ISC-PICES Framework for Scientific Cooperation in the North Pacific

Executive Summary

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

The framework for scientific cooperation in the North Pacific identifies three broad research themes of mutual interest, but does not prioritize these topics:

- Oceanographic conditions and the distribution and productivity of pelagic fish (Section 2.1);
- Environmental interactions with fishers and fisheries (Section 2.2); and
- Effects of climate change on the distribution and productivity of pelagic fish (Section 2.3).

The framework describes various collaborative mechanisms that can be followed, including joint working groups, joint workshops and symposia, topic sessions at PICES Annual Meetings, and joint strategic initiatives. The framework will be discussed by PICES at their Annual Meeting in October 2015 and at the ISC Interim-Meeting in December 2015. Final approval by PICES is required at their October 2015 Annual Meeting.

The SG-SCISC recommends that the framework for enhanced collaboration be implemented immediately after approval by both Organizations. The SG-SCISC recommends that representatives from each organization provide annual updates to the PICES Science Board and the ISC Plenary Session concerning the framework's implementations.

1. Background

ISC (International Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean) and PICES (North Pacific Marine Science Organization) are intergovernmental organizations with overlapping geographical areas and common interests in the sub-Arctic regions of the North Pacific Ocean (Figure 1). Both organizations are responsible for promoting and coordinating marine scientific research that addresses the linkages between climate variability and marine ecosystem components, specifically for ISC – understanding the impacts of climate variability on pelagic fish dynamics and spatial structure and the incorporation of these processes into stock assessments to support effective management decision-making for important commercial fisheries.

The joint Study Group for *Scientific Cooperation of ISC and PICES* (SG-SCISC) was established in April 2015 to review each organization's scientific needs and identify where similar key questions or scientific issues might be explored jointly by both organizations. The purpose of the Study Group (hereafter, SG) was to identify a framework that would foster enhanced collaboration between the two organizations to achieve a greater understanding of pelagic ecosystem structure and variability, and its effect on the dynamics and production of Pacific pelagic fish populations. Improvements in our understanding of these factors will lead to advancements in population modeling and stock assessment research, allowing for development of the next generation of stock assessment models that explicitly account for spatial structure and processes governing population regulation. The enhanced collaboration should allow ISC and PICES scientists to add value to their science, provide synergies on regional and global issues, and enhance the visibility of both organizations.

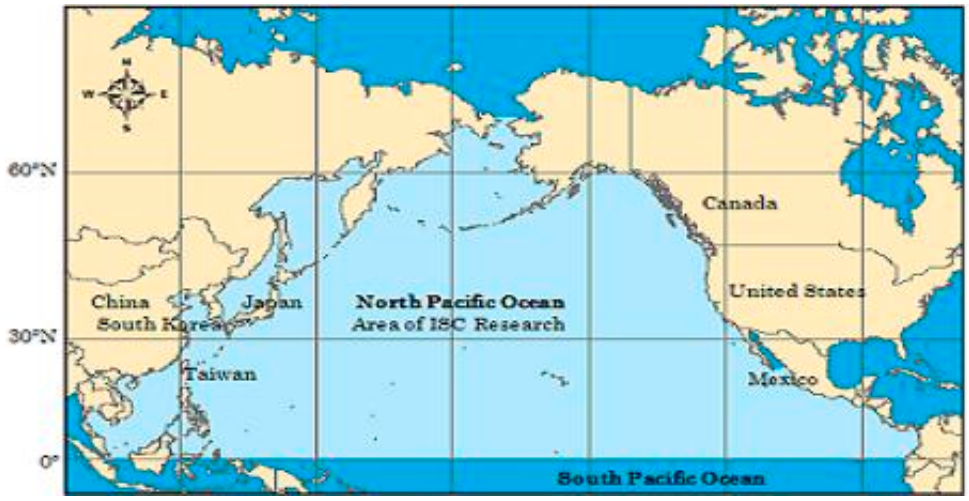

Figure 1 Area of interest for ISC in the North Pacific.

The following are the Terms of the Reference of the 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 ISC 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 ISC-PICES Secretariats by fall 2015.

The SG was co-chaired by Dr. Jacquelynne King (PICES, Canada) and Dr. Gerard DiNardo (ISC, USA). Membership of the SG comprised: Harold Batchelder (PICES Secretariat), Steven Bograd (PICES, USA), Sang Chul (ISC, Korea), John Holmes (ISC, Canada), Jaebong Lee (PICES, Korea), Elizabeth Logerwell (PICES, USA), Hideki Nakano (ISC, Japan), Sei-Ichi Saitoh (PICES, Japan), Chi-lu Sun (ISC, Chinese-Taipei), Thomas Therriault (PICES, Science Board), and Cisco Werner (ISC, USA).

The SG met July 13–14, 2015, immediately prior to the 15th Meeting of the ISC Plenary in Kona, Hawaii, USA. At the SG meeting, brief overviews of PICES and ISC organizational structures and scientific missions were provided, and scientific needs and overlapping issues that might be explored jointly by both organizations were discussed. Subsequent SG discussions and the writing of the framework were conducted by email correspondence.

1.1 ISC organizational structure and procedures

ISC was established in 1995 through an intergovernmental agreement between the governments of Japan and the United States of America to enhance scientific research and cooperation for conservation and rational utilization of the species of tuna and tuna-like fishes which inhabit the North Pacific Ocean during part or all of their life cycle using best available science (http://isc.ac.affrc.go.jp). Since its establishment and first meeting in 1996, ISC has undergone a number of changes to its charter and name, as well as guidelines for its operations. While ISC remains an independent regional fishery organization (RFO), in 2007 it entered into agreement to serve as the scientific provider to the Western Central Pacific Fisheries Commission, Northern Committee, providing requisite scientific support to advance effective fisheries management for tuna and tuna-like species in the North Pacific Ocean (http://www.wcpfc.int).

The structure of ISC is comprised of an oversight Committee (Plenary) and focused subsidiary bodies (Working Groups) (Figure 2). The ISC Committee consists of voting and non-voting Members with suitable scientific and fisheries qualifications. Voting Members are from coastal states and fishing entities of the region and fishing entities with vessels fishing for highly migratory species in the region, including Canada, Chinese Taipei, People's Republic of China, Republic of Korea, Japan, Mexico, and the United States of America. Non-voting Members are from relevant intergovernmental fishery and marine science organizations, including the United Nations Food and Agricultural Organization (FAO), Inter-American Tropical Tuna Commission (IATTC), North Pacific Marine Science Organization (PICES), and the Secretariat for the Pacific Community (SPC). Each Member shall have the right to appoint one representative (Leader), an alternate, if desired, and to be accompanied by experts or advisors with suitable scientific and fisheries qualifications to participate on the Committee.

A Chairperson and Vice-Chairperson are elected by Members of the Committee, and can serve two consecutive 3-year terms. The Chairperson serves as the leader of the Committee and is responsible for advancing the objectives of the ISC in a cost-effective and efficient manner. Responsibilities include chairing meetings of the Committee and supervising the work of subsidiary bodies, organizing meetings of the Committee, ensuring that ISC assignments and commitments are completed in a timely, efficient manner, and coordinates activities with the Chairpersons of subsidiary bodies. The Vice-Chairperson assists with all duties of the Chairperson. The Chairperson can form a Steering Committee comprised of Committee scientists to assist in planning, organizing and coordinating activities and meetings of the Committee, and for providing advice to the Committee Chairperson on administrative and scientific matters that arise during the intercession period.

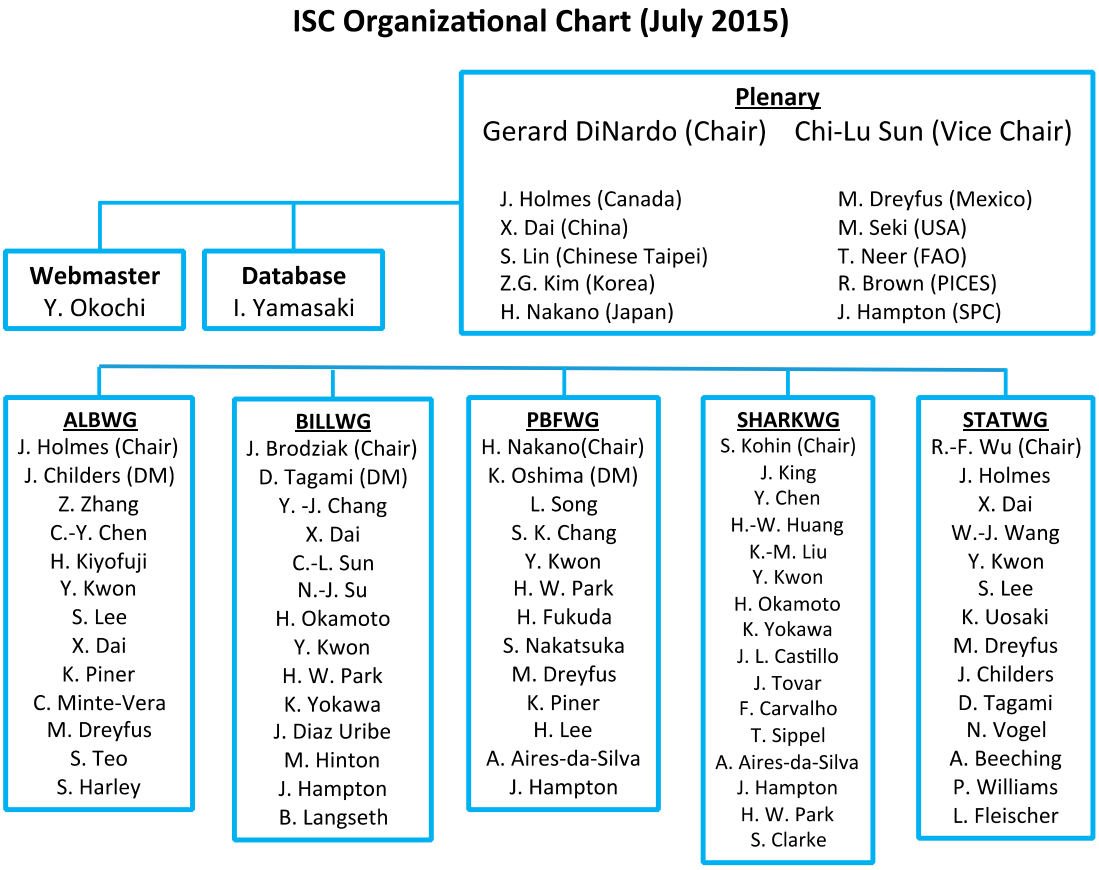

Figure 2 ISC organization chart as of July 2015. Under the Committee (Plenary), there are five Working Groups (WG): Albacore WG (ALBWG), Billfish WG (BILLWG), Pacific Bluefin Tuna WG (PBFWG), Shark WG (SHARKWG), and Statistics WG (STATWG). WG Chairpersons and Members are list under each WG.

Reports of findings, decisions and conclusions are prepared by the Committee for the record and for distribution. In adopting a report, the Committee strives for consensus of all Members and Non-voting Members; however, if reasonable efforts fail to reach a consensus, reports and findings may reflect opinions and the differing views. Timely exchange of complete and accurate fisheries and biological data are primary obligations of participants of the ISC. Each Member and Non-voting Member of the Committee shall appoint a Data Correspondent, who shall be responsible for meeting all requirements for timely submission of complete and accurate data as specified by the Data Protocol of the ISC. Scientific and fisheries experts, who are neither Members nor Non-voting Members of the Committee, may be invited to participate in the deliberations or work of the Committee. Decisions on inviting experts, nominated by Members, shall be made by consensus of Members of the Committee. The list of nominees must be circulated no later than 90 days before the event, and immediately distributed to Members for approval. If no objections are received by 45 days of the event, invitations are provided to approved nominees. Invited experts are not eligible to vote on ISC matters.

The Committee shall meet annually or more frequently if required and agreed to by the Members. The time and place of the Committee's plenary meeting (ISC Plenary) shall be decided by the Members. The working language of all meetings will be English, with formal interpretation into Japanese, as may be decided, for the plenary meetings only. The Committee may establish subsidiary bodies, including Working Groups, which may meet in the interim between Committee meetings, or more frequently, and report to the Committee. Every 5 years, or more frequently as may be decided, the Committee shall organize a team of three recognized peers with no Committee affiliation to review the function of the Committee and subsidiary bodies and to offer recommendations for improvement.

Currently, ISC has four established species' working groups (Pacific Bluefin Tuna Working Group, Billfish Working Group, Shark Working Group and North Pacific Albacore Tuna Working Group) and a Statistics Working Group. Working Groups provide a forum for cooperation/collaboration in research by Member and Non-voting Member scientists as well as for focused consideration of technical matters assigned by the Committee. The species Working Groups' primarily focus is on understanding the dynamics and ecology of the HMS and associated-species populations in order to accurately assess stock condition and status. The Statistical Working Group focuses on collection, exchange and archiving of fishery, biological and other data needed for stock assessments and for monitoring fishery developments, statistics and bycatch. The work of these Working Groups is guided by multi-year work plans and demands by the Committee. Their membership consists of scientists with appropriate credentials and experience that are appointed by Members and Non-voting Members of the Committee. A Working Group Chairperson with appropriate expertise and knowledge is elected by Members of each Working Group, and can serve two consecutive 3-year terms..

The ISC Database Administrator (DA) and Webmaster (WM) are full-time positions identified within the ISC organization and residing in the Office of the Chair (OoC). The DA is responsible for managing all data and information needs for the smooth functioning of the ISC technical Working Groups (WGs) and the OoC. The WM is responsible for coordinating all aspects of the ISC website including maintaining the site and all data portals in a flexible and agile manner so that website content is easily created, posted, and maintained by content contributors, ensuring that information can be quickly searched and navigated.

1.2 PICES organizational structure and procedures

The North Pacific Marine Science Organization (PICES) is an international, intergovernmental 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 the 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, Sidney, British Columbia, 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 (Figure 3). The scientific activities of PICES are established by a network of approximately 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. Science Board is formed by the Chairmen of the six permanent Scientific Committees and Technical Committees, and by the Co-Chairmen of the current scientific program. A Contracting Party that is not represented on Science Board is entitled to appoint one member to Science Board to represent its scientific interests.

The scientific work of PICES is conducted primarily by ephemeral study groups and working groups with 1- to 3-year lifespans, respectively, to achieve the results described in their terms of reference (Figure 3). Advisory panels and sections provide longer-lived expert groups to maintain specific expertise within PICES. Chairmanship for expert groups is usually shared between scientists from Asia and North America. 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.

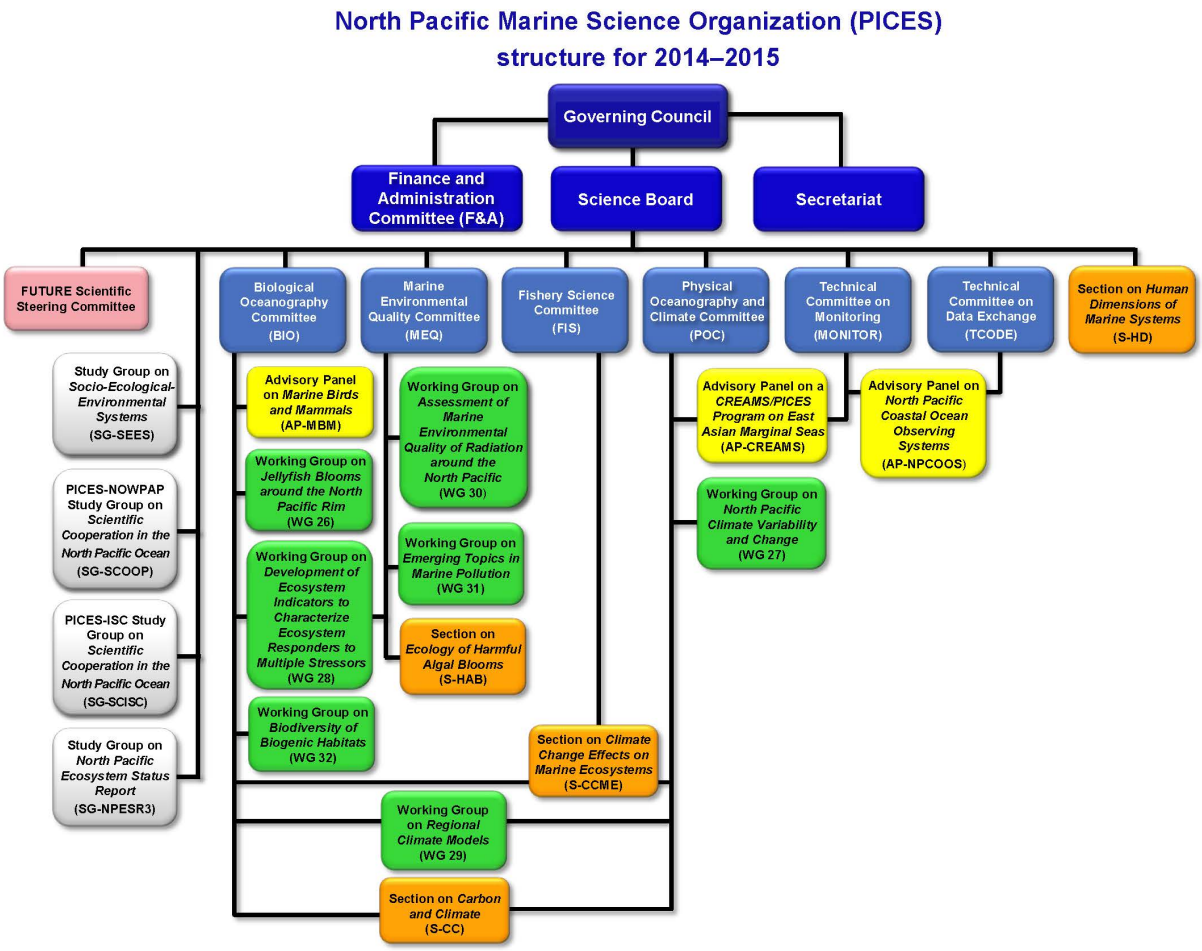

Figure 3 Organizational structure of PICES in 2014–2015. The uppermost rows are the Executive and Standing Committees. Expert groups under them are generally ephemeral, with their lifespan determined by the nature of their duties.

The work of PICES is determined primarily by the scientists of the Contracting Parties. They are supported by a Secretariat which is responsible for organizing their international meetings and workshops, publishing their work, fundraising, developing and maintaining 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 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 Scientific Topics of Joint Interest to ISC and PICES

PICES has a much broader scientific mandate than ISC. As described above, PICES is tasked with understanding how marine ecosystems respond to climate change and human activities. ISC focuses on provision of scientific advice for sustainable management of pelagic fish resources in the North Pacific. ISC is mandated to develop better information on stocks of tuna and tuna-like species in the North Pacific Ocean, in cooperation with relevant fisheries organizations. As such, ISC, in conducting stock assessments, is tasked with understanding the population dynamics and spatial distribution of many pelagic fish species, such as North Pacific albacore tuna and Pacific bluefin tuna, as well as sharks, and billfish.

The SG identified three broad research areas of mutual interest, each with various subtopics. A scientific area of overlap between the ISC and PICES is understanding how oceanographic conditions affect the distribution and production of commercial pelagic fish species in the North Pacific. Supplemental to this is research on climate change as it affects North Pacific marine ecosystems, with subsequent impact on pelagic fish dynamics. One of the scientific priorities in the PICES FUTURE Science Plan is understanding how human activities, such as fishing, can act as direct or indirect ecosystem stressors. For ISC, linking oceanographic conditions to fleet and fisher behavior is a fundamental component to using fishery indices in assessing stock status. All three of these research areas are inherently linked since climate variability affects oceanographic conditions which impact pelagic fish distributions and migration, and ultimately pelagic fisheries, the level of impact depending on the persistence, direction, and magnitude of the variability. Since many of the effects on pelagic fish dynamics occur at different temporal scales, research activities to assess impacts over both the short- and long-terms have been identified. Research activities outlined in Section 2.1 and 2.2 focus on short-term (1–5 years) impacts, including changes in oceanographic and demographic parameters driven by climate variability or changes that have already happened. Activities outlined in Section 2.3 focus on long-term (decadal) impacts, including projected changes at the population and ecosystem level. The following list is not prioritized, and there is some overlap among items listed.

2.1 Oceanographic conditions and the distribution and productivity of pelagic fish

Large-scale oceanographic processes and climate variability drive the distribution, productivity, growth and survival of many commercial pelagic fish populations in the North Pacific. Given a lack of fisheries-independent data, research on this theme will focus initially on relating species distributions, as determined by large-scale catch per unit effort (CPUE), to the environment. A working hypothesis is that these species have environmental thresholds and preferences that drive their distribution and productivity. Thus habitat models can be derived to relate distributions – by species, gear type, and life stage – to environmental conditions indexed by satellite-derived products such as SST, surface chlorophyll, and frontal probability. Additionally, assessment-derived recruitment series can be related to large-scale climate indices (*e.g.*, PDO, MEI, NPGO) that describe the ocean state. Details of the proposed research activities are provided below. A better understanding of the oceanographic drivers of species distributions and productivity will allow for the incorporation of environmental variables into stock assessments, and will provide a framework for projecting climate change impacts on these species.

Expertise in PICES with ocean modeling could provide a productive area of collaboration with scientists at ISC to better understand the factors affecting the distribution and production (through impacts on recruitment, mortality and growth) of commercial pelagic fish populations. Many of those factors are driven by climate variability and oceanographic processes.

2.1.1 Species' distribution

Pelagic fishes occupy surface waters of the North Pacific Ocean, from coastal shelf to open ocean ecosystems. Many of these species undertake large-scale feeding, spawning, and ontogenetic migrations linked to seasonal changes in water masses. For example, Pacific bluefin tuna use waters off Japan as a nursery habitat, undertaking an ontogenetic movement eastward to waters off North America where they remain as subadults for 2–3 years. Additionally, many pelagic species have environmental thresholds and preferences which limit their spatial distribution. The most important environmental factors include oxygen, salinity and temperature. Through the ISC–PICES collaboration habitat models (*e.g.*, GAMs) using estimates of relative abundance (CPUE) can be derived to relate distributions – by species, gear type, and life stage – to environmental conditions indexed by satellite-derived products such as SST, surface chlorophyll, and frontal probability. The identification of CPUE hot spots for pelagic fish will also provide insights on prey hot spots, contributing to increased understanding of predator–prey relationships and ecosystem resiliency.

2.1.2 Population productivity

Demographic parameters and recruitment dynamics

Survival and growth rates of pelagic fish are linked to oceanographic conditions, and changes to these conditions can have dramatic impacts on the composition of species assemblages within pelagic ecosystems, as well as the persistence and magnitude of individual pelagic fish populations. The impact of large-scale climate indices (*e.g.*, PDO, MEI, NPGO) that describe the ocean state on both demographic parameters and recruitment indices will be modeled to advance our knowledge of mechanisms that regulate distribution and productivity. Understanding potential regulation mechanisms and impacts resulting from changes in the pelagic ecosystem are necessary elements to ensure sound fisheries management and advancement of ecosystem modeling efforts in the North Pacific Ocean.

2.1.3 Inclusion of oceanographic conditions in assessment of stock status

Knowledge of the relationship between ocean conditions and productivity allows for the incorporation of environmental variables into stock assessments, which forms the basis for fisheries management. Advancing contemporary stock assessment approach methodologies through the inclusion of environmental variability is consistent with the direction of stock assessment research. Initial efforts will focus on the incorporation of spatially-explicit environmental data into future stock assessments of North Pacific albacore tuna, which is a priority for ISC.

2.2 Environmental interactions with fishers and fisheries

Tuna distributions vary seasonally and annually in their degree of spatial aggregation. In some years, fish are dispersed (and caught) over wide areas, but in other years fish are aggregated in smaller regions. Fleet dynamics respond rapidly to these aggregations, potentially impacting stock assessments and interpretation of fishery socio-economics data. The reasons for these spatial aggregation differences in tuna are not fully known, but it is likely due to fish responses to the local physical and biological environment, especially temperature and prey availability. Understanding the factors governing these differences and their impact on fisheries requires the integration of fishery and physical data, as well as socio-economic data and indicators. ISC can provide the fishery and economic data, while PICES can provide the physical data. There are many areas of possible collaboration between ISC and PICES to assess the influence of environmental conditions on fleet dynamics and fishers behavior, particularly with the PICES/ICES Section on *Climate Change Effects on*

Marine Ecosystems (S-CCME) and the Section on *Human Dimensions of Marine Systems* (S-HD), as well as the Fishery Science Committee (FIS) and Physical Oceanography and Climate Committee (POC).

2.2.1 Fleet dynamics in response to oceanographic conditions

Fleet distribution is determined by species distribution and availability of fish. These two factors are influenced by oceanographic conditions. Changes in availability affect catch rates, which are a cornerstone in all stock assessments. Understanding and identifying these changes reduce parameter uncertainty in the stock assessments leading to more precise stock status determinations. Research activities would include the spatial mapping of distant-water fishing fleets and estimation of spatial persistence over time. The identification of oceanographic factors (*i.e*., SST, oxygen concentrations, *etc*.) influencing fish distribution, from Theme 1 (Oceanographic conditions and the distribution and productivity of pelagic fish), could be linked with fleet dynamics data to develop a more comprehensive assessment of the impact of oceanographic variability on fishing, as well as increased understanding of the fisher decision-making process.

2.2.2 Socio-economic impacts of changing ocean conditions

Changing ocean conditions due to climate variability or climate change will have socio-economic impacts due to a myriad of factors such as fish productivity, resource availability to fleets, and fuel prices. Assessing the economic impact to fishers resulting from changes in oceanographic conditions allows for insights into the decision-making process of fishers and changes in fleet dynamics. Research will be conducted collaboratively with S-HD to quantify the impact of climate change on pelagic fisheries. The North Pacific albacore troll fisheries would be used as a case study, contributing to the development of the PICES North Pacific Ecosystem Status Report, as well as to future workshops by S-HD.

2.3 Effects of climate change on the distribution and productivity of pelagic pish

Understanding the links between oceanographic conditions and pelagic fish behavior, growth, recruitment, and production (Section 2.1) are paramount to understanding the impacts of climate change. 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, increasing mixed layer depth, and/or decreases in nutrient concentration. There are many areas of possible collaboration between ISC and PICES to understand these linkages, particularly with S-CCME.

The time scale for research under this theme is meant to be decadal and longer. The spatial scale is at the "biome", which is larger than the mesoscale. These scales are larger than those typical of work under Theme 1(Oceanographic conditions and the distribution and productivity of pelagic fish). The types of climate processes of interest would be global warming, regime shifts, ENSO dynamics, PDO dynamics, *etc*. Initial projects will likely be retrospective studies and will entail developing the proper data sets and indicators at these scales. Retrospective studies will examine environmental drivers and responses such as species distribution, life history traits (such as growth, maturation and fecundity), and recruitment at large spatial and temporal scales defined above. This work will link to Theme 1 in which drivers of species distribution and productivity will be identified. Retrospective studies will also examine the response of fleet distribution to climate change and will thus link to Theme 2 (Environmental interactions with fishers and fisheries). Another important research activity will be to synthesize known information on the tolerance of pelagic fish species to changes in temperature (warming) and to ocean acidification, and to suggest laboratory research for information that is lacking. Following the retrospective studies it is anticipated that forecasts of fish distribution, life history traits and of fleet dynamics would be developed. Albacore tuna would be a suitable species to focus on first. One outcome of the research described for this Theme will be a gathering of data sets

of drivers and indicators. This will be of use in the development of PICES North Pacific Ecosystem Status Report. Another outcome will be information needed to design scenarios and quantify uncertainties in a Management Strategy Evaluation model (or similar), which is a priority for ISC.

3 Implementation Procedures

Potential mechanisms for enhancing cooperation between ISC and PICES include:
1. Topic sessions at PICES Annual Meetings
2. Workshops
3. Symposia
4. Joint working groups
5. Strategic initiatives
6. Other

3.1 Topic 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 ISC. Many topic sessions have been convened jointly with other international science organizations at PICES Annual Meetings, and it is a relatively simple procedure to implement.

Topic session proposals related to joint ISC-PICES topics should come from scientists working either under the PICES or ISC umbrella. Proposals are submitted to the PICES website by the deadline, typically September 1 of the calendar year before the Annual Meeting of interest. Proposals should be developed jointly between ISC and PICES convenors and presented for discussion and approval at the ISC Plenary Meeting in July of the calendar year before the PICES Annual Meeting of interest.

PICES requirements for proposals include: a title, duration (full or half day), session description, list of convenors and corresponding convenor, proposed sponsoring PICES Standing Committee(s), proposed co-sponsoring organization(s) (if any), and whether (and where) a publication is intended. Within PICES, the proposals are then ranked by the Committees. At the Committee meetings during the Annual Meeting in the fall (the year before the proposed meeting of interest), recommendations for which session proposals to support are finalized. The Committee Chairmen present their recommendations to Science Board for discussion and final decision. Science Board will evaluate and agree on co-sponsoring of sessions. The decision will consider not just the scientific excellence and appropriateness of the proposals, but also the financial constraints.

3.2 Workshops

ISC and PICES have already held a joint 2-day Workshop on "*Dynamics of pelagic fish in the North Pacific under climate change*" at PICES-2014. Workshops offer the opportunity to explore emerging topics and to resolve complex issues that require more direct discussion. ISC will follow PICES procedures when proposing jointly sponsored workshops, and all proposals must be presented and approved by the ISC Plenary.

Within PICES proposals for jointly sponsored workshops are generally brought to the attention of Science Board by Committee Chairmen. Generally, a proposal for an inter-sessional workshop should resemble a proposal for a topic session, with additional information, such as the local host/organizer, institute/location, dates, and financial expectations of PICES (commonly for invited speakers from PICES and/or PICES convenors). Proposals for workshops to be held at the PICES Annual Meeting are submitted the same way and on the same timeline as topic sessions (see Section 3.1).

A joint ISC-PICES 2-day Workshop on "*Methods relating oceanographic conditions to the distribution of highly migratory species*" is proposed for PICES-2016 as a follow-up to the workshop held at PICES-2014. The intent of the 2016 workshop is to enhance ISC-PICES collaboration, bringing together oceanographic, fishery, and social scientists, as well as resource economists to discuss data sets potential collaborations.

3.3 Symposia

PICES has a long and successful history of co-sponsorship and co-organization of inter-sessional symposia with other international science organizations. These events have ranged from meeting co-sponsorship, which is generally limited to financial assistance for travel to 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 two or more organizations. Jointly co-organized meetings necessitate a longer duration of planning, as the organizations must have their representing scientists on the organizing or scientific steering committees. In addition, each 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 ISC and PICES. Symposia proposals should be developed jointly between ISC and PICES following PICES procedures, and can occur outside of PICES Annual Meetings and ISC Plenary Meetings. All joint proposals must also be presented and approved by the ISC Plenary.

Proposals to PICES for jointly sponsored symposia are generally brought to the attention of Science Board by the 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 PICES to co-sponsor a symposium 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 Standing Committees. Significant commitments of resources typically require 2–3 years advance planning. Potential jointly organized and co-sponsored symposia may require more lead time.

3.4 Joint working groups

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. 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 deliverables defined by the terms of reference.

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 in successfully establishing a new WG. The establishment of a WG usually follows after one or a series of topic sessions and/or 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 WG, with a typical duration of 3 years. The FUTURE Scientific Steering Committee reviews these proposals to determine their relevance and importance to the FUTURE 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 Science Board 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.

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.

Within PICES cross-cutting initiatives can be addressed by forming a new Section. A Section represents a sub-committee that has a longer lifespan than a WG under the direction of a Scientific Committee. 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 are 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".

3.6 Other

Other mechanisms for cooperation between ISC and PICES include regular representation at each other's annual meetings, mutual contributions to reports, and collaboration on research.

3.6.1 Representation at annual meetings

PICES and ISC have a long-standing tradition of exchanging invitations for representatives to attend their respective annual meetings. However, actual PICES and ISC representation at each other's meetings has been limited. Representatives could use this opportunity to report on their organization's activities of interest and develop avenues for ongoing collaboration.

3.6.2 Contribute to reports

PICES periodically produces the North Pacific Ecosystem Status Report. This report is intended to 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. ISC contribution with knowledge of pelagic fish dynamics would be beneficial.

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

3.6.3 Collaborate on research

Where PICES and ISC share research interests, it would benefit the projects for scientists from each organization to collaborate where possible. Examples include ISC scientists requesting collaboration on stock assessments and modeling. PICES might invite an ISC scientist to sit on a PICES expert group where ISC expertise is required. Regular participation in each other's annual meetings, workshops and symposia; and joint participation in SGs and WGs will facilitate this kind of collaboration.

4 Monitoring and Steering Cooperation

SG-SCISC concludes that this framework should provide sufficient guidance to the ISC and PICES communities to develop 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: Science Board in the case of PICES and the Plenary in the ISC.

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.

5 Conclusions and Next Steps

In conclusion, SG-SCISC recommends this framework be adopted by both organizations. The framework for scientific cooperation in the North Pacific identifies three broad areas of joint scientific interest to ISC and PICES:

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

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 ISC and PICES, including topic sessions at PICES Annual Meetings, joint workshops and symposia, joint working groups, strategic initiatives, and representation at each other's meetings. Procedures for other collaborations (*e.g.*, publications, training) may require further development.

The framework will be considered for final approval by PICES at their October 2015 Annual Meeting and by ISC at their December 2015 Interim-Meeting. Assuming the framework is approved by both organizations, the SG-SCISC recommends that the framework be implemented immediately, and that representatives from each organization provide annual updates to the PICES Science Board and the ISC Plenary Session concerning the framework's implementations.