

# Ten years FIS in PICES: An introspective, retrospective, critical and constructive review of Fishery Science in PICES

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## Introduction

The city of Victoria was the venue for the first and tenth anniversary meetings of PICES. This city has many reminders of its origins in the British Empire, and these illustrate an element of PICES. Within 100 m of the Conference Centre, there are statues and references to Rudyard Kipling, a British Nobel laureate poet who became symbolic of the British Empire. Perhaps his most famous line is from the "Ballad of East and West" which begins: "*OH, East is East and West is West, and never the twain shall meet,...*". The "twain" was the supposed cultural discontinuity between the east and west that Kipling thought was so great it would never be bridged. Clearly, the sentiments of this line do not apply to PICES. During the first ten years of PICES, east has met west, repeatedly and successfully - and this is an excellent achievement of PICES. On the other hand, some might say that within PICES there still are a number of "twains", unrelated to "east" or "west", that have yet to be bridged, especially interdisciplinary differences in perception and outlook among physical and biological oceanographers and fisheries biologists. In this report we make references to these differences, as we try to provide both a critical and constructive review of fisheries science in PICES. We acknowledge the many accomplishments of PICES but we also

comment on its deficiencies. We conclude with a suggestion that the Organization should re-examine its roots and mandate, and ask how PICES can respond to meet the developing challenges of marine science.

In our opinion, an introspective re-evaluation of PICES is warranted at this time and we provide a justification from a fisheries perspective. In the ten years since PICES formed, many fisheries throughout the world have unexpectedly destabilized. In a sense, as fisheries scientists, we did not get much right in fisheries management in the 1990s. Some stocks collapsed while others increased, sometimes dramatically. Well-known examples would include declines and/or recoveries of Pacific salmon, groundfish species, the California sardine and Japanese sardine. Of course, fish stock declines are well-known in other parts of the world, but the extent of change in the world's marine fish stocks may be greater than is realized. This assertion is based on the observation that there are a number of instances where massive changes have occurred among smaller or less-well-known stocks, including, for example, several species of smelts (Osmeridae) in the North Pacific. New revelations on the concept of decadal-scale regimes and how they might affect fisheries have emerged (Steele 1996) and calls for ecosystem-based management have

increased (NRC 1999; NMFS 1999). Some of the recent changes in fisheries have had large social and economic impacts. In British Columbia, changes in fisheries have devastated some coastal communities, of which many are First Nations. In Canada, and elsewhere, fisheries management agencies and scientists have been subjected to intense criticism. In this report, we suggest that organisations like PICES could do much more to bring more reliable information to those who want to better understand the issues.

PICES is a key scientific organization in the North Pacific, and the Fishery Science Committee (FIS) is the main structural component of fisheries science within PICES. First we ask about PICES: “what has PICES done to help clarify or assist with solutions to these problems in marine resources?” Second, we ask of FIS: “has FIS done anything in the last decade that will make a difference?” We cannot provide a definitive answer to either question, but we attempt the following: (i) for the question about PICES activities, we examine the existing structure of PICES and evaluate this against what the original founders of PICES indicated that PICES *should do* about fisheries science; (ii) for the question about FIS activities, we present a brief history of FIS in PICES and compare the effort and results of FIS activities in PICES with those of other Scientific Committees.

We test three hypotheses. *Hypothesis 1*: time devoted to FIS issues at Annual Meetings is lower than that of other Scientific Committees (POC - Physical Oceanography and Climate, BIO - Biological Oceanography, MEQ - Marine Environmental Quality). *Hypothesis 2*: time devoted to FIS issues at Annual Meetings is decreasing in recent years (relative to that of other Scientific Committees). *Hypothesis 3*: the numbers of pages of scientific reports devoted to issues of concern to FIS is lower than those devoted to other Scientific Committees. Also, we review the main objectives of PICES, as set out in the founding statutes, and provide an evaluation of the first ten years of PICES activities against these objectives. Then we briefly compare the structure of PICES with the Atlantic counterpart organization, ICES. We conclude with some suggestions for modifications in the structure and

function of PICES, and FIS activities in PICES, and general PICES activities for the next decade.

## **Methods and materials**

### ***Data and information sources***

We used PICES Annual Reports that provide minutes of all FIS meetings since 1994 (see references to “PICES”). This information was supplemented by references to some PICES Scientific Reports and Wooster and Callahan (1994).

### ***Tests of hypotheses***

To test the first and second hypotheses, we classified and quantified FIS activities at Annual Meetings (topics, symposia, working groups) based on analysis of PICES meeting schedules from 1993 to 2001 (see PICES Abstracts in references). The quantification was limited to time *within* formal meetings, so sessions hosted by CCCC Task Teams (REX, BASS and MODEL) were not included, but CCCC and Science Board (SB) were included (see below for more explanation of GLOBEC, also Perry *et al.*, this volume). We estimated the sum of time (hrs) devoted to each Scientific Committee including FIS. The cumulative hours for each session (usually in units of 4 hours, so one 8-hour day = two 4-hour sessions) were summed for each year from 1993 to 2001. We quantified the cumulative hours of “fishery science” topics presented by other groups, including some for BIO, POC, MEQ and CCCC. We compared FIS to other committees and activities. We used Excel spreadsheets to record the data. Data were analysed with Minitab© software.

To test the third hypothesis we reviewed all scientific publications from PICES and estimated the number of pages devoted to subject matter of interest to each committee. This included all PICES Scientific Reports and special publications of selected papers presented at various meetings organized and co-sponsored by PICES. We classified the content of the papers according to whether the subject material was, or was not, of direct relevance to fishery science. When a paper was clearly of interest to fishery science plus

another subject area, such as physical oceanography, we counted the entire paper as of interest to fishery science.

### ***Review of PICES activities***

To evaluate present PICES activities with those suggested by the founders of PICES, we consulted the key publication “The PICES papers” (Wooster and Callahan 1994) that provides a brief scientific history of PICES, and presents the main tenets of the scientific objectives of the Organization.

### ***Contrasting PICES to other organizations***

As a guide to what PICES structure, function and activities could occur, we briefly examine the present structure of ICES, the namesake organization in the Atlantic and a clear model for development of the basic structure of PICES during the formative stages in the 1980s. Also, we briefly comment on the structure and function of some of the other scientific organizations in the North Pacific, and on how these organizations interface with PICES.

## **Results**

### ***A short history of FIS in PICES***

The Fishery Science Committee was initiated in October 15, 1992, with Danuel M. Ware (Canada) named as the first Chairman. Members were from four member nations: Canada, Japan, People’s Republic of China and U.S.A. In October 1993, Qi-Sheng Tang (China) became the second Chairman of FIS. In that year the first FIS Working Group (WG 3) on “Dynamics of small pelagics in coastal ecosystems” was formed, chaired jointly by John Hunter (U.S.A.) and Tokio Wada (Japan). By 1995, Republic of Korea and Russia joined PICES, and additional members joined FIS. Working Group 3 presented their final report. In 1996, Chang-Ik Zhang (Korea) became the third Chairman of FIS and a new WG 12 on “Crabs and shrimps” was formed with Robert S. Otto (U.S.A.) and Vitaly E. Rodin (Russia) as Co-Chairmen. In 1999, Douglas E. Hay (Canada) became the fourth Chairman and in 2000, a third WG 16 was formed on “Climate change, shifts in

fish production and fisheries management” with Richard J. Beamish (Canada) and Tokio Wada (Japan) as Co-Chairmen. In 2001, the WG 12 report was completed. During this period the FIS Committee developed many scientific sessions, sometimes held in co-operation with other Scientific Committees (see below). FIS also sponsored special meetings and symposia that led to a number of scientific reports (see below).

### ***FIS activities in PICES***

The main activities of FIS in PICES have been: (a) the development of symposia and topic sessions, sometimes in conjunction with other Scientific Committees; (b) supporting specific Working Groups, usually with a term of 3 years, to address and prepare a report considered of key interest to PICES; (c) convening special meetings of FIS usually during Annual Meetings, to discuss and report on fishery science issues. The minutes of all meetings are recorded in the PICES Annual Reports.

Since 1994, FIS sponsored one or more topic sessions each year, sometimes in co-operation with other Scientific Committees (Table 1). Topics varied widely and represent more than 75 hours of scientific presentations. Since its inception, FIS has established three Working Groups, of which the results for two are complete, while the third is in progress. A forth Working Group has been proposed to start later in 2002. The dates, topics and Chairmen of the Working Groups are shown in Table 2. FIS has sponsored publications such as special volumes in *Progress in Oceanography* (Beamish *et al.* 1999 and McKinnell *et al.* 2001) and by Alaska Sea Grant (Loughlin and Ohtani 1999). The list of pages corresponding to FIS-sponsored reports within the PICES Scientific Report (PSR) Series, showing the approximate number of pages related is shown in Table 3.

### ***FIS in PICES - comparison and contrast to other Scientific Committees: POC, BIO and MEQ***

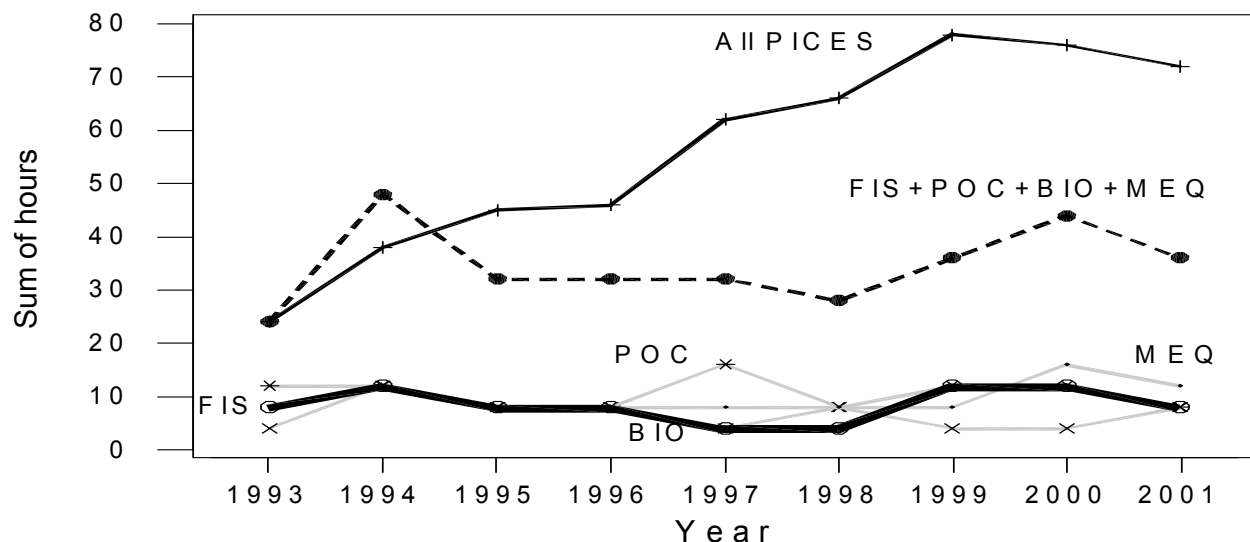
The cumulative hours of sessions by all four Scientific Committees were constant at 30-40 hours per year (Fig. 1). The hours of FIS sessions

**Table 1** Topics sessions sponsored by the Fishery Science Committee at PICES Annual Meetings.

Year	Topic
1994	Recruitment variability of clupeoid fishes and mackerels
1995	Density-dependent effects on fluctuations in the abundance of marine organisms
1996	Ecological effects of truncated age and size distributions and fishing on fish populations
1997	Models for linking climate and fish (FIS/BIO) Micronekton of the North Pacific (FIS/BIO)
1998	Climate change and carrying capacity in North Pacific (FIS/CCCC)
1999	GLOBEC and GLOBEC-like studies and application to fishery management
2000	Short life-span squid and fish as keystone species in North Pacific ecosystems
2001	Migration of key ecological species in the North Pacific Ocean The physics and biology of eddies, meanders and rings in the PICES region

**Table 2** FIS Working Groups: Dates, subjects and chairmen.

Years	Subject	Chairmen
1993 - 1995	Small pelagics (WG 3)	J. Hunter and T. Wada
1995 - 2001	Crabs and shrimp (WG 12)	R. Otto and V. Rodin
1999 - 2002	Fisheries and climate (WG 16)	R. Beamish and T. Wada
2002	In preparation	



**Fig. 1** The sum of hours of FIS sessions in PICES Annual meetings, 1993-2001. The solid dark line on the bottom indicates the total number of hours of FIS sessions during Annual Meetings, at about 10 hours per year, roughly similar to those of other Scientific Committees (POC, BIO and MEQ) indicated by grey lines. The sum of all the four committee sessions is shown as a dashed line, at about 40 hours per year. The total time for all PICES sessions, however, has steadily increased with time until 1999-2001, when it remained at about 70 hours. This increase is mainly related to the inclusion of sessions associated with GLOBES activities, especially the CCCC sessions.

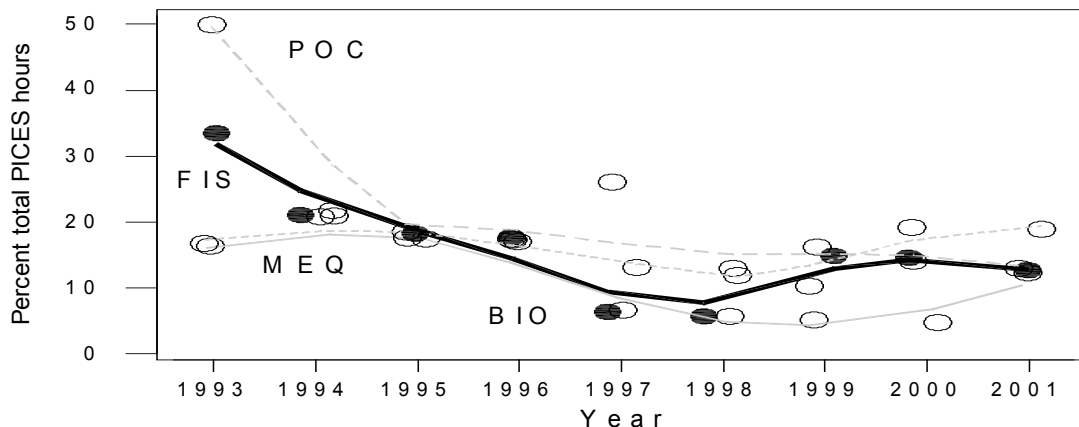
**Table 3** Scientific publications resulting from FIS activities in PICES, shown by year, and sponsors. The approximate number of pages in the publication and an estimate of the numbers of pages related to FIS inputs are indicated.

Year	Title	Sponsorship	All pages	FIS pages	POC pages
1993	Part 1. Coastal Pelagic Fishes Part 2. Subarctic Gyre (PSR 1)	FIS WG 3 (part 1) SB WG 6 (part 2)	130	24	106
1995	Okhotsk Sea and Oyashio regions (PSR 2)	POC WG 1	227	0	227
1995	Monitoring Subarctic North Pacific variability (PSR 3)	Science Board, STA (Japan)	94	0	
1996	Science Plan, Implementation Plan (Report of the PICES-GLOBEC International Program on Climate Change and Carrying Capacity, CCCC) (PSR 4)	CCCC Program	64	15	
1996	Modelling of the Subarctic North Pacific Circulation (PSR 5)	POC WG 7	91	0	91
1996	Proceedings of the Workshop on the Okhotsk Sea and adjacent areas (PSR 6)	POC	426	200	226
1997	Summary of the Workshop on Conceptual/Theoretical Studies and Model Development and the 1996 MODEL, BASS and REX Task Team Reports (CCCC) (PSR 7)	CCCC Program	93	30	
1998	Multilingual Nomenclature of Place and Oceanographic Names in the Region of the Okhotsk Sea (PSR 8)	POC	57	0	57
1998	PICES Climate Change and Carry Capacity Workshop on the Development of Cooperative Research in Coastal Regions of the North Pacific (PSR 9)	CCCC Program	59	10	
1999	Proceedings of the 1998 Science Board Symposium on the Impacts of the 1997/98 El Niño Event on the North Pacific Ocean and its marginal Seas (PSR 10)	Science Board	130	21	
1999	PICES GLOBEC International Program on Climate Change and Carrying Capacity. Summary of the 1998 MODEL, MONITOR, REX Workshops, and Task Team Reports (PSR 11)	CCCC Program	88	88	
1999	Proceedings of the Second PICES Workshop on the Okhotsk Sea and Adjacent Areas (PSR 12)	POC	203	0	203
2000	Bibliography of the Oceanography of the Japan/East Sea (PSR 13)	PICES	99	0	
2000	Predation by Marine Birds and Mammals in the Subarctic North Pacific Ocean (PSR 14)	BIO WG 11	165	0	
2000	Report on the 1999 MONITOR and REX Workshops, and 2000 MODEL Workshop on Lower Trophic Level Modeling (PSR 15)	CCCC BIO	140	60	
2001	Environmental Assessment of Vancouver Harbour Data Report for the PICES Practical Workshop (PSR 16)	MEQ	202	40	
2001	Report of the 2000 BASS, MODEL, MONITOR and REX Workshops, the 2001 BASS/MODEL (PSR 17)	CCCC BIO	118	50	
2001	Proceedings of the PICES/CoML/IPRC Workshop on "Impact of Climate Variability on Observation and Prediction of Ecosystem and Biodiversity Changes in the North Pacific" (PSR 18)	PICES, Census of Marine Life	205	90	
2001	Commercially Important Crabs, Shrimps and Lobsters of the North Pacific Ocean	FIS WG 12	79	79	
	All PICES Reports		2670	707	910

were relatively constant at 10-12 hours, or approximately one-quarter of the total session time for all Committees. The hours for all PICES sessions, however, has increased - reflecting developments of special Science Board symposia and inclusion of sessions and symposia associated with the CCCC Program. These two items have accounted for almost half of the PICES Annual Meetings in recent years. When expressed as a percentage of total time at meetings, FIS topics decreased since the First Annual Meeting (Fig. 2), but this same trend is seen for all Committees. This decrease is not associated with a reduction in FIS activities, rather it is an increase in total PICES activities during Annual Meetings.

There is a total of about 2,670 published pages of PICES scientific reports, of which about 700 are derived from FIS topics (Table 3). In contrast, the number of POC pages is about 900, slightly greater but not by much. Therefore, from the data shown in Table 3, which are only approximate, one could not conclude that publications of FIS topics were severely under-represented, relative to other Scientific Committees in PICES.

We maintain, however, that to have all fishery science represented by a single Scientific Committee with only one-quarter of all the scientific sessions, is a severe under-representation of the marine science composition of member countries. The remedy for this is the expansion of fishery science activity in PICES.



**Fig. 2** The percentage of time devoted to scientific sessions from each Scientific Committee during PICES Annual Meetings, 1993-2001. The solid dark line (and closed circles) indicates the percentage of time that FIS sessions contributed at them. The time for other Scientific Committees are shown as a grey dashed line (POC), a grey dotted line (MEQ) and a thin solid grey line (BIO).

### ***The vision and objectives of PICES: Review and evaluation of the first ten years***

Several key original scientific tenets of PICES, as prepared by its founders are shown below, followed by an evaluation (*in italics*).

The general purpose of the Organization as stated in Article III of the PICES Convention shall be:

- (a) to promote and co-ordinate marine scientific research in order to advance scientific knowledge of the Convention area (*i.e.*, North Pacific) 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

***Evaluation:*** *To our knowledge, aside from the exchange of information at PICES Annual Meetings, relatively little dedicated activity has occurred in this regard, especially in FIS issues. (We comment further on this below.)*

(b) to promote the collection and exchange of information and data related to marine scientific research in the Convention Area.

**Evaluation:** *To our knowledge, there has been little collection and exchange of fisheries information occurring directly as a result of PICES, although the current FIS WG 16 will address this issue. This issue will also be addressed in some GLOBEC-type activities, of which PICES is a keen sponsor.*

More specific objectives of PICES are indicated in Article V (Functions of the Governing Council Organization). The original documents do not identify the Fishery Science Committee, specifically, as charged with the task of achieving PICES objectives, because the structure of PICES was not established. In fact, the scientific administrative structure was not defined beyond the requirement for a "Scientific Board". The FIS Committee, as a member of the Science Board, is the organizational component that advises and implements the directives of the Governing Council relative to fisheries activities. Part 1 of Article V states that the scientific functions of the Governing Council shall be:

(a) to identify research priorities and problems pertaining to the area concerned (i.e., North Pacific) as well as appropriate methods for their solution;

**Evaluation:** *To our knowledge, such has yet to be prepared. There are lists of research priorities, however, for small pelagics (from FIS WG 3) and crabs and shrimps (from FIS WG 12).*

(b) to recommend co-ordinated research programs and related activities pertaining to the area concerned, which shall be undertaken through the national efforts of the participating Contracting Parties;

**Evaluation:** *To our knowledge there has been little attempt to develop co-ordinated international research field programs. Some limited programs may have occurred, but such programs, when they do take place, might have happened in the absence of PICES (through bilateral agreements, etc.), or, through related initiatives, such as programs fostered through GLOBEC initiatives. In this sense, it may be unfair to conclude that there has been no PICES role in such programs, but*

*probably it is accurate to conclude that relatively little internationally co-ordinated research has emanated directly from PICES, especially in fisheries.*

(c) to promote and facilitate the exchange of scientific data, information and personnel;

**Evaluation:** *To our knowledge relatively little exchange of scientific data in fisheries has occurred directly, and no exchange of scientific personnel as a result of PICES activity. Probably the main reason for these shortcomings is related to limited funds.*

(d) to consider requests to develop scientific advice pertaining to the area concerned;

**Evaluation:** *To our knowledge, PICES has not yet received any requests to provide scientific advice to member governments or any other agency.*

(e) to organize scientific symposia and other scientific events; and

**Evaluation:** *Without doubt, the organization of scientific meetings has been a successful aspect of PICES. The last decade has seen the development of a first rate scientific meeting that accompanies the Annual Meeting. The scientific meetings are successful, in part because of a vibrant mixture of disciplines, including oceanography and fisheries. We endorse this activity, and encourage more interactions - with the qualification that the objective should be to provide meaningful, useful scientific information in support of fisheries issues. This is an important point, because we note that the Annual Meeting is the foremost scientific activity of PICES. If important issues in fishery science are not addressed in the next ten years, in a way that can make a difference to how we understand and conduct fisheries in the North Pacific, then PICES may have little to justify its continued existence.*

(f) to foster the discussion of problems of mutual interest.

**Evaluation:** *To our knowledge, little discussion has occurred except within the context of Annual Meetings. It is possible, however, that some aspects of this original objective have been achieved by the FIS Working Groups. Clearly, however, there is much more that could be done to meet this original objective.*

## **Discussion**

### ***Successes of PICES***

We acknowledge the fine achievements of PICES. The Annual Meetings have developed into first rate international scientific meetings. Further, the PICES Secretariat has done a superb job of producing high-quality scientific publications in a timely manner. Our position is, however, that fishery science is under-represented in PICES, and we recommend expanding its role in the Organization. We emphasize that we are advocating an “expansion”, not a re-apportionment of existing resources. We do not advocate that such an expansion should occur at the expense of existing committees or activities. We acknowledge and salute the developing inter-disciplinary rapport between fishery science and other disciplines. Continued development is essential for the future of PICES.

### ***Fishery science in PICES - a contrast to ICES***

Clearly, the name and structure of PICES were modelled after ICES (the acronym for the original Atlantic organization: International Council for the Exploration of the Sea). The structures are similar in the sense that ICES is a scientific organization, consisting of scientific committees and working groups, and which holds annual scientific meetings, etc. There are, however, some key differences. Among 4 Scientific Committees, PICES has a single Fishery Science Committee and two Oceanographic Committees. ICES consists of 7 scientific committees, of which there is only a single oceanographic committee and fishery science activities could occur in 4 or more of the standing scientific committees. As a consequence the profile of fisheries matters is much higher in ICES than PICES. ICES also has a distinct advisory role that does not occur in PICES. A review of ICES documents shows that there are 3 advisory committees and much of the working group activity is directed towards specific assessment activities. Another difference between PICES and ICES is that ICES working groups are not limited to a 3-year term, which appears to be the norm for PICES. This restriction, however, is not one specified in the original statutes. Therefore it is clear that the content and profile of

fishery science in ICES is substantially greater than that of PICES. In some ways this seems odd, because fisheries matters always appeared to be a prominent justification for the initial developments of PICES (Wooster and Callahan 1994).

In the last 5-6 years, PICES has opted to work closely with GLOBEC, and started the CCCC (four C's) Program (referring to “Climate Change and Carrying Capacity”). Within PICES this consists of 4 Task Teams (REX-Regional experiments), BASS (Basin Scale experiments), MODEL (an oceanographic and biological modelling initiative) and MONITOR. The CCCC Program is represented by two participants on the PICES Science Board, and in that respect, has input to the direction of PICES. We also note that the NPAFC (North Pacific Anadromous Fish Commission) with member countries of Canada, Japan, Russia and the U.S.A., serves as an observer in PICES with respect to international regulation and concern about salmonids.

### ***Present profile of fishery science in PICES***

Compared to ICES, the role of fishery science in PICES is not high, although specific concerns about the diminishment of fishery science, relative to that of other Scientific Committees, is not justified. That is, the level of participation of FIS (as measured by the number of hours of scientific presentations, or the numbers of pages of scientific reports) is approximately equal to that of other Committees. Further, there is no justification for concern that contributions of the FIS Committee are declining with time. Indeed, there “appears” to be a relative decline in contribution within scientific meetings, but such a decline has occurred among all Scientific Committees and is mainly related to the incorporation of GLOBEC-like activities into PICES.

### ***Increasing the profile and expanding the role of fishery science in PICES - suggestions***

There are a number of ways to increase fishery science profiles and activities in PICES, and we list only a few general suggestions. For instance, the PICES Science Board could add an additional committee, or two, that is focussed on issues of fishery science. One such committee could be an



aquaculture committee, a suggestion endorsed informally by several countries, as aquaculture is a topic of major concern to most member nations. Such a committee could also provide strong future linkages to MEQ activities. There are, however, many possible committees that could be added.

An alternate suggestion would be to add a second member, from the Fishery Science Committee, to the Science Board, and proportionally expand (*i.e.*, approximately double) the time given to fishery science issues in Annual Meetings. A concern with this approach, however, is that the Annual Meetings are already long (4-5 days) and packed with concurrent sessions. Perhaps a more viable suggestion would be to increase the support for Working Groups sponsored by the FIS. Further, such Working Groups could be encouraged to hold some smaller, inter-sessional meetings on specialized topics, leading to PICES publications.

PICES should also examine its relationships with the national members to stimulate greater participation. Many participants in PICES meetings use the Annual Meeting as a venue to present and discuss their own research, but the time available to become involved in collaborative PICES activities is limited due to the pressure of work at their own institutions or agencies. PICES should work to impress upon the agencies, and representatives of the member nations, the importance of PICES initiatives such as Working Groups to assure that the scientific manpower required for these efforts can better be met. If successful, this would go a long way towards improving cooperative work in fisheries.

#### ***What more should FIS and PICES do?***

Finally our general conclusion is that while PICES can be proud of its first decade of life, because in many ways it did a good job, however, it did not fulfil all of the key objectives and visions of the founders of PICES. Overall the activities of PICES were not enough; they were not sufficient to address issues of great concern and misunderstanding on global fisheries issues.

At the operational level, PICES should develop better adherence to the Article V of the PICES

Convention. Specifically, three parts of Article V need attention:

- (a) to identify research priorities and problems pertaining to the area concerned (i.e., North Pacific) as well as appropriate methods for their solution;*
- (b) to recommend co-ordinated research programs and related activities pertaining to the area concerned, which shall be undertaken through the national efforts of the participating Contracting Parties;*
- (c) to promote and facilitate the exchange of scientific data, information and personnel;*

Item (a) could be addressed with a working group or other approaches; item (b) is expensive and difficult because many national governments are struggling to support their vital national programs - and may have little sympathy for co-operative international field programs that may jeopardise national activities. Item (c), however, is fundamental and relatively inexpensive. It is not difficult or expensive to develop exchanges of scientific personnel. The results have broad benefits both for the scientists and the host organization and countries. PICES could also play a role in improving fisheries data shortcomings identified in the North Pacific (*e.g.*, Watson and Pauly 2001). This would be particularly valuable because resulting scientific products are expanded into international databases. In this regard, we should point out that PICES fishery science should take a page from our ICES colleagues, who have now presented extensive fisheries databases on the web. Indeed, we might also learn from our oceanographic colleagues who also make their data accessible on web sites. We must begin to do the same with fisheries data. The PICES Secretariat, and PICES web site, are obvious choices for this proposed development. Therefore PICES could consider substantial expansion of its website, to meet some of the original objectives of the PICES founders. Specifically, an expanded PICES website would be an ideal solution to addressing Article 5c - exchange of scientific data and information.

An additional approach would be to develop much stronger links with existing marine science

organizations operating in the North Pacific. Specifically, we suggest that there could be much stronger linkages with the North Pacific Anadromous Fish Commission (NPAFC). This organization consists of four member countries (Canada, Japan, Russia and the U.S.A.) that are also PICES members. Stronger linkages could be forged by developing more joint participation (not just representation) at annual and interim meetings. Linkages with NPAFC, and other organizations, could develop into jointly configured standing committees or working groups that would be capable of reviewing scientific information and providing advice. In this regard, if PICES were able to develop the capacity to provide meaningful review, information and advice on the non-salmonid fish species within its mandate area, the way that NPAFC does for salmonids, then it would become a much more useful and meaningful organization. Such issues are of keen interest, not only to scientists, but also to the tens of millions of people who make their living from the sea, throughout coastal regions of the North Pacific Ocean.

Aside from organization modifications, what else could we do? What should we do? In a nutshell, we need to communicate more broadly outside of PICES and broadcast the extent of our collective ignorance - of fishery science in particular and marine science in general. We need to advise those among the non-scientific community and especially the decision- and policy-makers, that we (PICES fishery scientists) do not know the answers to many of the key issues affecting marine fish - indeed we do not even know many of the appropriate questions. Put another way, we need to spend as much energy explaining what we do not know, as what we do know. The systems we study, usually with inadequate resources, are vast and complex. Our understanding is insufficient. We suggest that we need to improve the general understanding about marine systems - including our abilities and limitations.

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