McKinnell (PICES Secretariat), Hiroaki Saito (FUTURE/COVE Advisory Panel Chairman), and Thomas Therriault (Chairman-elect, Science Board) from PICES. James Irvine and Elizabeth Logerwell co-chaired the group.

The SG's only face-to-face meeting occurred during PICES-2013 in Nanaimo, BC, Canada, on October 16, 2013. Most SG members were present, including several observers: Mark Saunders (NPAFC/DFO), Vladimir Radchenko (NPAFC), Laura Richards (PICES/DFO), John Field and Catherine Michielsens (Pacific Salmon Commission), and Sue Grant (DFO).

At the SG meeting, brief overviews of PICES and NPAFC organizational structures and scientific missions were provided, and scientific needs and overlapping issues that might be explored jointly by both organizations were discussed.

Presentations describing the SG were made to the COVE Advisory Panel and FIS Committee as well as PICES Science Board. A SG-SC-NP Workshop entitled "*Towards improved understanding of linkages between Pacific salmon and their marine ecosystems*" was approved for the PICES 2014 Annual Meeting in Yeosu, Korea.

Preliminary work on the framework for cooperation between NPAFC and PICES was initiated at the SG meeting, and a commitment made to continue this work afterwards. After the meeting, the SG continued discussion, consideration, and drafting of the framework for enhanced cooperation by email correspondence.

1.1 NPAFC organizational structure and procedures

The NPAFC is an international inter-governmental organization established under the Convention for the Conservation of Anadromous Stocks in the North Pacific Ocean that came into force in 1993. The Contracting Parties include Canada, Japan, Republic of Korea, the Russian Federation, and the United States of America. The primary objective of NPAFC is to promote the conservation of anadromous stocks in the Convention Area. The anadromous stocks covered by the Convention are Pacific salmon (sockeye salmon, *Oncorhynchus*

nerka; pink salmon, *O. gorbuscha*; chum salmon, *O. keta*; coho salmon, *O. kisutch*; Chinook salmon, *O. tshawytscha*; masu salmon, *O. masou*) and steelhead trout (*O. mykiss*).

The NPAFC Convention Area is the waters of the North Pacific Ocean and its adjacent seas, north of 33°N beyond the 200-mile exclusive economic zones (EEZs) of the coastal states (Fig. 1).

The NPAFC manages its treaty responsibilities under three standing committees (Fig. 2): Committee on Finance and Administration (F&A), Committee on Enforcement (ENFO), and Committee on Scientific Research and Statistics (CSRS). As its title suggests, the F&A Committee deals with matters internal to NPAFC and is not relevant to further discussion for this framework, except that every proposal for NPAFC funds must be approved by the F&A Committee. The primary objective of the ENFO Committee is to deter illegal, unregulated, and unreported fishing in the Convention Area. To achieve this, ENFO exchanges information on fisheries enforcement, high-seas patrol efforts, and inspection. As such, ENFO's responsibilities are largely outside the concern of the scientific framework. The scientific framework provides a pathway for coordination with NPAFC through its third standing committee—CSRS. The responsibilities of the CSRS are: (1) to provide the best available information on the condition of anadromous populations and, as appropriate, ecologically-related species, and their marine ecosystems; (2) to promote acquisition, analysis, and dissemination of scientific information pertaining to anadromous populations and ecologically related species in the ocean; and (3) to coordinate and establish effective mechanisms for international cooperation to promote conservation of anadromous populations in the ocean.

The CSRS is composed of one spokesperson and advisors from each of the five Contracting Parties. The individual Parties determine who will attend the CSRS meeting. So at any particular CSRS meeting, the participants can change, although in practice some of the same people participate at meetings over several years, and some members have participated at CSRS meetings for a decade or more. The CSRS convenes once per year, routinely at the NPAFC annual meeting, which will begin meeting in May in 2014.

The CSRS currently has one sub-committee and five working groups that help to carry out its functions (Fig. 2). These six sub-groups of the CSRS are not permanent, but most have continued for more than five years, as they continue to serve the CSRS by drafting scientific planning documents, or creating and maintaining databases in support of CSRS responsibilities. In addition to these sub-groups, occasionally more ephemeral sub-groups are created by the CSRS to serve a more focused purpose, for example to organize a meeting or draft a report or proposal to answer a specific requirement.

Membership in any of the sub-groups of CSRS is composed of a Chairperson and at least one person from each of the five Contracting Parties who is named by the Party.

Decision making at the NPAFC follows from deliberation of the CSRS and acceptance of the CSRS report and its recommendations to the representatives at the NPAFC annual meeting. The origin of a proposal can be from one of the CSRS sub-groups, or from the CSRS itself. Discussion of a proposal is held at the annual meeting of the CSRS, which is usually held at the NPAFC Annual Meeting. If a proposal is unanimously supported by the CSRS, the proposal is incorporated as a recommendation into the committee's report and presented to the plenary session of the Commission at the annual meeting, where the CSRS requests approval by the Commission of its report and its recommendations. At the point when the representatives approve the CSRS report and its recommendations, the proposals initiated at the CSRS have been approved by NPAFC. Any proposal that requires funding must also be approved by the F&A Committee.

The NPAFC Secretariat supports the work of NPAFC by providing administrative services to the Commission; compiling and disseminating statistics and reports, organizing meetings, developing and maintaining the website, handling the routine of running the organization, and other functions as determined by the Commission.

Currently the NPAFC is working under the 2011-2015 Science Plan (NPAFC Doc. 1255, 2010; available at www.npafc.org). The Science Plan was developed by the Science Sub-Committee and approved by the CSRS and the Commission. The Science Plan recognizes a strong need for international cooperative research to provide better scientific information on the ecological mechanisms regulating production of anadromous populations, to estimate climate impact on salmon populations in North Pacific marine ecosystems, and to examine the extent to which salmon populations can be used as indicators of conditions in North Pacific marine ecosystems. The goal of the Science Plan is to forecast Pacific salmon production in the ocean ecosystems under changing climate. Under this overarching theme, there are five research components:

- (1) Migration and survival mechanisms of juvenile salmon in the ocean ecosystems;
- (2) Climate impacts on Pacific salmon production in the Bering Sea (BASIS) and adjacent waters;
- (3) Winter survival of Pacific salmon in the North Pacific Ocean ecosystems;
- (4) Biological monitoring of key salmon populations;
- (5) Development and applications of stock identification methods and models for management of Pacific salmon.

To accomplish the goals set out in the 2011-2015 Science Plan, the Parties' scientists have published results in scientific journals, submitted information in the form of NPAFC documents, and NPAFC has organized and sponsored workshops and published technical reports. In May 2015, there will be an open NPAFC science symposium in Kobe, Japan. The goal of the symposium is to bring together international scientists to discuss and review progress on research relevant to these five components. Articles submitted at the symposium will be peer-reviewed and, if accepted, published in the NPAFC Bulletin series.

In 2015, the Science Sub-Committee will be considering and developing a new science plan for approval by the CSRS and the Commission. As appropriate, any initiatives developed in this framework could be incorporated into the next Science Plan.

1.2 PICES organizational structure and procedures

The North Pacific Marine Science Organization (PICES) is the international, inter-governmental organization that is responsible for coordinating and promoting marine scientific research and scientific information exchange among its members (Canada, Japan, People's Republic of China, Republic of Korea, the Russian Federation, and the United States of America). The primary area of interest to the Organization is the northern North Pacific Ocean, bounded at the south by 30°N latitude and in the north by Bering Strait. PICES was established by international convention in 1992, with a Secretariat hosted by Fisheries and Oceans Canada at the Institute of Ocean Sciences, Patricia Bay, Canada.

Two delegates from each Contracting Party plus a Chairman elected by the delegates form a Governing Council that is responsible for policy, general direction, decision-making, and priority setting (Fig. 3). The scientific activities of PICES are established by a network of 300 scientists, appointed by the members to serve on standing committees and various thematic expert groups. Governing Council is advised by its Science Board on scientific priorities. The Science Board is formed by the Chairmen of the six permanent Scientific Committees and Technical Committees, and Advisory Panels of Scientific Programs. Should any Contracting

Party not be represented on Science Board by virtue of not having a chairmanship, it can appoint a representative to serve its scientific interests.

The scientific work of PICES is conducted primarily by ephemeral working groups and study groups with 1- to 3-year lifespans to achieve the results described in their terms of reference (Fig. 3). Advisory panels and sections provide longer-lived expert groups to maintain specific expertise within PICES. Chairmanship for expert groups is often shared by Asian and North American scientists. The Scientific and Technical Committees are responsible for the planning and direction of major disciplinary themes. They provide general supervision to the expert groups and report their activities to Science Board.

From time to time, Science Board has provided formal scientific advice to a Contracting Party, but it is not a major activity. Scientists in PICES have focused on reporting status and trends in the North Pacific and understanding the nature and consequences of global climate change. New initiatives will seek to communicate this understanding to society.

The work of PICES is determined primarily by the scientists of the Contracting Parties. They are supported by a Secretariat that is responsible for organizing their international meetings and workshops, publishing their work, fundraising, maintaining and developing the PICES website, maintaining and enhancing relations with other international organizations, and for the day-to-day running of the Organization. When called upon, the Secretariat leads the development of major scientific products.

The PICES Strategic Plan describes how the organization will implement its mission to promote and coordinate marine scientific research (www.pices.int/about/strategic_plan.aspx). The plan lists several goals, the first five of which are especially relevant to this framework:

- (1) Understand the functioning, resilience, and vulnerability of marine ecosystems;
- (2) Understand and quantify how marine ecosystems respond to human activities and natural forcing;
- (3) Provide scientific advice pertinent to North Pacific ecosystems;
- (4) Ensure that PICES products are relevant, timely, and broadly accessible;
- (5) Collaborate with organizations and scientific programs relevant to PICES.

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 undertaken by the Contracting Parties 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, and to communicate new insights to its members, governments, stakeholders and the public. *FUTURE* will be one of the highest priority activities of PICES for the next decade (www.pices.int/members/scientific_programs/FUTURE/FUTURE-main.aspx).

2.0 Major scientific topics of joint interest to NPAFC and PICES

PICES has a much broader scientific mandate than NPAFC. As described above, PICES is tasked with understanding how marine ecosystems respond to climate change and human activities. Climate change is a major component of the current NPAFC Science Plan, but research focuses on the conservation of anadromous salmon. This can include, as outlined in the Convention, scientific research on other ecologically-related species.

Improved collaboration should allow NPAFC and PICES scientists to add value to their science, provide synergies on regional and global issues, and enhance the visibility of both organisations. This strategy should be adaptive to allow the organisations to respond to changing priorities of each organization's Contracting Parties and of the scientific world.

The SG identified two broad research areas of mutual interest, each with various subtopics. The following list is not prioritized, and there is some overlap among items listed.

2.1 Effects of climate change on the dynamics and production of Pacific salmon populations

Climate change will likely result in increases in ocean temperature that could impact the survival of many marine organisms, including salmon. Furthermore, climate change could result in changes to many characteristics of an ecosystem, such as species biomass, community species composition, and seasonal dynamics of prey and predators. These changes could result from increasing ocean temperature, increasing stratification, increased mixed layer depth, and/or decreases in nutrient concentration. There are many areas of possible collaboration between NPAFC and PICES, particularly with the PICES/ICES Section on *Climate Change Effects on Marine Ecosystems* (S-CCME). Some focused research topics include the following:

- (1) Key climatic and oceanographic factors affecting long-term changes in food production and salmon growth rates;
- (2) Environmental factors that affect salmon ocean distribution (*e.g.*, temperature, salinity, prey biomass, *etc.*) and how distribution (including winter) may be affected by climate change;
- (3) Linkages between salmon marine survival and climate and ocean change;
- (4) Impacts of climate change on available salmon habitat and salmon production;
- (5) The human dimension of ecosystem change, a new area of interest for PICES, is a key element of its FUTURE research initiative. Although NPAFC's mission is the conservation of salmon, its salmon scientists may be able to collaborate on specific research questions.

2.2 Oceanographic properties and the growth and survival of Pacific salmon

Expertise in PICES with ocean modeling, with experience with non-salmonids, could provide a productive area of collaboration with salmonid experts at NPAFC to better understand the factors affecting salmon growth, mortality and ultimately production.

2.2.1 Early marine period

The early marine life history phase is generally regarded as a critical period in determining brood stock abundance for Pacific salmon. However, linkages between oceanographic factors and salmon survival and growth are poorly understood. The collaborative activities of NPAFC and PICES could improve our understanding of how juvenile salmon growth and survival are affected by oceanographic conditions.

2.2.2 Winter diet and growth/survival of salmon

Biomass of many zooplankton taxa (copepods, euphausiids, gelatinous zooplankton and others) is low in the winter in the subarctic Pacific. Many planktivorous pelagic and some mesopelagic myctophids migrate south during winter. Demersal fish are often piscivorous and thus may rely on cannibalism in the winter when prey abundance is low. This raises the question of how lower trophic level prey resources in winter influence salmon growth and ultimately survival and population dynamics.

2.2.3 Density dependent effects on salmon growth and survival in a varying environment

Salmon abundance in the North Pacific is at all-time high levels, yet growth and survival for some populations is declining. PICES completed a 10-year program on Climate Change and Carrying Capacity (CCCC) in 2009 and is now focusing on a new research program, FUTURE. The expertise of PICES and NPAFC scientists could bring new insight to understanding density dependent effects on salmon and forecasting salmon production.

2.2.4 Density independent effects on salmon growth and survival – Ocean nutrients

Density independent effects on salmon tend to be hard to predict, have high impact, but are infrequent. One example is the hypothesis that episodic injections of allochthonous nutrient sources (*e.g.*, iron) may be responsible for enhanced biological production leading to higher abundances of salmon. NPAFC scientists could provide time series of salmon abundance and biomass at appropriate geographical scales. PICES scientists could provide relative magnitudes of interannual variability in nutrients and resultant phenology and productivity of lower trophic levels, and together researchers could review ocean ecosystem models of the North Pacific to explore the ecosystem effects of nutrient injections.

3.0 Implementation procedures

Potential mechanisms for enhancing cooperation between NPAFC and PICES include:

1. Theme sessions at PICES annual meetings
2. Joint working groups
3. Symposia
4. Workshops
5. Strategic initiatives
6. Other

3.1 Theme sessions at PICES annual meetings

Joint topic sessions at PICES annual meetings held normally in October are an excellent potential mechanism for cooperation between PICES and NPAFC. There are numerous past examples of sessions that PICES has co-convened with other organizations, such as ICES (International Council for the Exploration of the Sea), IMBER (Integrated Marine Biogeochemistry and Ecosystem Research), GESAMP (Group of Experts on Scientific Aspects of Marine Pollution), NOWPAP (Northwest Pacific Action Plan), ISC (International Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean), Ocean Network Canada, U.S. CLIVAR, SOLAS (Surface Ocean Low Atmosphere Study), and many others. The benefits of sharing research findings and expertise have been demonstrated by these examples. Convening topic sessions at NPAFC annual meetings is not a mechanism used by NPAFC for public review of science. Open discussion of NPAFC science is typically achieved through workshops and symposia that are often held immediately after annual meetings.

PICES – Topic session proposals by scientists working under the PICES umbrella should be submitted to the PICES website by the deadline, typically September 1 of the calendar year before the Annual Meeting of interest. Proposals should include: a title, duration (full or half day), session description, list of conveners, sponsoring PICES Scientific Committee(s), co-sponsoring organizations (if any), and whether (and where) a publication is intended. The proposals are then ranked by all Committee members online. At the Committee

meetings at the Annual Meeting in the fall (the year before the meeting of interest), recommendations for which session proposals to support are finalized. The Committee Chairmen then present the recommendations to the Science Board (SB) for final decision. The PICES SB will evaluate and agree on co-sponsoring of sessions. The agreement will consider not just the scientific excellence and appropriateness of the proposals, but also the financial constraints of funding such sessions.

NPAFC – To implement a joint PICES-NPAFC topic session or workshop at a PICES annual meeting, the NPAFC process starts when the Science Sub-Committee (SSC), working with a PICES counterpart, develops the proposal and the other information required by PICES. Proposals for workshops and topic sessions are submitted on-line by early September of the calendar year before the PICES annual meeting of interest. At the NPAFC annual meeting in May (the year before the PICES annual meeting of interest), the proposal comes from the SSC to the CSRS who may recommend it to the Commission, which can approve it at the same meeting. The conveners would then submit the proposal to PICES during the summer according to the PICES process described above. If there are NPAFC travel funds to be requested, then at the NPAFC annual meeting in May of the calendar year when the topic session will take place, the request for funding would originate from the SSC, and if agreed by the CSRS it would be forwarded to the F&A Committee for possible approval by the Commission. Successful implementation of a topic session from the NPAFC perspective requires that agreement and approval be obtained at each organizational level—SSC, CSRS, F&A (if funds are requested) and the Commission at the annual meeting in May. Minimum lead time is approximately one and half years.

3.2 Joint working groups

PICES and NPAFC have limited experience with joint working groups with other organizations. PICES has one previous example of a joint working group with another organization (ICES) that led to the establishment of a PICES Section with a broader mandate and longer lifetime based on the success of the joint working group. NPAFC has no previous experience of a joint working group with another organization, other than short-lived co-organizing committees and the study group that developed this framework. Potentially, joint working groups represent one of the most effective mechanisms for cooperation when there is the need to focus on a specific topic with specific deliverable defined by the terms of reference.

PICES – The activities of Working Groups (WG) in PICES are overseen by its Scientific Committees (Fig. 3). In general, few are formed each year so effective planning is a crucial element of successfully establishing a new WG. The need to establish a WG usually follows after one or a series of topic sessions and workshops that are organized on a common theme over a period of 1 year or more. Thereafter, a request for a Study Group (SG, generally 1 year in duration) can be a first step in establishing the Terms of Reference and potential membership of a Working Group, with a typical duration of 3 years. FUTURE Advisory Panels will review these proposals to determine their relevance and importance to the FUTURE Science Program. As a consequence of the relatively lengthy process, there is no set schedule for submitting proposals, except to note that SG/WG proposals can be brought to the attention of Science Board by a Committee Chairman either at the inter-sessional meeting in the spring or at the annual meeting in the fall. As decisions are taken by consensus, scientists from all Contracting Parties should be consulted.

NPAFC – Scientific groups (such as working groups and the Science Sub-committee) are established by the CSRS. Currently there are five working groups and one sub-committee (SSC; Fig. 2), and each group has a terms of reference (available at www.npafc.org). The continuing existence of a group and creation or modification of a group's terms of reference is determined by the CSRS. All working groups and the SSC

report on their work and progress at the CSRS annual meeting in May. The CSRS established the SSC in part to review opportunities for scientific collaboration with other international organizations. With regard to a possible future joint working group with PICES, the CSRS will decide how to synchronize responsibilities between the SSC and a joint working group depending on the duration, proposed terms of reference, and potential membership of the joint working group. To initiate the process, a proposal to form a joint study group would be discussed by the SSC and the CSRS, and with agreement, approval of its formation would be recommended to the Commission.

Because of the potentially lengthy process, those from PICES or NPAFC wishing to submit a proposal for a joint working group are asked to engage at an early stage with the Secretariats of both bodies to explore ways of implementing proposals.

3.3 Symposia

There is a long and profitable history of co-sponsorship and co-organization of inter-sessional symposia (*i.e.*, outside the annual meetings of each organization) between NPAFC and PICES (see *Appendix 2*). These events have ranged from meeting co-sponsorship, which is generally limited to financial assistance for a meeting, to a jointly co-organized meeting, which arises from a deeper level of cooperation as indicated by a meeting that may be co-conceived, co-organized, and co-sponsored by both organizations. Jointly co-organized meetings necessitate a longer duration of planning, as both organizations must have scientists on the organizing or scientific steering committees. In addition, either organization can nominate speakers, convene sessions or workshops during the symposium, *etc.* Co-sponsoring sessions at international symposia can raise the profile of research being conducted by NPAFC and PICES.

PICES – Proposals generated internally within PICES for jointly sponsored symposia are generally brought to the attention of Science Board by Committee Chairmen at one of its two meetings during the year. The nature of the discussion often depends on whether PICES is asked to be the organizer. Normally, PICES organizes one major symposium per year in the spring. Typically, this symposium is jointly sponsored because of the financial commitments required to organize a major symposium. Organizations seeking co-sponsorship of a symposium by PICES should direct a letter of invitation to the Executive Secretary of PICES. In addition to the scientific imperative, the letter should include the names of other co-sponsoring organizations and a summary of role and financial/in-kind contributions expected of PICES. The Executive Secretary will circulate the invitation to the relevant Committees. Significant commitments of resources typically require 2–3 years advance planning. Potential jointly organized and co-sponsored symposia may require more lead time.

NPAFC – The topical theme and approximate timing of NPAFC symposia are generally planned according to a tentative schedule outlined in the NPAFC Science Plan. The current Science Plan covers the time period 2011–2015 (available at www.npafc.org/new/science_plan.html) and there is a NPAFC Symposium organized for May 2015 in part to review progress on the plan (International Symposium on “*Pacific Salmon and Steelhead Production in a Changing Climate: Past, Present, and Future*”). With enough lead time, joint symposia (co-organized and co-sponsored) can be described in the new Science Plan as it is being conceived. Detailed development of the next Science Plan will take place in 2015–2016. The Science Sub-Committee takes the lead in formulating and drafting the Science Plan, which is submitted to the CSRS and the Commission for approval. Subject to approval by the CSRS at the annual meetings in May, the SSC provides strategic planning for scientific meetings, including the main topic, organizing committee members, and the schedule. Proposals for joint symposia not listed or described in the Science Plan or co-sponsored symposia

(usually limited to financial contributions) can also be considered. However, as true for any NPAFC symposia, the theme of a jointly co-organized or co-sponsored symposium needs to fit the objectives of the NPAFC Science Plan. The minimum lead time from the initial proposal stage to a joint co-organized symposium is generally 2–3 years to allow for enough time that an organizing committee can be created from members of both organizations. A request for co-sponsorship of a symposium is generally one year.

3.4 Workshops

PICES and NPAFC have been co-sponsoring, and co-organizing workshops throughout their mutual history (see *Appendix 2*). New 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 NPAFC and PICES expertise in co-sponsored workshops. The most recent example is the PICES-NPAFC workshop on “*Linkages between the winter distribution of Pacific salmon and their marine ecosystems and how this might be altered with climate change*” to be held at the 2014 PICES Annual Meeting. This workshop was organized by the PICES-NPAFC SG on *Scientific Cooperation in the North Pacific*.

PICES – Proposals for jointly sponsored workshops are generally brought to the attention of Science Board by Committee Chairmen. For the most part, a proposal for a workshop should resemble a proposal for a scientific session, with some additional information depending on whether it is associated with a PICES or NPAFC annual meeting, local host/organizer, institute/location, dates, financial expectations of PICES (commonly for invited speakers from PICES and/or PICES conveners). Proposals for workshops to be held at the PICES annual meeting are submitted the same way as for theme sessions (see 3.1 above).

NPAFC – Generally, workshops are organized the same way as symposia, but the lead time can be shorter, *e.g.*, at least 12 months after approval by the CSRS and the Commission at the annual meeting in May. As with symposia, proposals for joint workshops or co-sponsored workshops are formulated by the Science Sub-Committee and proposed to the CSRS. Plans for joint or co-sponsored workshops can be incorporated into a Science Plan as it is being developed, or it can be proposed after the plan is accepted, as long as the theme of the workshop fits with the objectives of the Science Plan. Therefore, the process for initiating a plan for a joint or co-sponsored workshop starts the same way as a symposium—coordination with and a proposal from the Science Sub-Committee to the CSRS and a decision for support at the Commission’s annual meeting.

3.5 Strategic initiatives

It may be of interest for both organizations to initiate new cross-cutting activities that require the engagement and participation of several organizations. The initiatives would be aimed at multi-disciplinary topics that could benefit from additional coordination.

PICES – Cross-cutting initiatives can be addressed by forming a new Section in PICES. A “Section” represents a sub-committee under a scientific committee that has a longer lifespan than a working group. Its purpose is to provide input to the parent scientific committee on specific issues for which expertise may be lacking on the parent committee. Sections should be reviewed periodically to ensure they continue to meet their objectives. A recent example is the joint ICES-PICES Section (Strategic Initiative) on *Climate Change Effects on Marine Ecosystems (S-CCME)*, which aims to ensure that “*ICES and PICES will become the leading international organizations providing science and advice related to the effects of climate change and variability on marine resources and ecosystems*”.

NPAFC – Any new scientific initiative at NPAFC must be a part of the CSRS structure and pertain to its terms of reference. Depending on decisions by the CSRS, the committee can address a new scientific initiative on its own, or create a sub-group to manage it. In the past, an international strategic planning initiative was organized by NPAFC with outside funding. The initiative was originally proposed by the Science Sub-Committee and endorsed by the CSRS and the Commission. This project was the “*Long Term Research and Monitoring Plan (LMRP) for Pacific Salmon in the North Pacific Ocean*” (NPAFC Special Publication Nos. 1 and 2; available at http://www.npafc.org/new/pub_special.html). In addition, the BASIS Working Group has been coordinating and reporting on an ongoing multi-disciplinary initiative to understand how climate change will affect productivity of the Bering Sea. This Working Group was the first group to establish an individual science plan within the boundaries of the NPAFC Science Plan developed by the CSRS. New strategic initiatives of long term duration would best be incorporated into a science plan developed and proposed by the Science Sub-Committee and approved by the CSRS and the Commission. In particular, the Science Sub-Committee will begin working on the development of a new science plan next year for review by the CSRS in May 2016. Initiatives that have not been incorporated into the science plan begin with coordination and a proposal from the Science Sub-Committee for review and approval by CSRS and it must fit within objectives of the science plan. If the CSRS agrees that formation of a new group is necessary to carry out CSRS functions, then it will create the new group. All sub-groups of the CSRS report on their work and progress at the CSRS annual meeting in May.

3.6 Other

Other mechanisms for cooperation between NPAFC and PICES include regular representation at each other’s annual meetings, mutual contributions to reports, collaboration on research, and coordination of science plans.

3.6.1 Representation at annual meetings

PICES and NPAFC have a long-standing tradition of exchanging representatives to annual meetings, where representatives can use the opportunity to report on their organization’s activities of interest. Cooperation with other relevant international organizations is a component of NPAFC Convention (Article IX. 9; available at www.npafc.org/new/about_convention.html.) and consideration of scientific cooperation is reviewed annually by the CSRS.

3.6.2 Contribute to reports

A recent example of this kind of collaboration is that NPAFC has agreed to participate and support the PICES North Pacific Ecosystem Status Report. This report is intended to periodically review and summarize the status and trends of the marine ecosystems in the North Pacific, and to consider the factors that are causing or are expected to cause change in the near future.

In general, publications from NPAFC take the form of NPAFC Bulletins (peer-reviewed articles from symposia) or NPAFC Technical Reports (non peer-reviewed extended abstracts from workshops). With this perspective, contribution to NPAFC Bulletin Nos. 3 and 4 and NPAFC Technical Report Nos. 2, 4, and 8 have resulted from co-organized NPAFC-PICES symposia and workshops.

Further collaboration on reports lead by either organization would advance the cause of increased cooperation.

3.6.3 Collaborate on research

Where PICES and NPAFC share research interests, it would benefit projects for scientists from each organization to collaborate where possible. Examples include PICES scientists requesting collaboration on the NPAFC

BASIS cruises, and PICES scientists being invited to participate in NPAFC micronekton inter-calibration experiments. Regular participation in each other's annual meetings, workshops and symposia; and joint participation in study groups and working groups will facilitate this kind of collaboration.

3.6.4 Coordinate science plans

To further promote collaboration in many of the activities described above, NPAFC and PICES could include shared elements in their science plans.

PICES – The PICES Strategic Plan describes the overarching mission and strategy of the Organization. The actions and activities required to meet each of the goals of the PICES Strategic Plan change over time, and are implemented through action plans. Three-year action plans are prepared for the executive committees, scientific and technical committees, and the Secretariat. These plans describe specific actions and tasks needed to achieve the goals identified above. To monitor performance, the action plans are reviewed at each annual meeting, and revised if necessary. Elements in the action plans that specify collaboration with NPAFC would facilitate coordinated activities between the two organizations.

NPAFC – The current NPAFC Science Plan outlines the scientific activities through 2015 and will culminate in a symposium in May 2015 titled, “*International Symposium on Pacific Salmon and Steelhead Production in a Changing Climate: Past, Present, and Future*”. Currently, the SSC is in the preliminary stages of considering a draft of a new Science Plan that will be discussed by the CSRS at the annual meeting in 2016. Proposals for shared initiatives with PICES, as well as potential timing and subject of co-organized symposia and workshops would be facilitated if incorporated into the new Science Plan.

4.0 Monitoring/steering cooperation

The SG concludes that this framework should provide sufficient guidance to the NPAFC and PICES communities to develop bottom-up joint activities, with clear procedures for approval and implementation (see section 3.0). The implementation of these activities needs to be agreed upon by the organizations' respective science bodies: the Science Board in the case of PICES and the CSRS in the case of NPAFC.

When considering cooperative proposals, these bodies also need to take into account their own scientific priorities as determined by their science, implementation, and/or strategic plans. Additional considerations are the financial and structural constraints under which the organizations operate, and the balance of cooperative activities in their own profiles.

A mechanism is needed to monitor and steer NPAFC – PICES collaborations, and to act as an interface between the two organizations and the proponents of joint activities. It is proposed that this role be filled for NPAFC by a representative of the CSRS and a representative of the NPAFC Secretariat and for PICES by a representative of the Science Board and a representative of the PICES Secretariat.

This group of four would ensure a responsive structure with a light footprint and minimal additional costs, and with the mandate to implement specific cooperative activities, such as joint meetings, working groups, and strategic initiatives, identified in this framework. In addition, it is suggested that a strategic analysis be conducted every 3–5 years, and that this includes an additional 2–5 members of each organization.

5.0 Conclusions and next steps

In conclusion, the SG recommends this framework be adopted by both organizations. The framework identifies two broad areas of joint scientific interest to NPAFC and PICES, but does not prioritize them:

- Effects of climate change on the dynamics and production of Pacific salmon populations; and
- Oceanographic properties and the growth and survival of Pacific salmon.

The SG recognizes that topics of interest will change over time and does not provide a time table for their investigation.

The framework identifies various mechanisms for implementing enhanced cooperation between NPAFC and PICES, including theme sessions at PICES annual meetings, joint working groups, symposia, workshops, strategic initiatives, and continued representation at each other's meetings. Procedures for other collaborations (*e.g.*, publications, training) may require further development.

Both organizations require lead time to identify, evaluate, and formulate ongoing commitments as next steps toward enhancing cooperation. Already a joint 1-day workshop on “*Linkages between the winter distribution of Pacific salmon and their marine ecosystems and how this might be altered by climate change*” is planned for PICES 2014. It is anticipated that this joint workshop will bring together NPAFC and PICES researchers in fisheries and oceanography to improve understanding of the mechanistic linkages between salmon and their ecosystem. Workshop conveners, invited speakers, and fisheries, oceanographers, and climate specialists together can provide a kernel for continued joint scientific investigation into this topic. When given opportunities for co-involvement by scientists of both organizations through the implementation mechanisms identified in this framework, enhanced cooperation in areas of mutual scientific interest should expand.

The framework will be considered by the inter-sessional meeting of the PICES Science Board in April 2014 and at the May 2014 Annual Meeting of NPAFC. Final approval by PICES will be required at their October 2014 Annual Meeting. Assuming the framework is approved by both Organizations, the NPAFC-PICES Study Group recommends that if the framework be implemented immediately, and that two persons from each Organization provide annual updates to the PICES Science Board and the NPAFC CSRS concerning the framework's implementations.

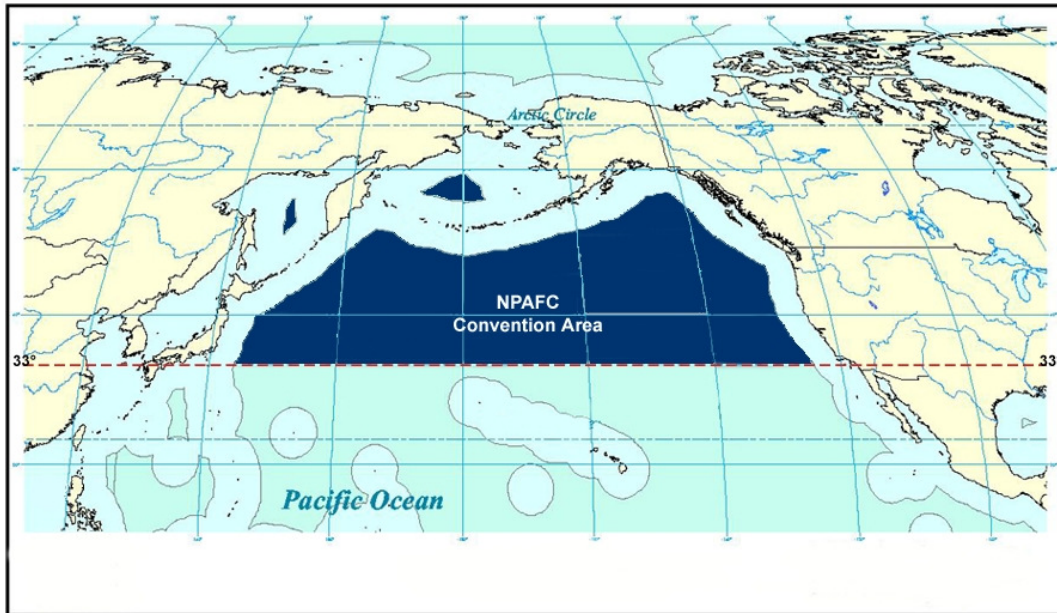


Figure 1. The NPAFC Convention area is the waters of the North Pacific Ocean and its adjacent seas, north of 33 degrees North Latitude beyond the 200-mile zones of the coastal States.

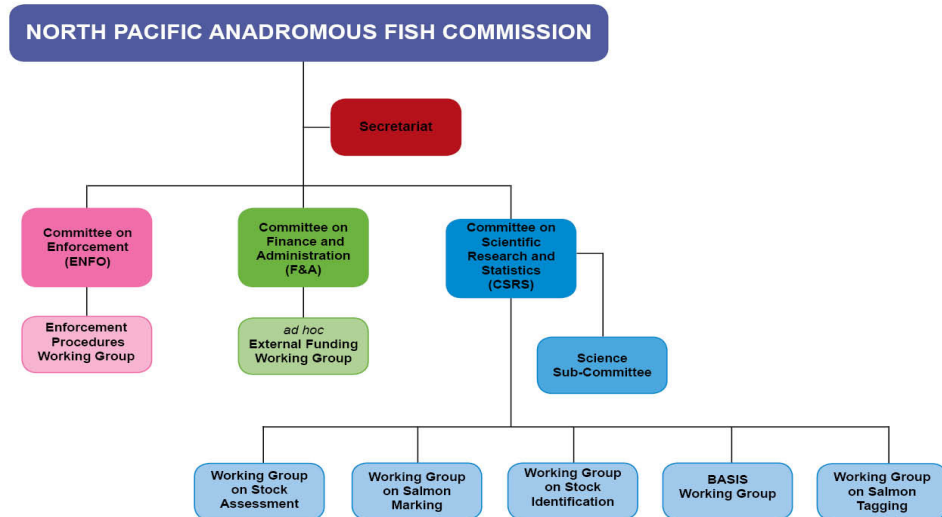


Figure 2. Organizational structure of the North Pacific Anadromous Fish Commission in 2013.

**North Pacific Marine Science Organization (PICES)
structure for 2013–2014**

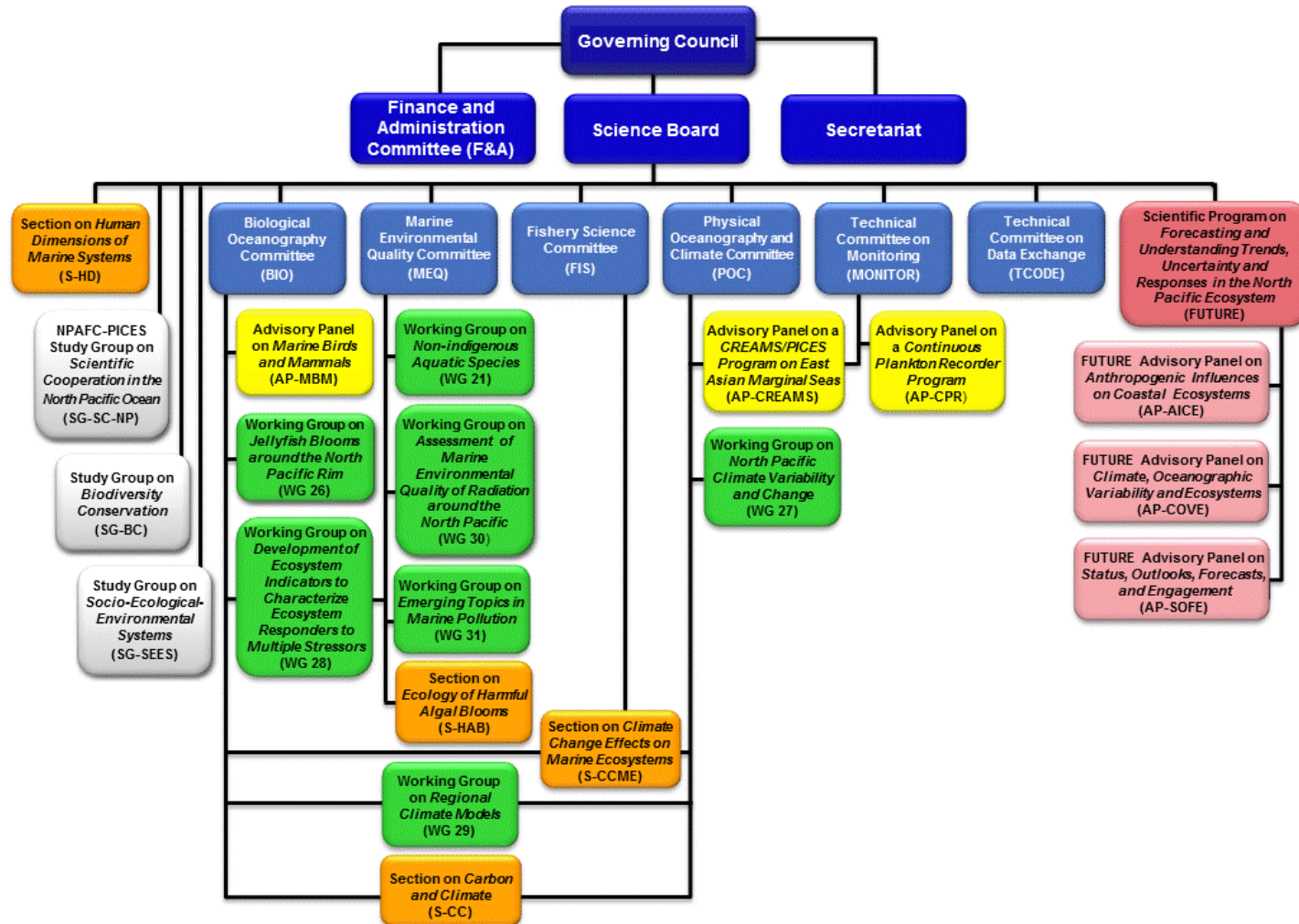


Figure 3. Organizational structure of PICES in 2013–2014. The uppermost rows are the executive and standing committees. Expert groups under them are generally ephemeral, with their lifespan determined by the nature of their duties.

Appendix 1: 1998 Memorandum of Understanding between the North Pacific Marine Science Organization and the North Pacific Anadromous Fish Commission

Recognizing that the North Pacific Marine Science Organization (PICES), exists to: (a) 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 (b) to promote the collection and exchange of information and data related to marine scientific research in the area concerned;

Recognizing that the North Pacific Anadromous Fish Commission (NPAFC) exists to: (a) promote the conservation of anadromous stocks in the Convention Area; and (b) consider matters related to the conservation of ecologically related species in the Convention Area;

Recognizing the mandatory powers, constraints and obligations under which PICES and NPAFC respectively operate;

Desiring to provide a frame work for mutual cooperation;

PICES and NPAFC, hereinafter called “the Parties”, have agreed to the following:

1. To maintain reciprocal consultations and regular contacts on matters of common interest in the field of marine scientific research;
2. To regularly exchange with information, documents, and publications relating to program and project plans and to the results of activities agreed by the Parties to be of mutual interest, joint or otherwise;
3. To invite each other to be represented, in an observer capacity, at meetings of common interest, to the extent that this is possible within their respective working procedures;
4. To undertake joint activities, as appropriate, including when agreed, the establishment of joint subsidiary bodies or other suitable arrangements, to study and report on matters of common interest;
5. To consult, as appropriate, on ways in which cooperation between them can be further improved and extended. Specific joint programs and activities may be defined through addenda to this agreement;
6. To coordinate the time and place of annual meetings to facilitate the work of both Parties;
7. This Memorandum of Understanding (Memorandum) shall enter into force upon signature of the person duly authorized by each Party and shall remain in force unless either Party withdraws pursuant to paragraph 9 below;
8. The terms of the Memorandum may be revised by the Parties if they both agree. The Memorandum shall continue on the basis of the existing terms until new terms have been agreed;
9. Either Party may withdraw from the Memorandum at any time subject to giving one year’s written notice to the other Party.

[Signed by the President (NPAFC) and Chairman (PICES) in 1998]

Appendix 2: Timeline of NPAFC/PICES Cooperation

1993

- CSRS forms a working group to discuss questions or problem areas regarding anadromous species that could be posed to PICES. The Parties agreed that NPAFC and PICES could jointly examine the critical issue of the impact of change in productivity of the NPO on Pacific salmon. These issues should include analysis of factors affecting current trends in the productivity of the NPO and their impacts on salmonid carrying capacity; and factors affecting changes in biological characteristics of Pacific salmon. These characteristics include growth, size at maturity, age at maturity, oceanic distribution, survival, and abundance.
- CSRS recognizes that the issues identified above are complex and will be difficult to resolve in the short term. Accordingly, such questions may be addressed by interim reports for next year from PICES and NPAFC, accompanied by advice on the time frame that may be expected for more complete answers, as well as advice on data deficiencies and research needs.
- CSRS recognizes that it may be useful to develop cooperative activities with other organizations regarding questions or problems relating to anadromous species. CSRS might consider developing these cooperative activities after obtaining responses from invitations sent to representatives to be observers at NPAFC (PICES and other organizations).

1994

- Invitations given to each other's meetings (NPAFC and PICES).
- NPAFC Annual Report reaffirmed the need for NPAFC and PICES to jointly examine (1) factors affecting productivity of the North Pacific and their impacts on salmonid carrying capacity and (2) factors affecting changes in the biological characteristics of Pacific salmon including growth, size and age at maturity, oceanic distribution, survival, and abundance. PICES invites liaison from CSRS to join membership in PICES-GLOBEC Study Group.

1995

- PICES recommends a CCCC Workshop in Nemuro in late 1996. The scientific steering committee for the workshop should be established based on the MODEL Task Team, with additional members from Working Group 7 and 9, and NPAFC SSC.
- NPAFC requests PICES help in getting statistical information from NPAFC non-members for the statistical yearbook.
- One member of SSC participates in PICES sponsored workshop as an observer and NPAFC should cover travel costs for one member of SSC to go to workshop.
- Dr. Wooster extends willingness to support scheduled NPAFC 1996 International Symposium on "*Assessment and Status of Pacific Rim Salmon Stocks*" in various ways, including distributing information to its Parties.

1996

- CSRS recommends CSRS should discuss proposal by Dr. Wooster and examine the progress on mutual cooperation between NPAFC-PICES.

1997

- NPAFC provides travel money for SSC Chairperson to attend and present at PICES CCCC Executive Committee meeting.

1998

- Invitation by PICES for a NPAFC member to join steering committee of PICES meeting “*El Niño and beyond: A conference on Pacific climate variability and marine ecosystem impacts from the tropics to the Arctic*”.
- NPAFC becomes co-organizer (Dr. Low is on the steering committee).
- NPAFC provides travel money for SSC Chairperson to attend and present at PICES CCCC Executive Committee meeting.
- MOU between PICES and NPAFC is signed. The organizations agree to maintain reciprocal consultations and regular contact on matters of common interest, regularly exchange information, invite each other as observers to meetings, undertake joint activities, and consult on ways cooperation can be further improved.

1999

- NPAFC to host and PICES to join in organizing Juvenile Salmon Workshop I in Tokyo in 2000.
- NPAFC provides travel money for SSC Chairperson to attend and present at PICES CCCC Executive Committee meeting.
- PICES will produce a document that summarizes PICES scientific activities that might be of interest to NPAFC. Document will be presented to CSRS by PICES representative.

2000

- WGSA discusses decision by CSRS to participate in preparation of the North Pacific Ecosystem Status Report.
- PICES editor joins editors of Technical Report No. 2.
- PICES presents list of papers from their annual meeting to NPAFC that might be relevant to salmon.
- First joint PICES/NPAFC workshop on “*Factors affecting production of juvenile salmon and climate*” took place in Tokyo (NPAFC Technical Report No. 2 and NPAFC Bulletin No. 3, “*A Review of the Research on the Early Marine Period of Pacific Salmon by Canada, Japan, Russia, and the United States*”).
- At CSRS, PICES discusses two proposals for possible future collaborations between NPAFC and PICES: (1) hold workshops involving salmon and climate led by NPAFC and (2) produce a North Pacific Ecosystem Status Report led by PICES. CSRS agrees to contribute salmon information to the PICES status report. The PICES proposal for a series of salmon and climate workshops is not accepted by CSRS.
- SSC Chairperson goes to PICES meeting and discusses coordination of science plans and cooperative activities (joint workshop, publications).

2001

- SSC Chairperson goes to PICES meeting where coordination and cooperative activities are discussed.
- WGSA will prepare a report for ecosystem status report.

2002

- SSC Chairperson will represent NPAFC at PICES Annual Meeting.
- PICES proposes co-sponsorship of joint meeting as a form of cooperation between the two organizations.

- CSRS agrees to co-sponsor PICES symposium or workshop on “*The Okhotsk Sea and Adjacent Areas*” in Vladivostok in 2003. At later date, NPAFC would nominate scientists to give invited talks on status of stocks in the area.
- PICES invites CSRS to consider co-sponsorship or co-membership in proposed PICES WG on ecosystem based approaches to fisheries management. Some scientists belong to both groups, so co-membership might be possible.
- WGSA will contribute to PICES ecosystem status report.
- Joint meeting of “*Causes of marine mortality of salmon the North Pacific Ocean and North Atlantic Ocean, and Baltic Sea*” in Vancouver, March 2002, co-organized and co-sponsored by IBSFC, ICES, NASCO, PICES, and NPAFC. NPAFC Technical Report No. 4 (Causes of Marine Mortality of Salmon in the North Pacific and North Atlantic Oceans and in the Baltic Sea) published.

2003

- CSRS Chairperson represents NPAFC at PICES annual meeting.
- PICES observer presents response to SSC report on coordination and implementation of NPAFC and PICES Science plans.
- PICES will co-sponsor symposium at 2005 NPAFC meeting “State of the Pacific salmon and their role as indicators of the North Pacific ecosystem”.
- A PICES representative is invited to the RPCM and BASIS meetings.

2004

- PICES members request possible collaboration in BASIS cruises; NPAFC discussed contribution to PICES ecosystem status report; joint NPAFC-PICES symposium was approved by PICES Science Board to be held in 2005 in Korea.

2005

- Symposium held in Oct-Nov 2005 in Jeju, Korea; NPAFC and PICES co-sponsor the symposium. Results published in NPAFC Bulletin No. 4 (Status of Pacific Salmon and Their Role in North Pacific Marine Ecosystems)

2006

- PICES inquires if several scientists from the MIE-AP can join BASIS cruises in 2007.
- PICES would be prepared to consider joining NPAFC, NASCO, ICES in co-sponsoring a symposium “*Understanding the causes of marine mortality of salmon*” to be held in spring 2010.

2007

- PICES scientists are invited to board the R/V *Oscar Dyson* for micronekton inter-calibrations experiment (MIE-AP).
- WGSA will contribute to the PICES ecosystem status report.

2008

- NPAFC invited to join PICES and ICES as a co-sponsor for the symposium on “*Forecasting climate change impacts on fish and shellfish*” (tentative title) in spring 2010. NPAFC agreed to participate, and SSC Chairperson would be on the symposium steering committee.
- PICES requests NPAFC to participate and support the next ecosystem status report. Drs. Irvine and McKinnell will meet and discuss details.

2009

- PICES ecosystem status report: Dr. Irvine will attend PICES ecosystem status meeting and provide salmon inputs.
- Dr. Irvine will represent NPAFC and CSRS at the PICES meeting and ask for a preliminary report so NPAFC can comment on the North Pacific ecosystem status as it pertains to Pacific salmon.
- CSRS Chairperson reports at the PICES annual meeting.
- NPAFC will co-sponsor International Symposium on “*Forecasting climate change impacts on fish and shellfish*” to be held in Sendai in April 25–30, 2010. NPAFC’s proposal for a 1-day workshop “*Salmon workshop on climate change*”, April 25, 2010, is accepted by the steering committee.

2010

- Dr. Irvine provided input to the PICES ecosystem status report; cooperation was widely recognized as a positive development by CSRS.
- CSRS Chairperson reported on NPAFC activities at PICES annual meeting.
- NPAFC requested PICES co-sponsorship of NPAFC workshop “*High abundance of pink and chum salmon in the North Pacific Ocean*”. NPAFC Technical Report No. 8 (International Workshop on Explanations for the High Abundance of Pink and Chum Salmon and Future Trends) published.

2011

- NPAFC co-sponsors PICES symposium “*Effects of climate change on the world’s oceans*” in Korea in 2012.
- CSRS Chairperson attended PICES Annual Meeting and provides information at their meeting.
- PICES agrees to co-sponsor workshop on *High abundance of pink and chum salmon in the North Pacific Ocean*”.

2012

- SSC Chairperson will attend PICES Annual Meeting to propose the formation of a PICES/NPAFC joint study group session in conjunction with the 2013 PICES Annual Meeting in Nanaimo for improving collaboration and communication between the two organizations.
- Draft proposal and NPAFC participants to be identified at the April 2013 CSRS meeting.

2013

- CSRS recommends formation of the NPAFC-PICES Study Group, its terms of reference and study group members from NPAFC. Goal of the Study Group is over approximately one year will develop a framework of enhanced collaboration between the two organizations to achieve better and/or more rapid understanding of natural and anthropogenic variability in marine ecosystems. The Study Group will review each organization’s scientific needs and identify where similar key questions or scientific issues might be explored jointly by both organizations.
- PICES agrees and the joint Study Group is formed.

2014

- The NPAFC-PICES Study Group develops the framework of enhanced collaboration between the two organizations and submits it to PICES and NPAFC for approval.