

Scientific Cooperation in the North Pacific: The PICES Project

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I. INTRODUCTION

While individuals carry out scientific research, their local, national, and international institutions also play an important role. This is particularly true in the case of marine science, where the vast scale and complexity of ocean resources demands not only cooperation among individuals and their institutions, but also an interdisciplinary approach that allows for interaction among fields such as physics and biology. Marine science also demands effective interaction between those who seek understanding of natural systems and their resources and those who wish to apply that understanding in utilizing those resources.

These interactions have all played a role in the development of international institutions concerned with marine scientific research and with management of fisheries in the North Pacific. The agreements

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embodied in the 1982 United Nations Convention on the Law of the Sea (CLOS), along with the creation of the Exclusive Economic Zone (EEZ) and its extension of national jurisdiction over living marine resources out to 200 miles offshore, have also made a significant impact on institutional development at the global level. The management of fisheries operating in coastal waters has become a national responsibility. This has had a profound effect on international fishery organizations, much of whose authority now passes to coastal states.

The principal international institution for marine scientific cooperation and fishery management in the North Pacific was the International North Pacific Fisheries Commission (INPFC). While its principal concern was with anadromous stocks, it also promoted studies of other species and investigation of the marine environment within which they lived. While important oceanographic studies were sponsored by INPFC, however, they tended to be closely tied to fishery questions. When INPFC was transformed into the North Pacific Anadromous Fish Commission (NPAFC), in large part as a consequence of CLOS, the focus of research was significantly narrowed, primarily to the anadromous stocks and, geographically, to the high seas.

Of course, there are some inherent differences in the research priorities of fishery and marine science organizations. The former usually have responsibility for management of specific fisheries, and the scientific efforts they sponsor are directed toward that practical aim. A principal concern of the science organizations, on the other hand, has been environmental and ecosystem research. Some sort of convergence between these two approaches seems likely, as understanding of fish population variability increases.

In the 1970s, interest arose for the establishment of a regional organization in the North Pacific devoted to marine science, as no such body existed. Relevant global organizations, especially the Intergovernmental Oceanographic Commission (IOC) of the United Nations Educational, Scientific and Cultural Organization (UNESCO), together with the fisheries section of the Food and Agriculture Organization (FAO) and the ocean interests of the World Meteorological Organization (WMO), did exist; however, these global bodies seldom focused on the specific scientific problems of most concern in a region such as the North Pacific. They were unlikely, for example, to convene a workshop on the development of cooperative research in coastal regions of the North Pacific.¹ The only good example of a successful regional marine science organization was the International Council for the Exploration of the Sea

1. See PICES Scientific Report 9 (1998), available at http://www.pices.int/publications/scientific_reports/Report9Sci_Rep_9.pdf.

(ICES), which had been functioning in the North Atlantic since 1902. Indeed, ICES became a model for the North Pacific development of what came to be known informally as the Pacific ICES (PICES). The development of PICES paralleled the establishment of the NPAFC and, as you will see, involved many of the same personalities and national interests.

II. CREATING PICES

In February 1973, fisheries scientists from around the world met in Vancouver, Canada for a four-day FAO Technical Conference on Fishery Management and Development.² Following the formal sessions, Dayton Lee Alverson, then Director of the U.S. Northwest Fisheries Center, National Marine Fisheries Service U.S. Commissioner to the INPFC, gathered with about a dozen scientists in a separate informal meeting.³ They discussed the need for a regional organization devoted to examining the marine research problems of the North Pacific from a larger perspective than solely fisheries and with more permanency than ad hoc meetings. Alverson later strongly promoted the idea of such an organization within the INPFC.⁴

2. *FAO 1973 Technical Conference on Fishery Management and Development*, 30 J. FISHERIES RES. BD. CAN. 1921 (1973).

3. Telephone interview with Lee Alverson (Feb. 5, 2002) (on file with author). Alverson recalls that between eight and twelve scientists were present, including Lee Alverson, Donald McKernan, Richard Van Cleve, Alfred Needler (Canadian), and M. A. Bogdanov (Russian from the Russian Federal Research Institute of Fishery and Oceanography (VNIRO)). Megan Callahan (*see* footnote 13) says Japanese participants were also present. Needler took part in the first organizational meeting of INPFC in 1954 and, as Chairman of the Committee on Biology and Research, he developed a research program on salmon distribution. He was an INPFC Commissioner from 1963-1967 and 1970-1971.

4. Lee Alverson received his PhD in Fisheries from the University of Washington and was an undergraduate there while McKernan was a graduate student. In 1958, he was appointed Director of the Exploratory Fishing and Gear Research Base of the U.S. Bureau of Commercial Fisheries. He served as the scientific advisor to the U.S. National Section of the INPFC, taking part in the research work of the Commission throughout the northern part of the Pacific Ocean. He also acted as advisor to the U.S. Department of State on the negotiation of the Law of the Sea, on the effects of a change in the breadth of the territorial sea, on fishery problems and relationships between the U.S. and the U.S.S.R., and on the negotiations with Japan about salmon conservation. In addition, he served as Chairman of the Advisory Committee on Marine Resources Research of the FAO. Drawn from ROY I. JACKSON & WILLIAM F. ROYCE, *OCEAN FORUM: AN INTERPRETATIVE HISTORY OF THE INTERNATIONAL NORTH PACIFIC FISHERIES COMMISSION* (1986).

Don McKernan, another critical participant of this meeting, was the first director of the Institute for Marine Studies (now the School of Marine Affairs) at the University of Washington.⁵ He had a role in developing Japanese Pacific fisheries after World War II when he advised General MacArthur's staff, and, like Alverson, he served on the INPFC.⁶ McKernan and Alverson, both graduates of the University of Washington, shared a view of marine research as extending beyond traditional fisheries. They envisioned a North Pacific marine science organization that would have a comprehensive international membership and would be truly interdisciplinary, encompassing not just fisheries or oceanography, but all marine science. Canada, China, Japan, the United States, and the U.S.S.R. were obvious potential members. Determined to create a North Pacific marine science organization, Alverson and McKernan returned to Seattle to find the right person to lead the effort.

Three years later, McKernan and Alverson thought they found the right person in Warren Wooster, who had broad scientific training and interests, as well as international experience. Wooster originally trained as a chemical oceanographer at Scripps Institution of Oceanography, then extended his interests to physical oceanography, then again to what was coming to be called fishery oceanography.⁷ He joined the University of Washington in part because of its strength in marine sciences and in part because his support would come from both the University and the NMFS

5. The University of Washington Institute for Marine Studies was established as a graduate program in 1972 to provide teaching, research, and public service on contemporary problems in ocean and coastal management. The Director and faculty were appointed starting in 1974.

6. Donald Lynn McKernan (1918-1979) graduated from the University of Washington, College of Fisheries, in 1940. In 1950, McKernan served as a fishery specialist to the staff of Supreme Commander for the Allied Powers (SCAP) in Tokyo. He directed Alaskan fisheries research and was the first Director of the U.S. Bureau of Commercial Fisheries (1957-1966), where he was responsible for all aspects of U.S. participation in the INPFC. He returned to the University of Washington in 1974 as Professor of Fisheries and Marine Studies and was the first Director of the Institute for Marine Studies until his death in 1979.

7. Wooster received his B.S. in Chemistry from Brown University. After serving three years in the U.S. Naval Reserve, he earned his M.S. in Chemistry from the California Institute of Technology in 1947 and his PhD in Oceanography at the University of California at Los Angeles (1953). He became a research oceanographer at Scripps Institution of Oceanography for the next dozen years. In 1957, he was invited to Peru for a year to work on the Peru Current. Four years later, he moved to Paris as director of the Office of Oceanography for UNESCO and served as first general secretary of the IOC. In 1963, he returned to Scripps, where he served as a professor for ten years. In 1973, he became Dean of the Rosenstiel School of Marine and Atmospheric Science at the University of Miami, Florida. He went to his first ICES meeting when he was secretary of the IOC and afterwards was attracted by the lack of formality and bureaucracy in non-governmental organizations. Wooster served as Secretary to the Scientific Committee on Oceanic Research (SCOR) from 1964-1968 and as President from 1968-1970 and 1970-1972.

(through Alverson).⁸ This combined funding appealed to Wooster, who had embraced the attitude prevailing at Scripps in the 1950s that oceanography had something to offer to fisheries and vice versa. International work also appealed to Wooster because of his own international experience and because it combined the talent and resources of many countries to address common problems.⁹

Once Wooster arrived at the University of Washington, McKernan brought him together with William T. Burke, Professor of Law and Marine Affairs, to systematically explore the need for an organization of marine science for the North Pacific.¹⁰ If Wooster and Burke could convincingly substantiate its need, then they could start looking for an appropriate model. For example, would it be appropriate to imitate the ICES, or would the North Pacific require a novel approach to scientific organization? Using ICES as a template would raise important issues about both structure and goals for the organization. Of course, the regions of concern to the two organizations differed significantly. The North Pacific has a much wider span, yet its shores are lined with fewer countries than surround the ICES seas. These differences and the unique fishery politics of the North Pacific strongly colored the negotiations that ultimately led to establishment of PICES.

The first small and informal meeting to discuss a new international organization was held in Seattle in 1978 with twenty American and Canadian participants.¹¹ They agreed on the pressing need to effectively

8. The funding sources reflected the explicit joining of two worlds.

9. Wooster was elected the first American president of ICES (1982-1985). In the late 1970s, he became chairman of the National Academy of Science Ocean Sciences Board and advisor on ocean affairs to the U.S. Department of State. Some of his professional activities included attending the U.N. Law of the Sea meetings in the mid-1970s.

10. William Burke is a lawyer at the University of Washington School of Law who specializes in marine law as well as marine studies. He is particularly interested in international law and issues surrounding the Law of the Sea negotiations. For instance, how do we protect the right of ocean researchers to work off shore of other countries? Would the 200-mile extended zone include scientific research? Would researchers be cut off from access without permission, which is highly political? See WILLIAM BURKE, *TOWARDS A BETTER USE OF THE OCEANS: CONTEMPORARY LEGAL PROBLEMS IN OCEAN DEVELOPMENT, COMMENTS AND RECOMMENDATIONS BY AN INTERNATIONAL SYMPOSIUM* (1968); see also Wilbur Chapman, Comment: *Concerning Fishery Jurisdiction and the Regime of the Deep-sea Bed*, *id.* at 154-74.

11. Research Contract abstract to Northwest Fisheries Center from Wooster and Burke with title *Scientific Coordination for Fisheries in the North Pacific*, desired grant period September 16, 1977, to September 15, 1978. "With enactment of the Fishery Conservation and Management Act of 1976, and with other extensions of national

coordinate oceanographic and fisheries research in the north Pacific and to foster exchange of data. Although not all participants thought that a new organization was necessary or a good idea, they discussed its possible function, activities, and structure.¹² Coordination of scientific efforts would increase understanding of the influence of the ocean on weather and climate and possibly inform the growing conflicts of ocean use. Unlike existing international organizations (e.g., WMO, IOC, FAO) that emphasized developing countries, the proposed organization would focus on northern Pacific countries such as Canada, Japan, the U.S., and the U.S.S.R. Existing fishery conventions like the INPFC and the IPHC had limited membership, none of them encompassing as many countries as the proposed new intergovernmental organization. Further, changes in national jurisdiction over fisheries threatened to restrict the effectiveness of fisheries conventions and to curtail their scientific research functions.

Participants at the first meeting were well aware of the contentious relationship between creating scientific information and applying it in policy and management. As the meeting report stated: "It is clear that there is a delicate line between science and politics in the interest of coastal states. On the one hand, it is important that the proposed organization deal with problems of direct interest to governments. On the other, it is important to avoid politicizing desirable scientific studies."¹³ Wooster and others reasoned that an effective and comprehensive exchange of data would come only through an intergovernmental organization, with state rather than personal members. Governments had access to data and resources that no individual could have. The

jurisdiction over fishery resources within 200 miles of the coasts of countries bounding the North Pacific, it becomes necessary to modify or replace existing international arrangements for consultation on fishery matters. While separate species-specific management bodies may be established, scientific issues relate to a variety of fisheries and other ocean uses, and eventually it may be desirable to establish a new multilateral scientific organization broadly concerned with ocean problems in the North Pacific. In considering such an organization, it is necessary to evaluate the political realities within which it must be established and operate, to specify its objectives and functions, and to determine alternative structures within which they could be carried out." Warren S. Wooster Collection, Acc. No. 3354-002, University of Washington Libraries [hereinafter Wooster, Box 1].

12. In the June 19, 1978 report on informal discussions held on March 31, 1978, Wooster says in part: "In considering this report, it should be understood that not all participants were convinced that a new scientific organization was necessary or desirable. Most agreed, however, that the proposal merited further consideration. For this purpose, a further informal meeting will be needed to explore the views of scientists from other countries and, if sufficient support is evident, to prepare for a subsequent intergovernmental meeting." Wooster Box 1: Burke files.

13. THE PICES PAPERS: REPORTS OF MEETINGS LEADING TO THE ESTABLISHMENT OF THE NORTH PACIFIC MARINE SCIENCE ORGANIZATION (PICES), 1978-1992 7 (Warren S. Wooster & Megan M. Callahan eds., 1994).

proposed structure was explicitly patterned after that of ICES, with a Secretariat, scientific bodies, a governing Council, and annual meetings. In contrast to ICES, however, the first meeting document concluded: "It must be clear that the focus of the organization is on scientific rather than management questions."¹⁴

The relationship between basic and applied science and its links to managers continued to intrigue and challenge participants. In between informal meetings, proponents of the PICES concept corresponded with policy makers, government officials, and colleagues to foster the idea of a Pacific ICES. Government officials usually wanted to know how such an organization would be useful to fisheries. The third informal meeting in 1981 focused on this fisheries justification for a new organization and drew stronger parallels with the fisheries function of ICES. In thinking about a scientific organization for the North Pacific, Burke and Wooster looked to models in the fisheries world because they were the only functioning intergovernmental agreements in the region, and several of them, such as the INPFC, had successfully produced good science. Scholars of the INPFC, such as Yvonne DeReynier, Roy Jackson, and William Royce, pointed out that the INPFC acted more like a scientific than a management organization between 1952-1977.¹⁵ If a strong case could be made for a fisheries justification for PICES, then U.S. agencies such as the Department of State and the National Oceanic and Atmospheric Administration were more likely to support its creation. Once again, the general idea of cooperative scientific research was roundly supported, and it was reasserted that while coastal states would directly manage their fisheries, PICES could supply information relevant to management decisions.

The 1981 meeting recalled that the creation of a PICES was foreseen in the 1979 amendments to the original 1952 International Convention for the High Seas Fisheries of the North Pacific Ocean. The amendments, which arose from a bid to increase the protection of salmon originating from U.S. waters, followed the enactment of the U.S. Fishery Conservation and Management Act of 1976 that established the 200-mile fishery conservation zone, but introduced inconsistencies between the new fisheries law and the old Convention. Both Article III and Article IV of the protocol

14. *Id.* at 12.

15. Yvonne DeReynier, *Evolving Principles of International Fisheries Law and the North Pacific Anadromous Fish Commission*, 29 OCEAN DEV. & INT'L L. 147, 150 (1998); JACKSON & ROYCE, *supra* note 4.

amending the Convention proved significant to the mandate of PICES. Article III set forth the functions of INPFC and said, in part, that it would still carry out research on nonanadromous fish pending the establishment of an international organization as set forth in Article IV. As an INPFC Commissioner, Alverson was instrumental in introducing the amendment to Article IV, which said in part:

The Contracting Parties shall work towards the establishment of an international organization with broader membership dealing with species of the Convention area other than anadromous species When such an international organization becomes functional, the functions of the Commission under the provisions of Article III . . . shall be terminated and transferred to the new organization.¹⁶

The creation of a PICES within the INPFC was never seriously considered.¹⁷ INPFC membership was limited (no U.S.S.R. or China), the organization focused primarily on fisheries issues rather than on broader marine science issues that influenced fisheries, and it had few links with academic scientists.¹⁸

The issue of fisheries versus marine science remained alive a decade later. L.S. Parsons, the Canadian delegate to PICES, presented a short paper on harmonizing the roles of NPAFC and PICES at the first PICES meeting in 1992. He suggested, in part, that PICES assume functions previously performed by the INPFC such as data collection and analysis, as well as take charge of maintaining INPFC's statistical databases. PICES would then be a primary source for NPAFC and other multilateral organizations to gain scientific services, including advice on fish stock status.¹⁹ This was the approach in the North Atlantic, where the North Atlantic Salmon Conservation Organization (NASCO), the north Atlantic equivalent of NPAFC, received advice from ICES. The Canadian proposal was rejected by Japan, the Russian Federation, and the United States because they did not want their fisheries management driven by yet

16. Wooster to Bill Sullivan, Dec. 23, 1987. "Alverson says he was instrumental in getting Article IV adopted (INPFC) specifically to provide for development of PICES. He will discuss this with Elmer Rasmusson and will put together a statement that can be used for clarification in the matter." 1978 INPFC Convention, art. IV, April 25, 1978, available at http://www.npafc.org/inpfc_cv; Wooster Box 2: PICES Sept.-Dec. 1987.

17. An INPFC document in 1986 does suggest it ought to be discussed sometime. INPFC archives. "Agenda US Section Meeting, INPFC, Anchorage, Alaska Public Meeting Saturday Sept. 27, 1986." University of Washington Fisheries Science Building, Box 80, folder UW 998 (Courtesy of Kate Myers).

18. Larry Snead, Bureau of Oceans, may have proposed to develop PICES first within INPFC and then at an appropriate time to have it become separate and independent. *Wooster Aide Memoire*, May 21, 1986. Wooster Box 3: PICES Jan-July 1986.

19. A major concern of Canada was the risk that PICES' advisory function, both scientific and fishery, would be duplicated in two Conventions. L.S. Parsons to W.S. Wooster, May 17, 1993. U.S. Department of State, Office of Ocean Affairs OES/OA files (courtesy of Elizabeth Tirpak, R/V Clearance Officer).

another body. PICES proponents had interpreted Article IV as indicating that the new organization would be complementary to, rather than in competition with, the INPFC. Certainly some scientists worried that the long tradition of research by the INPFC would be diluted by the creation of another organization, but others pointed out that NPAFC jurisdiction was now being limited to the waters beyond 200 miles off shore.

Avoidance of a management role should not preclude providing scientific advice to fishery management bodies such as the NPAFC. Some worried, however, about the high cost of providing specific management advice. The ICES Secretariat had become a large and expensive body in performing its role of advising such organizations as the Baltic Sea Fisheries Commission (BSFC), the Northeast Atlantic Fisheries Commission (NAFC), NASCO, and the European Union (EU). In 2000, for example, the ICES budget was approximately \$3 million, about eight times that of PICES.²⁰ Of course, ICES had 19 state members and many commissions to provide financial resources. An important characteristic of ICES fishery advice should be kept in mind—scientific questions of evaluating status have been scrupulously kept separate from the political decisions of allocating harvests. The question of what PICES' role should be in providing scientific advice remains salient today.

A long dormant period followed the first informal PICES meetings. Don McKernan died in 1979 and, a year later, Alverson retired as director of the Northwest and Alaska Fisheries Center. International politics that year also impeded efforts to develop international cooperation, especially with the U.S.S.R., when the Russians invaded Afghanistan and when, in 1981, the Reagan Administration was inaugurated in the United States. The lack of momentum was also due in part to continuing Law of the Sea negotiations with attendant uncertainty about scientific access to EEZs. In 1986, however, the process was reinvigorated when the University of Alaska convened a meeting with participants from the Pacific Rim nations of Canada, Japan, People's Republic of China, the United States, and the U.S.S.R.

That meeting caused events to move along quickly. While Japanese speakers expressed reservations about duplication of efforts, others saw the proposed organization as complementary to other bodies. Everyone agreed that scientific cooperation was the key to better scientific

20. ICES, *Budget Financial Year 1999/2000*, ICES ANNUAL REPORT FOR 1998/1999, DKK 22, 688, 835 at 138.

understanding of the region and recognized that there was not a body at present that focused on the interaction of atmosphere, ocean, and fish. Once again it was emphasized that the proposed organization would not be concerned directly with management, regulations, or resource boundary mandates.

An intergovernmental meeting was held in 1987 to discuss a concept paper prepared by Canada. There was general agreement (Japan abstaining) which led to a further meeting the next year to discuss a draft Convention. Japan was still reluctant, but by a final drafting meeting in 1989, it had changed its position to strong support. At a plenary session in Ottawa the next year, the final draft convention, the final report, and letter of understanding were accepted. The heads of delegations from Canada, China, Japan, the United States, and the U.S.S.R. took part in a signing ceremony in anticipation of ratification of the Convention.

The scientific workshop that followed a year later in Seattle was a welcome return to scientific matters after years of negotiation. Participants were charged with reviewing the state of knowledge of the North Pacific, identifying research gaps and priorities, and considering cooperative activities. This was the real substance of the future of PICES. The working groups explicitly transcended disciplinary boundaries by the topics they addressed: climate change, the Bering Sea, environmental quality, and fishery oceanography.

The Convention entered into force on March 24, 1992, after ratification by Canada, Japan, and the United States, three of the five signatory states. China ratified before August 1992 and took part in the First Annual Meeting in October 1992 in Victoria, British Columbia. Although the U.S.S.R. had participated in all of the intergovernmental discussions leading up to the establishment of PICES, the Russian Federation did not ratify until December 1994. Korea became a member in mid-summer 1995. Now it was time to fulfill the aspiration of increased scientific cooperation and exchange in the North Pacific. Exactly how to accomplish this would become an ongoing negotiation between individual scientists, disciplines and missions, and member countries.

III. MARINE SCIENTIFIC RESEARCH AND ITS APPLICATIONS

The early 1990s saw establishment of two new intergovernmental organizations in the North Pacific. NPAFC was devoted to the conservation of anadromous fish stocks in the region while the other organization, PICES, was devoted to promoting and coordinating marine scientific research. Though these might seem to be two sides of the same coin, they in fact reflect the different aspirations and priorities of the professional

communities involved in the several countries bordering the region. These communities include the academic marine scientists (oceanographers), the fishery scientists, and the fishery managers. Other communities, such as those concerned with environmental protection, were not important factors in the early discussions.

Relations between PICES and NPAFC, as well as other organizations, are colored by the tension between the fields of oceanography and fishery science, which both involve different motivations and institutions. For example, most oceanographers work in academic laboratories, while most fishery scientists work in government fishery laboratories. The goal of oceanographers is to gain understanding of how the ocean works, while that of fishery scientists is to predict the abundance and availability of fish stocks and the effect of harvest upon them. Fishery management is a political process that incorporates scientific assessments along with social and economic factors in its allocation of harvests and of the sacrifices necessary to sustain those harvests. Fishery science has long been dominated by a paradigm that attributes changes in fish stocks largely to human activities. Recent research, however, has shown the important influence of climate variations on marine ecosystems, including species of commercial interest.

A recent paper by the economist Pontecorvo attributed the failure of fisheries management to these matters:

[T]he insularity among oceanographers, fishery biologists and economists has been an element in the failure of fisheries management to create a sustainable and profitable industry. . . the failure of fisheries management stems, in large part, from the inability of the individual disciplines to recognize the uncertainty created by the complexity of the ocean environment.²¹

Of course, there is a fundamental difference between managing the use of a resource and providing the information on which management decisions can be made. That difference bears on the potential role of PICES in providing advice to management organizations such as NPAFC. In his recommendation to the Senate to ratify the Convention establishing PICES, Secretary of State James Baker noted that PICES would be a purely scientific body with no management responsibilities. He said: "Separation of scientific and management functions in this fashion should help ensure that the scientists are not swayed by political or

21. Giulio Pontecorvo, *Insularity of Scientific Disciplines and Uncertainty about Supply: The Two Keys to the Failure of Fisheries Management*, 27 *MARINE POL'Y* 69 (2003).

economic factors during their scientific deliberations and that the scientific advice they provide will be completely unbiased.”²²

As noted earlier, it was agreed from the very beginning of discussions that PICES would not “manage” the fisheries of its members. This has been interpreted to mean that it also would not be responsible for providing scientific advice to fishery management bodies such as INPFC. ICES, on the other hand, has long had such an advisory responsibility with respect to organizations such as the BSFC, the NAFC, the NASC, and the EU. The provision of fishery advice, as well as advice on marine pollution questions, accounts for the relatively large ICES Secretariat, scores of working groups, and large budget which includes financial contributions from the agencies receiving advice.

While fulfilling the advisory responsibility consumes more than half of ICES’ energies—some say, at the expense of scientific efforts—it greatly increases the salience of the organization to its members. PICES, on the other hand, has devoted its energies to the development of studies of the marine ecosystems of the sub-arctic Pacific and to their responses to variations in the ocean climate. These studies appeal to the interests of academic marine scientists and are much closer to “basic science” than the highly applied character of most fishery research.

Until recently, an underlying assumption of fishery scientists and hence of fishery management has been that the major changes in abundance of fish stocks resulted from human activities. However, evidence has now accumulated that large effects also arise from other sources, in particular, from climate variations. As noted in a recent NPAFC Newsletter: “There is now solid evidence that large fluctuations in salmon abundance occurred for thousands of years (i.e., long before there was significant human fishing). No longer do scientists believe that fishing is the only factor affecting salmon abundance.”²³

This recognition may lead to a changed role for PICES in providing advice for fishery management as well as to other human activities in the sub-arctic Pacific. The studies that PICES has promoted, such as its program on Climate Change and Carrying Capacity, lead to the possibility of regularly prepared ecosystem status reports. These reports could combine information on changes in physical and biological oceanography with those in the higher trophic levels, including commercial fishes, marine mammals, and sea birds. They should be made available in real time, for example, on the internet. They would thereby constitute

22. James A. Baker, Secretary of State, Letter of Submittal to the President (June 27, 1991); DeReynier, *supra* note 15, at n.134.

23. *Accomplishments Over the Past Ten Years and Vision for Future*, NPAFC Newsletter (2002) v. 7 (1), p. 2.

a valuable source of advice to members and to management bodies in the region. This would effectively join the extremes of basic science and applications to human activities, such as fishing, and provide a firm foundation for future marine science.

